BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF

ROBERT A. WEIMAR

ON BEHALF OF
THE PITTSBURGH WATER
AND SEWER AUTHORITY

Docket Nos. M-2018-2640802 and M-2018-2640803

Pittsburgh Water and Sewer Authority
Compliance Filing Proceeding

Various Regulatory Requirements
Infrastructure and Operations
Lead Remediation
LTIIP

May 6, 2019

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND CURRENT POSITION WITH PWSA.

A. My name is Robert "Bob" A. Weimar. My position with The Pittsburgh Water & Sewer Authority ("PWSA" or "Authority") is Executive Director.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY IN THIS PROCEEDING?

A. Yes. On February 14, 2019, I submitted direct testimony marked as PWSA St. No. C-1. The direct testimony was accompanied by 27 exhibits marked as RAW/C-1 through RAW/C-27.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of my rebuttal testimony is to respond to (1) the direct testimony on behalf of the Bureau of Investigation and Enforcement ("I&E") by Anthony Spadaccio (I&E St. 1), Ethan Cline (I&E St. 3) and Israel Gray (I&E St. 4); (2) the direct testimony on behalf of the Office of Consumer Advocate ("OCA") by Ashley Everette (OCA St. 1), Scott Rubin (OCA St. 2) and Terry Fought (OCA St. 5); and (3) the direct testimony on behalf of Pittsburgh UNITED by Mitchell Miller (UNITED ST. C-1), Bruce Lanphear (UNITED ST. C-2) and Gregory Welter (UNITED ST. C-3). In broad terms, my rebuttal testimony addresses issues regarding infrastructure and operations such as capital projects, metering, non-revenue water, leak detection and surveying, as well as issues regarding PWSA's lead remediation efforts and its Long-Term Infrastructure Improvement Plan ("LTIIP"). I also provide updates on the status of programs that have materially changed since the submission of my direct testimony.

II. UPDATES SINCE DIRECT TESTIMONY

Q. WHAT IS THE CURRENT STATUS OF THE COMMISSION'S ACTION REGARDING PWSA'S RATE CASE SETTLEMENT?

A. At the time of my direct testimony, the Commission had not issued a final order approving the Rate Case Settlement. The Commission entered a final order on February 27, 2019.[1] PWSA filed compliance tariffs on February 28, 2019,[2] which became effective on March 1, 2019.[3] The Commission Order approved a settlement among the Parties in which PWSA committed to filing additional information and reports, as well as taking additional steps requested by the Parties.

Q. WHAT IS THE CURRENT STATUS OF THE INTRODUCTION OF ORTHOPHOSPHATE INTO PWSA'S SYSTEM?

A. PWSA has implemented a PA DEP-approved systemwide orthophosphate treatment to manage lead corrosion through its system. Consistent with its permit from PA DEP, PWSA began introduction of orthophosphate into its system at different points in March and April 2019. After the introduction of orthophosphate, PWSA has analyzed samples from the water system continuously and orthophosphate was detected in those samples as having treated the primary reservoirs (except Highland No. 1 which remains offline until the MFP upgrades are completed). PWSA expects that the orthophosphate treatment will result in reduced lead levels to below action levels at properties with lead service lines. Two consecutive 6 month systemwide customer lead test results less than 15 parts per billion will eliminate the required 7% per year replacement of remaining lead service

[1] http://www.puc.state.pa.us/pcdocs/1607493.docx.

[2] http://www.puc.state.pa.us/pcdocs/1607874.pdf; http://www.puc.state.pa.us/pcdocs/1607875.pdf.

[3] http://www.puc.state.pa.us/pcdocs/1608677.docx; http://www.puc.state.pa.us/pcdocs/1608676.docx.

lines. PWSA's lead service line replacement program has continued with the assistance of the Commonwealth (PENNVEST loans and grant).

III. UPDATE ON COMPLIANCE PLAN

Q. HAS PWSA MONITORED ITS PROGRESS IN SATISFYING ITS PLAN FOR COMING INTO COMPLIANCE WITH PUC RULES AND REGULATIONS THAT IT FILED ON SEPTEMBER 28, 2018 AND WHICH IT SUPPLEMENTED ON FEBRUARY 1, 2019?

A. Yes. PWSA has attempted to monitor the commitments it made in its Compliance Plan and Supplemental Compliance Plan. Attached as Exhibit RAW/C-28 is PWSA's First Compliance Plan Progress Report. The Report shows the commitments PWSA made in its initial Compliance Plan, or which were added by the Tariff Proceeding or the Supplemental Compliance Plan and shows its progress as of this filing in completing those tasks. PWSA proposes to continue to file such Progress Reports on a quarterly or semi-annual basis after the Commission reviews its initial plan.

IV. OVERALL OBSERVATIONS

Q. MR. WEIMAR, CAN YOU PROVIDE AN OVERALL RESPONSE TO THE TESTIMONY THAT WAS FILED BY THE VARIOUS PARTIES IN RESPONSE TO PWSA'S COMPLIANCE PLAN AND ACCOMPANYING TESTIMONY?

A. Yes. Generally, the testimony submitted by the Parties was thorough and thoughtful. On behalf of PWSA, we appreciate all these efforts and take the comments as part of the Parties' continuing efforts to assist PWSA in its transition to full PUC regulation and to fulfilling its goal of being a first class water/wastewater/stormwater utility, providing excellent service efficiently and at reasonable rates. But in reviewing all the recommendations and positions I believe it would be appropriate for the Commission to consider several points.

First, the Commission should recognize that PWSA's coming into compliance with all PUC regulatory requirements will be a process. In some instances, witnesses have not completely recognized that a transition process will be necessary. They have pointed out that PWSA is not currently in compliance with a particular regulation and have asked that the Authority revise its Compliance Plan to put forward a plan as to how it is going to be in compliance.

To reflect the fact that it simply is not possible for PWSA to immediately come into 100% compliance with all PUC rules, the PWSA Compliance Plan put forth several proposals to transition to full compliance. In some instances that transition consists of a gradual movement towards full compliance. In others it includes taking partial steps in order to complete all the tasks necessary for compliance at some later date. The Commission should recognize that this is the only reasonable and practical approach. I am also advised by counsel that this is what appears to have been contemplated by the Pennsylvania General Assembly when it mandated that PWSA was to submit a compliance plan that shall include "provisions to bring [PWSA's] existing … operating systems and procedures into compliance with [PUC] requirements …."[4] In my view, what the Commission should be requiring here is not 100% compliance with all PUC rules but a plan to come into compliance with those rules over a realistic time frame. The Commission should be looking for PWSA to increase its human capital, consultant or support resources to address the outstanding issues in a manner consistent with its ability to effectively manage the agreed upon compliance activities while maintaining the utility's ability to meet its customer requirements and needs.

[4] 66 Pa. C.S. § 3204(c).

PWSA has made substantial investments in its staff, rolling stock and physical plant (including IT and Supervisory Control and Data Acquisition) over the past 2 years. A wholly new management team and organization is in place. We have developed a comprehensive capital program, including addressing the primary water reservoir covers, water treatment plant chemical feed facilities, Supervisory Control and Data Acquisition (SCADA), pump station electrical upgrades, meter installations, among others. In addition, PWSA has performed more than 3,000 residential lead service line replacements since 2017. PWSA has also implemented a Combined Sewer Overflow abatement program to comply with our Federal and State compliance responsibilities. There should be no question that PWSA is taking its obligations seriously and making positive steps at meeting its various goals.

Second, I believe that the Commission should keep in mind the sheer size and scope of the effort that is going to be necessary to bring PWSA into full compliance with PUC rules. This at the same time that the Authority must address mandates to update infrastructure and service imposed by entities that have primary jurisdiction over PWSA's water quality – the PA Department of Environmental Protection ("PA DEP") and the US Environmental Protection Agency ("EPA"). It also must be recognized that, while, as Ms. Presutti has testified, PWSA believes that it can access the capital it needs to finance its construction and other compliance plans, that may not be the case if additional obligations are imposed or timeframes are expedited. There is only a certain level of spending that PWSA will be able to sustain at current rates. While PWSA plans to borrow more, it must be cognizant of the debt burden it can reasonably maintain and is affordable to our ratepayers. The hard reality is that PWSA is not going to be able to

simultaneously complete or finance all of the tasks that the Parties have laid out for us to achieve PUC compliance *and* continue to comply with PA DEP and EPA mandated timelines *and* restructure and realign its relationship with the City and the Allegheny County Sanitary Authority. PWSA's various compliance proposals were made with this backdrop. Before these proposals are changed or expedited, the PWSA, the Parties and the PUC should try to agree on how any such modification changes the priorities or its funding abilities.

V. SPONSORSHIP OF DOCUMENTS

Q. PLEASE DESCRIBE I&E'S CONCERN REGARDING THE EXHIBITS ATTACHED TO YOUR TESTIMONY.

A. In the Direct Testimony of Mr. Spadaccio, he notes that PWSA did not sponsor ten documents listed in Directed Question 1 as exhibits. I&E Statement No. 1 at 10-12.

Q. WHAT DOES MR. SPADACCIO RECOMMEND?

A. Mr. Spadaccio recommends that PWSA immediately provide, as part of this proceeding, all of the missing documents that he identified so that the review the Commission requested is possible. I&E Statement No. 1 at 12.

Q. WHAT IS YOUR RESPONSE TO MR. SPADACCIO' S CONCERN AND RECOMMENDATION?

A. To the extent I&E's view is the PWSA failed to provide documents requested by the Commission or was in some way not in compliance with what PWSA was required by the Commission to do, I do not agree. The directed question appears not to understand the specific documents upon which PWSA intends to rely in support of its Compliance Plan and directs PWSA to "introduce into evidence those materials it intends to use as support for the Compliance Plan."(See Exhibit RAW/C-1 Question 1). PWSA did not

interpret this as a mandate for PWSA to introduce the specifically identified documents as exhibits to be moved into the record as part of this Stage 1 proceeding. Rather, as explained in my Direct Testimony, PWSA reviewed the list of documents identified by the Commission and carefully considered which of those documents should be appropriately submitted as part of the evidence of this record to support PWSA's Compliance Plan. PWSA's views of each of the documents identified in the Directed Questions is set forth in my direct testimony. (PWSA St. C-1 at 9, footnotes 10 and 11). Based on our review of these materials, I sponsored and included as exhibits those documents from the Commission's list that PWSA will move to admit into the record of this proceeding as support for its Compliance Plan. (PWSA St. C-1 at 9). While PWSA is certainly willing to provide copies of any documents referenced in this list or its Compliance Plan, for purposes of supporting its Compliance Plan, PWSA does not view admission of those documents not already included with my direct testimony as required by the Directed Questions. I hope this helps to clarify PWSA's position. I would also note that if another Party feels that a document is relevant to this proceeding and otherwise admissible they are free to move for its admission.

VI. INFRASTRUCTURE AND OPERATIONS

A. Capital Projects: PA DEP Order

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING THE ASPINWALL TREATMENT PLANT HIGH SERVICE PUMP STATION.

A. As I&E witness Mr. Cline notes, the schedule for (1) the Aspinwall Pump Station Improvements, (2) the Bruecken Pump Station Improvements, and (3) the Clearwell Emergency Response Project depend upon the schedule for the Aspinwall Treatment

Plant High Service Pump Station. I&E St. 3 (Cline) at 6. Mr. Cline notes that specific timelines were not provided for these three projects, since they are dependent upon the schedule for the Aspinwall Treatment Plant High Service Pump Station. I&E St. 3 (Cline) at 6-7. A preliminary concept study of the High Service Pump Stations has been submitted to PWSA and is now under review by PWSA engineering and management. Once a final plan is approved, PWSA intends to update its Capital Improvement Plan, and implement the appropriate projects to minimize risk of water system failure.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends PWSA provide an update to I&E-RB-26 regarding the status of the Aspinwall Treatment Plant High Service Pump Station in its rebuttal testimony, PWSA should acknowledge whether it has or has not decided to move forward with the project at that time. I&E St. 3 (Cline) at 7. Mr. Cline also recommends that PWSA should either provide the missing project timeline information through its rebuttal testimony or explain why such information is not available. I&E St. 3 (Cline) at 7.

Q. WHAT IS YOUR RESPONSE?

A. The High Service Pump Station concept planning activities are being completed, and a draft report with conclusions and recommendations is expected to be ready for submittal to PA DEP for review by the end of May. Typical PA DEP review times are 90 to 120 days, before final design is authorized. PWSA will submit its draft High Service Pump Station plan to the Commission for informational purposes.

B. <u>Capital Projects: Capital Projects</u>

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING OTHER CAPITAL PROJECTS.

A. Mr. Cline notes that PWSA failed to identify the design engineer or company affiliation for the (1) 2019 Large Diameter Water Main Improvements, (2) Aspinwall Water Treatment Plant High Service Pump Station, (3) Clearwell Emergency Response Project, (4) Clearwell Improvements, and (5) MFP Assessment and Critical Process Improvements project. I&E St. 3 (Cline) at 7-8. He further notes that, PWSA simply indicates that it will be using borrowing to fund its capital improvement projects. I&E St. 3 (Cline) at 8.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that, in rebuttal, PWSA should provide both design engineer and company affiliation for each project, as asked by the Commission's Directed Questions, or explain why such information is unavailable. I&E St. 3 (Cline) at 8. Additionally, Mr. Cline recommends that PWSA should provide more specific details about the funding sources that it plans to use for each project. As an alternative, if more specific information cannot be provided, PWSA should explain why and indicate when it anticipates being able to identify a specific funding source for each project. I&E St. 3 (Cline) at 8.

Q. WHAT IS YOUR RESPONSE?

A. A list of projects, their current status, the assigned consultant, nominal completion schedule and current risks has been attached as Exhibit RAW/C-29 for the Commission's information. PWSA is prepared to discuss the current status of the concept plans, costs, and inherent schedules at the Commission's convenience.

C. <u>Capital Projects: Aspinwall Clearwell Improvement Project</u>

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING THE ASPINWALL CLEARWELL IMPROVEMENT PROJECT?

A. I&E appears most concerned about the Aspinwall Clearwell Improvement Project. I&E St. 3 (Cline) at 9. Mr. Cline states that PWSA did not provide sufficient information on the Clearwell or the Clearwell Emergency Response Project. I&E St. 3 (Cline) at 14-15. Mr. Cline also notes that other projects need to be completed before the Clearwell can be taken out of service for rehabilitation or replacement. I&E St. 3 (Cline) at 10-11. He states that PWSA did not provide sufficient information on these projects. I&E St. 3 (Cline) at 12-14.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that the Commission find that PWSA will not be providing safe and reliable service until PWSA provides expedited plans to bypass the Clearwell and continue to provide service in the event of a failure. I&E St. 3 (Cline) at 15.

Mr. Cline also recommends that, to comply with its obligation to ensure safe and reliable service, the Commission order PWSA to submit a new Compliance Plan that expedites the completion of the Clearwell projects. I&E St. 3 (Cline) at 15.

Q. HOW DO YOU RESPOND?

A. PWSA agrees that the Clearwell condition presents a clear risk to the PWSA water system operation. Since 2015, PWSA has engaged several consultants to study optional approaches to provide service should the Clearwell fail. Attached for the PAPUC's information as Exhibit RAW/C-30 is a study prepared by Matt MacDonald in March 2017 entitled "Alternatives Evaluation – Clearwell Redundancy Project."

The following initial phases of the Clearwell replacement project have begun:

1. Development and implementation of an emergency bypass to avoid total loss of supply if a Clearwell failure occurs prior to completion of the Clearwell full capacity backup system;
2. Route selection, design and construction of the parallel rising main to the Lanpher Reservoir to allow use of the Lanpher and Highland No. 2 reservoirs to temporarily provide the Clearwell disinfection treatment;
3. The concept plan and preliminary design for a Clearwell bypass pipe;
4. High Service Pump Station evaluation and preliminary facilities plan; and,
5. Preliminary approval of the Clearwell construction and operational phasing from PA DEP.

PWSA awaits PA DEP's proposed Administrative Order which specifies the key projects that must be implemented on a specified schedule. Once received, PWSA will submit their Draft Administrative Order to PA PUC for its information.

D. <u>Capital Projects: PA DEP Evaluation– Highland Membrane Filtration Plant</u>

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING THE HIGHLAND MEMBRANE FILTRATION PLANT.

A. Mr. Cline notes that there is a PA DEP Administrative Order regarding the Highland Park No. 1 Reservoir, which is an uncovered distribution system reservoir that is attached to the Highland Membrane Filtration Plant ("HMFP"). I&E St. 3 (Cline) at 16-17. Additionally, he notes that PWSA agreed to provide in its next base rate case a cost/benefit analysis comparing the cost of continuing to operate the HMFP, including the 24-hour security, and covering and placing a physical barrier around the Highland Park No. 1 Reservoir. *Id.*

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that discussion of the HMFP and Highland Park No. 1 Reservoir continue when PWSA provides the cost/benefit analysis in its next base rate case. I&E St. 3 (Cline) at 19.

Q. WHAT IS YOUR RESPONSE?

A. PWSA's water system was built to rely on three reservoirs: Highland No. 1, Highland No. 2, and the Lanpher Reservoir. The Highland No. 2 and Lanpher Reservoirs were covered in the 1990s to comply with the EPA requirements. Highland No. 1 was not covered as a result of political intervention on behalf of the local residents and park enthusiasts. The intervention resulted in the Membrane Filtration plant which has operated since 2002.

The plan to address the Highland No. 1 operational value is being developed through a review of the system operational pressures, systemwide demands, and water age. However, the existing Membrane Filtration Plant and Highland No. 1 reservoir remain as critical components of the existing water supply system. This system will be needed to provide adequate water supply system resiliency from facility failure or power loss, as well as providing capacity and peak demand backup until permanent alternatives have been put in place.

Also, on a quarterly basis, PWSA has been sharing cost breakdown information concerning repairs to the HMFP pursuant to a commitment in the Rate Case Settlement.[5]

PWSA is on schedule to provide a cost/benefit analysis of the relevant legal, technical, and policy considerations, as well as a cost comparison, of operating the HMFP

[5] Rate Case Settlement, Para. III.H.4.

instead of covering and placing a physical barrier around the Highland No. 1 Reservoir in the future. Note that the HMFP is still not fully operational nor operating under PA DEP consent, so operations and maintenance cost projections cannot be verified until the system is fully on line. The MFP operation will begin upon completion of the ongoing upgrades required by PA DEP, expected to be complete within the next 90 days.

E. Competitive Bidding Processes: Water Supply, Production & Storage and Wastewater Conveyance Projects

Q. PLEASE DESCRIBE I&E'S CONCERN REGARDING COMPETITIVE BIDDING.

A. Mr. Gray recognizes that PWSA's testimony explains the competitive bidding processes used by PWSA. He is concerned that PWSA failed to provide any estimation of the number of projects that will be competitively bid. I&E St. 5 (Gray) at 9.

Q. WHAT DOES MR. GREY RECOMMEND?

A. Mr. Gray recommends that PWSA provide the percentage of projects that are to be competitively bid or, if this information is unavailable, that PWSA track and provide this information as part of a revised Compliance Plan filing. I&E St. 4 (Gray) at 9-10, 38.

Q. DO YOU HAVE A RESPONSE?

A. As I explained in my direct testimony, any capital construction project or purchase of equipment/materials with a cost in excess of $20,600 must follow an open and public bid process, in accordance with the Municipality Authorities Act, and be awarded to the lowest responsible bid; Professional services solicitations are awarded to the best value proposer. *See* PWSA St. C-1 at 14-17; PWSA Exh. RAW/C-15 and RAW/C-16. So, the percentage of projects or purchases that are to be competitively bid is virtually 100%, if

that project or purchase will cost in excess of the amount specified in 53 Pa.C.S. 5614 (as determined by the Department of Labor and Industry each year). *Id*.

In addition, I would note that PWSA has begun to monitor several metrics related to cost effectiveness and cost reporting relative to its projected capital spending. It is using the eBuilder project management software to track project costs and progress, which allows advanced calculation of performance metrics. Currently, PWSA is tracking project total costs and cash flow relative to budget. PWSA is working on defining additional metrics such as Estimated Cost at Completion (ECAC), schedule variance, change order volume and percentage of total project, etc. Note that, except for emergency projects that are based upon negotiated bid proposals from vendors and construction contractors, PWSA's construction change orders have averaged less than 5% of the original bid amount.

F. 52 Pa. Code § 65.17 - Standards of Design – 4-Inch Diameter Mains

Q. PLEASE DESCRIBE I&E'S CONCERN REGARDING 4-INCH DIAMETER MAINS.

A. Mr. Cline points out that designs should conform to standard acceptable engineering practices and the regulatory requirement of PA DEP and the Commission. I&E St. 3 (Cline) at 35. For example, 52 Pa. Code § 65.17(b) states distribution systems must be adequate to maintain minimum pressures required by 52 Pa. Code § 65.6 and distribution main less than 6 inches shall not be used except in cul-de-sacs where the mains will not be extended and are less than 250 feet in length. I&E St. 3 (Cline) at 36. Mr. Cline notes that PWSA intends to incorporate the design requirements, specifications, and standard

details into a formalized Design Manual, to be completed in 2019 and 2020. I&E St. 3 (Cline) at 35.

There are still 27 miles of 4-inch diameter mains in its system. I&E St. 3 (Cline) at 36. Mr. Cline expressed concern that PWSA has not provided a timeline or projected completion date for the replacement of all 27 miles of 4-inch diameter mains. I&E St. 3 (Cline) at 37.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that PWSA should include an update on the progress of the proposed Design Manual in its rebuttal testimony so that the parties and the Commission can consider the status in evaluating PWSA's compliance. I&E St. 3 (Cline) at 36.

Mr. Cline also recommends that the Commission determine that PWSA is not in compliance with Section 65.17 unless and until PWSA provides a revised Compliance Plan that includes a timeline and projected completion date for the replacement of all 4-inch diameter water mains. I&E St. 3 (Cline) at 37.

Q. DO YOU HAVE A RESPONSE?

A. In accordance with the PUC's standards of design, PWSA is focused on continuing to replace all 4" water mains, which will be addressed in the Master Plan, and incorporating the PUC's design requirements, specifications, and standard details into a formalized design manual. PWSA is on target to address these issues within the specified timeline. Our small diameter water main replacement program will prioritize 4 inch diameter mains as they experience frequent breaks and are often located in areas where lead service lines predominate.

G. <u>52 Pa. Code § 65.7 – Metering Unmetered Properties</u>

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING METERING FOR UNMETERED PROPERTIES.

A. Mr. Cline states that there are 200-400 municipal buildings within the City of Pittsburgh ("City"), as well as 500 flat rate customers that are not currently metered. I&E St. 3 (Cline) at 19-20, 51. Mr. Cline also states that the buildings and properties should be metered so that PWSA can begin accurately billing for water usage and use that additional revenue to fund critical infrastructure projects. I&E St. 3 (Cline) at 21.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that PWSA should complete metering municipal buildings as soon as possible (on an expedited basis), as opposed to the 5 years proposed by PWSA. I&E St. 3 (Cline) at 21, 57. He also recommends that metering should be done at PWSA's expense. I&E St. 3 (Cline) at 22-23. Regarding the later recommendation, Mr. Cline appears to be speaking of both unmetered flat rate customers and municipal facilities.

Q. DID MR. CLINE PROVIDE A TIMELINE OR ANY COST ESTIMATES?

A. No. Other than stating that the work should be done as soon as possible (on an expedited basis), Mr. Cline did not provide any specifics.

Q. DO YOU HAVE A RESPONSE?

A. Before I address Mr. Cline's recommendation, I wish to clarify the number of meter installations that will be required to meter all municipal properties. Consistent with my direct testimony, there are approximately 200-400 municipal buildings that are not currently metered. Additionally, there are between 300-400 municipally-owned fountains, pools, etc. that need to be metered.

The five year timeframe represents the amount of time that PWSA anticipates it will take to complete the metering of all municipal properties. As I explained in my Direct Testimony, PWSA's metering plan is a substantial project that is dependent on factors outside of PWSA's control, including negotiations with the City as to each entity's specific responsibilities, cost share for supplemental interior plumbing improvements, the availability of capital funding versus the priority of other capital expenditures and the ability to find a sufficient amount of staff and plumbing contractors to perform the work. PWSA also has many other projects and capital investment priorities that have to be taken into consideration, such as core water supply infrastructure investments, its lead remediation project, and the installation of approximately 500 customer meters at currently unmetered locations. As such, PWSA needs flexibility to reprioritize and shift anticipated timelines, if necessary, to ensure that all projects are handled within available funds, and that priority items can be addressed.

That said, as I also explained in my direct testimony, I believe PWSA may be able to complete the metering of municipal buildings within two to three years, if City resources are mobilized to provide all interior building plumbing upgrades prior to scheduling meter installation. While I believe that the Commission should grant PWSA a five-year time period in which to complete the metering of municipal buildings, PWSA will strive to complete the project as soon as practicable, including the metering of all other City uses. PWSA has selected a consultant and awarded a contract to assist in identifying and evaluating unmetered municipal facilities (as well as flat-rate customers). PWSA's Board of Directors approved a consulting contract with the selected vendor on April 26, 2019. While these metering efforts are already underway, it would be prudent

to set the time frame for completion of the metering of municipal buildings at five years to give PWSA the flexibility that it needs, particularly in consideration of the factors that are outside of PWSA's control and the other high risk water supply projects that PWSA is undertaking.

Additionally, PWSA anticipates that it will take approximately five years to complete the metering of flat rate customers. I recommend, however, that the Commission grant PWSA flexibility in these efforts as well, in the event that factors beyond PWSA's control delay the installation of these meters.

As for I&E's recommendation that PWSA pay for the metering of municipal buildings *and* flat-rate customers, PWSA does not have the funds readily available to finance the installation of approximately 1,000 meters, give or take (including residential, municipal buildings, and municipally-owned fountains, pools, etc.). Under PWSA's proposal, residential customers will pay for the initial installation of their meters. The meter and any appurtenances are then owned, installed, tested, and maintained by PWSA. Customers will not be required to pay for the replacement of meters or appurtenances. As for meter installations at municipal properties, PWSA has an agreement with the City to split these costs 50/50.

This proposal is reasonable under the existing circumstances. Before PWSA became a regulated public utility, PWSA was authorized to offer flat rate services to residential customers, provide unmetered and/or unbilled services to municipal buildings, and to charge customers for the installation of meters. These prior, authorized practices have resulted in the current situation. Becoming compliant with Commission regulations takes time, and I ask the Commission to consider the specific circumstances of this case

in determining the appropriate steps and time for PWSA to take in order to achieve full compliance. If PWSA is forced to pay for the installation of all unmetered properties within a short time frame, PWSA may be forced to reduce its investments in other critical projects and high risk priorities. As such, I recommend that the Commission authorize PWSA to collect the cost of meter installations and other related appurtenances.

H. Implementing Rates For Unmetered and/or Unbilled Usage (including City Usage)

Q. DO THE OTHER PARTIES HAVE CONCERNS AND RECOMMENDATIONS REGARDING IMPLEMENTING RATES FOR UNMETERED AND UNBILLED USAGE?

A. Yes. Mr. Cline for I&E and Mr. Rubin for OCA provided testimony regarding unmetered and unbilled usage.

Q. PLEASE DESCRIBE MR. CLINE'S VIEWS.

A. Mr. Cline offers that all unmetered buildings and properties should immediately be charged a flat rate (to be established in PWSA's next base rate case) so that PWSA can begin billing for wastewater and water usage. I&E St. 3 (Cline) at 56-57.

Mr. Cline notes that it is unclear if PWSA's proposed 20/40/50/80 plan is being offered to non-City water customers and/or wastewater users as well. I&E St. 3 (Cline) at 54, 57. He further noted the City has had knowledge of the need to meter and pay for its water usage since 2017. I&E St. 3 (Cline) at 53-56.

Additionally, Mr. Cline stated that public fire hydrants are a service provided to the City and therefore costs related to this service should be recovered from the City. I&E St. 3 (Cline) at 59.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. For water service, Mr. Cline recommends that the Commission determine that PWSA's plans regarding unbilled and unmetered customers are not in compliance with the Code. I&E St. 3 (Cline) at 56. He also recommends that, in PWSA's next base rate case, it introduce a flat rate for all unbilled customers, which, at minimum, charges the customer charge for that customer's class. I&E St. 3 (Cline) at 56. He further recommends that, as customers are metered, their usage should be billed immediately. I&E St. 3 (Cline) at 56.

For wastewater collection service, Mr. Cline recommends that unmetered wastewater customers should also be billed a flat rate and immediately billed for usage when the building is metered, similar to water customers. I&E St. 3 (Cline) at 57.

With regard to public fire hydrants, Mr. Cline notes his opinion that it is appropriate for the Commission to determine in this compliance proceeding whether PWSA's current practice of recovering public fire hydrant costs from all rate classes complies with the Code. I&E St. 3 (Cline) at 58-59. He recommends that the Commission direct PWSA to file a revised Compliance Plan stating that PWSA will provide a new rate design reflecting allocation of all public fire hydrant costs to the City with its next rate case proposal. I&E St. 3 (Cline) at 59.

Q. HOW DO YOU RESPOND?

A. PWSA had been operating for many years as a non-regulated entity under Municipality Authorities Act regulations. Mr. Cline fails to recognize that becoming fully compliant with Commission regulations may take some time. The goal of this proceeding is to arrive at an acceptable plan for compliance, not to simply identify where PWSA currently is not in compliance. PWSA's proposed plan will result in the (eventual) metering of all PWSA customers and the full payment by those customers for water and wastewater

conveyance services. PWSA's proposals for achieving full compliance are based on the specific circumstances of this case and the goal of achieving full compliance with Commission regulations in a timely and efficient manner. I submit that this approach is fully consistent with the requirements of Chapter 32.

Here, the proposed 20/40/60/80/100 percent phased and stepped billing approach is appropriate in consideration of the fact that the City has never been billed for water at its unmetered and/or unbilled locations, is neither aware of the amount of water it uses nor the dollar amount it will have to pay once billing for the water begins, and has just emerged from Act 47 state oversight. The City needs a reasonable amount of time to understand what the obligations will be and to consider taking steps to try to mitigate its current water use. The City also needs lead time to incorporate these payment obligations in future budgets and tax levy as required.

Mr. Cline's proposed flat-rate approach would be a "rate shock" to the City, as all currently unbilled municipal buildings would be required to pay for water and wastewater conveyance services all at once. The fact that the City may have known that PWSA was going to be subject to PUC authority since 2017 does not change the fact that the City has never had to pay for these expenses and must begin incorporating these expenses into future budgets in a gradual and affordable manner. As such, I recommend that the Commission adopt PWSA's proposed 20/40/60/80/100 percent phased and stepped billing approach for water and wastewater conveyance services.

I also note that PWSA's proposed 20/40/60/80/100 percent phased and stepped billing approach is limited to the metered municipal facilities.

PWSA currently charges unmetered non-municipal properties a flat rate, and PWSA will continue to do so until these properties are metered. PWSA has begun its consideration of the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties/buildings served by PWSA but wants to be sure that any methodology applied is defensible and equitable. The Authority plans to conduct its analysis before the next rate case.

As for Mr. Cline's recommendation regarding public fire hydrants, PWSA has already agreed to provide a new rate design reflecting allocation of all public fire hydrant costs to the City with its next rate case proposal.

The Authority has every intention of assessing water consumption and sewer demand charges to unmetered customers. However, the majority of the unmetered customers are non-residential, which complicates development and assessment of a flat rate, because the buildings are not homogeneous and water line size is not necessarily indicative of use. As such, assessing a flat rate will be dependent on the Authority's ability to accurately estimate use and avoid assessing an inequitable charge. The Authority plans to conduct its analysis before the next rate case.

The goal of this initiative includes efforts to record water use for street sweeping, firefighting uses, and other public works uses. In so doing, PWSA will reduce its unaccounted-for water. PWSA has provided general provisions for metering incidental uses. PWSA is working to have the City of Pittsburgh's Department of Public Works determine appropriate sites for meters for filling street sweeping vehicles, as well as reporting protocols. PWSA has a stock of hydrant meters and is assigning them to paving and street sweeping project uses. PWSA anticipates that these protocol and procedures

are on-schedule for complete implementation by October 2019. However, there will need to be some training and culture change with City staff to get them accustomed to routinely meter these incidental uses for public works maintenance and other related unspecific uses.

Q. PLEASE DESCRIBE MR. RUBIN'S TESTIMONY REGARDING METERING.

A. Mr. Rubin expresses concern that PWSA is not in compliance with the Municipality Authorities Act. He opines that PWSA is not in compliance with the requirement for reasonable and uniform rates under 53 Pa.C.S. § 5607(d)(9). OCA St. 2 (Rubin) at 5-6. He further opines that, by not charging for the City, PWSA is not in compliance with 53 Pa.C.S. § 5612(a.1). Mr. Rubin next expresses concern over the (alleged) lack of urgency in resolving these compliance issues by way of implementing a flat rate for non-metered service. OCA St. 2 (Rubin) at 6-7.

Q. WHAT DOES MR. RUBIN RECOMMEND?

Mr. Rubin does not oppose PWSA's proposed five-year transition plan of unmetered accounts of the City of Pittsburgh and certain non-profit organizations to metered service. He claims, however, that the plan should be modified to include a flat-rate charge that also would ramp up during the five-year period. OCA St. 2 (Rubin) at 3, 7-8. Mr. Rubin further recommends that the Authority should be required to implement flat-rate billing for each property that is receiving service but is awaiting the installation of a meter. OCA St. 2 (Rubin) at 7.

Q. HOW DO YOU RESPOND?

A. I have the same response as I had for Mr. Cline's recommendation regarding a flat rate charge, and I incorporate that response herein.

I. 52 Pa. Code § 65.8 – Meter Testing & Replacement

Q. DO THE OTHER PARTIES HAVE CONCERNS AND RECOMMENDATIONS REGARDING METER TESTING AND REPLACEMENT?

A. Yes. Mr. Cline for I&E and Mr. Fought for OCA provided testimony regarding meter testing and replacement.

Q. PLEASE DISCUSS MR. CLINE'S VIEWS ON BEHALF OF I&E.

A. Mr. Cline acknowledges that as many as 50,000 meters are out of compliance with the Commission's meter testing requirements and that PWSA plans to achieve compliance by 2024. I&E St. 3 (Cline) at 24. He opines that PWSA does not currently have an adequate workforce or facilities to complete this work. I&E St. 3 (Cline) at 24-26.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. In his direct testimony, Mr. Cline recommends that PWSA provide updates in its rebuttal testimony in the following areas: (i) Whether the Authority has awarded the contract and remains on track to begin testing meters greater than three inches on April 1, 2019; I&E St. 3 (Cline) at 26; (ii) The identification and status of PWSA's parameters for testing meters two inches and larger as referenced in its response to I&E-RB-8 (I&E Ex. No. 3, Sch. 8), I&E St. 3 (Cline) at 27; (iii) The status of the realignment of the current warehouse to house a new meter test bench has been completed and the new test bench is in use, I&E St. 3 (Cline) at 27; and (iv) Whether PWSA is revising its original 2022 goal for commercial meter testing to extend that goal to 2024 (as with the residential meters). I&E St. 3 (Cline) at 27.

Mr. Cline also recommended that PWSA provide in rebuttal testimony a discussion of the feasibility of the meter testing triage plan referenced in the Commission's Directed Questions. I&E St. 3 (Cline) at 28.

Mr. Cline recommends that the Commission find the 2024 projected date of compliance to be acceptable pending PWSA providing the missing information as discussed above. I&E St. 3 (Cline) at 29.

Q. HOW DO YOU RESPOND?

A. Regarding Mr. Cline's specific requests for updates: i) The Authority has entered into a contract with a company to test meters greater than 3", and has begun testing these meters; ii) PWSA has hired a firm to test meters greater than 2", the testing parameters are consistent with the American Water Works Association's ("AWWA") standards; iii) The realignment of the current warehouse to house a new 24 meter test bench has been completed and the new test bench has been in use as of April 15, 2019 for meters up to 2 inches. These meters will not go back into service in the system. Operations staff have reached out to the Commission to clarify requirements for the meter testing and will then develop appropriate testing protocols based on the response. PWSA believes that the last sentence of the PUC Regulations, Section 65.8. Meters (d) (2), which says "Meters permanently removed from service and replaced by new meters utilizing remote reading devices are exempt from this provision" permits PWSA to only test a fraction of the meters pulled from service when they are no longer going to be used in the system. PWSA uses an AMI network for getting data from meters which qualifies as a "remote reading device"; and iv) As indicated in my Direct Testimony, commercial meters are on a different testing schedule, and PWSA hopes to complete testing of commercial meters within a 3-year time period. *See* PWSA St. No C-1 at 33.

As for Mr. Cline's recommendation for PWSA to discuss the feasibility of the meter testing triage plan, I discussed this issue in my Direct Testimony. Specifically, I

explained how PWSA currently uses a triage plan with the hierarchy identified in the Commission's Directed Questions. *See* PWSA St. No. C-1 at 30-31.

According to best available information, PWSA has as many as 50,000 meters that have exceeded the Commission's recommended testing schedule and will need to be tested and/or replaced. Unfortunately, much of the meter data including installation date was lost in a billing system transition, so this number cannot be validated. In its Compliance Plan, PWSA committed to increasing its plumbing staff and changing out 5,000-6,000 meters per year. PWSA currently has open advertisements for plumbers and has coupled its residential meter replacement program with its lead service line replacement program, which has decreased the number of individual appointments that need to be scheduled. To date, PWSA has changed out more than 1,000 residential meters (817 changeouts in April), and is on track to change more than 1,000 meters in 2019.

Q. PLEASE DISCUSS MR. FOUGHT'S VIEWS ON METERING.

A. Mr. Fought notes that PWSA's goal is to be in compliance by June 30, 2024 and that additional research by PWSA will be necessary to determine how many additional meters will be out of compliance until June 30, 2024. OCA St. 5 (Fought) at 6.

Q. WHAT DOES MR. FOUGHT RECOMMEND?

A. Mr. Fought recommends that PWSA should do whatever research necessary to locate the meters that need to be tested and/or replaced so that it can be done in an efficient manner. OCA St. 5 (Fought) at 6.

Q. DO YOU HAVE A RESPONSE?

A. As I have noted, according to best available information, PWSA has as many as 50,000 meters that have exceeded the Commission's recommended testing schedule and will need to be tested and/or replaced. Unfortunately, much of the meter data including

installation date was lost in a billing system transition, so this number cannot be validated. With no records for install dates, PWSA has determined that meter replacements (available records suggest that most meters exceed 20 years install age) are the most timely and cost effective way to establish proper meter records and metering accuracy.

J. 52 Pa. Code § 65.11 and §65.20- Water Conservation Issues

Q. DO THE OTHER PARTIES HAVE CONCERNS AND RECOMMENDATIONS REGARDING WATER CONSERVATION?

A. Yes. Mr. Cline as well as Mr. Gray on behalf of I&E provided testimony regarding water conservation issues.

Q. PLEASE DISCUSS MR. CLINE'S VIEWS ON WATER CONSERVATION.

A. Mr. Cline stated that PWSA has provided no indication of when it intends to begin distributing its proposed educational materials to customers. I&E St. 3 (Cline) at 40. He acknowledges that PWSA estimates that its leak detection program can be completed in three to four years. I&E St. 3 (Cline) at 41.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that the Commission order PWSA to file a revised Compliance Plan, including a detailed timeline and start date for which PWSA can commit to begin providing the required educational information to customers. I&E St. 3 (Cline) at 40.

Mr. Cline recommends PWSA provide the Commission with annual reports summarizing the progress of the efforts to ensure that they are efficient, cost-effective, and yield results. He also recommends that an annual breakdown of costs and timelines be included with the leak survey data. I&E St. 3 (Cline) at 42.

Q. PLEASE RESPOND.

A. PWSA has an abundant water supply and therefore has never experienced and is not likely to experience a period where there would be inadequate source water to meet demands. Therefore, I would very much prefer that compliance with this obligation be "staged" to phase in PWSA's obligations. Our largest transmission pipes may be a source of significant water leakage; the past 10 years have experienced an average of 1 major transmission line break per year, one of which resulted in a 10,000 gpm leak for several weeks before it was located. In fact, another major leak has been detected on this same rising main this year, and PWSA is presently assessing the extent and most effective approach to its repair. PWSA's engineering team has been evaluating potential innovative vendor methods to evaluate large diameter riveted steel and prestressed concrete cylinder pipe (PCCP) conditions, leak locations and volume. This evaluation has been complicated by the inability to shut down these primary transmission pipes as well as the primary failures which result from external corrosion and caused by catastrophic pipe "blowouts." A national vendor has been engaged to assist with known critical transmission main leaks, which if successful we intend to deploy to test large diameter pipes throughout the transmission system. In the meantime, PWSA also recently hired a senior leak detection expert as a Senior Manager and purchased new equipment to improve and increase the capacity of leak detection capable staff. Training and deployment has begun, and we are seeing improvement in PWSA's leak detection capability and performance. While this is an important skill which we will continue to develop, PWSA's limited resources should be primarily focused on modernizing its existing facilities and assuring that its drinking water meets all Federal and State standards at all times.

Q. PLEASE DISCUSS MR. GRAY'S VIEWS ON BEHALF OF I&E.

A. Mr. Gray states that PWSA does not have standard operating procedures for situations that require mandatory water conservation measures. I&E St. 4 (Gray) at 12. In doing so, he recognizes that PWSA anticipates that it will comply by 2020 and that PWSA has not faced any situations that would require mandatory conservation measures in at least the past ten years. *Id.* Notwithstanding, he expressed concern over the (alleged) lack of explanation of why it is necessary for it to delay implementing such procedures until 2020.

Q. WHAT DOES MR. GRAY RECOMMEND?

A. In his direct testimony, Mr. Gray recommends that PWSA file a revised Compliance Plan stating PWSA will (1) develop mandatory water restriction procedures by no later than the close of 2019, and incorporate those procedures into PWSA's pending Emergency Response Plan; and (2) pursue interconnections with other regional water suppliers to enhance system resiliency. I&E St. 4 (Gray) at 13-14, 39.

Q. DO YOU HAVE A RESPONSE?

A. As previously noted, PWSA has an abundant water supply and therefore has never experienced and is not likely to experience a period where there would be inadequate source water to meet demands. However, source contamination or a significant failure in the treatment or delivery system may necessitate periods of mandatory conservation. These are extremely rare, and as such, PWSA has not yet developed Standard Operating Procedures, including communications protocols, for periods of mandatory conservation. However, PWSA and our safety and emergency preparedness partners have conducted tabletop exercises which simulate a loss of supply. General water system emergency procedures have been deployed during Boil Water Advisories over the past few years.

Presently, the Authority is advertising for an Environmental Health and Safety professional who will be tasked with developing and communicating this standard operating procedure ("SOP"). PWSA intends to task this individual to more completely develop the requisite SOPs, and to ensure that staff roles and responsibilities are understood and dry runs performed. We will share our progress in this regard in our quarterly Compliance Plan progress reports.

K. Non-Revenue Water, Leak Detection and Leak Surveying

Q. PLEASE DESCRIBE OCA's CONCERN REGARDING NON-REVENUE WATER.

A. In his direct testimony, Mr. Fought expresses concerns that (1) the volume of water delivered to the distribution system is not metered, (2) the volume of unmetered water used for non-revenue uses is not being estimated and recorded, and (3) the volume of water sold to unmetered customers is not being estimated. OCA St. 5 (Fought) at 4-5.

Q. WHAT DOES MR. FOUGHT RECOMMEND?

A. Mr. Fought recommends that PWSA should immediately start recording estimated non-revenue water used for blow-offs, street sweeping, flushing, firefighting, main breaks, tank overflows, etc. OCA St. 5 (Fought) at 5. He testified that such estimates are needed for both the PUC and AWWA methods of determining unaccounted-for-water/non-revenue water and should be made and recorded shortly after their occurrences. OCA St. 5 (Fought) at 5-6.

Mr. Fought further recommends that, in order to estimate "Unavoidable Losses," PWSA should determine the lengths of water mains and service connections and average pressure in each pressure zone. OCA St. 5 (Fought) at 6. Mr. Fought also notes that PWSA should be prepared to provide and document the information on Section 500 of

the PUC Annual forms, which PWSA agreed to file as part of the 2018 rate case settlement. OCA St. 5 (Fought) at 4.

Q. DO YOU HAVE A RESPONSE?

A. PWSA's Board of Directors has approved the Water Distribution System Master Plan, with a targeted completion date of late 2019. The Master Plan will address master metering and non-revenue water and will include a water audit that follows AWWA guidance using available data. This plan will also recommend locations for implementation of the district metering program, which is discussed in the next section.

PWSA's Plan includes new metering devices at each of its intakes on the Allegheny River, and at two of the main pump stations serving the City (the Aspinwall and Bruecken Pump Stations). In addition, the Plan includes master meter locations recommended by the Water Distribution System Master Plan at key locations within the distribution system. This is on schedule to be completed in early 2020.

PWSA committed to recording water used for flushing by having crews record the time flushed and using flow gauges to record the water used. PWSA has shifted a manager to oversee its flushing program, and has developed a system-wide flushing plan, which has already been approved by the PA DEP. PWSA has implemented the flushing program to facilitate its orthophosphate addition program. This metering program is on track to be in place by October 2019 and will be more fully discussed in subsequent sections of this testimony.

As noted, PWSA has assigned one of its operations managers to formalize its valve operation, flushing, and leak detection programs, and has hired three additional staff members to ensure that the programs are appropriately resourced. The Operations Department has also started a restructuring effort, which includes assigning designated

crews to focus on programmatic valve operation, flushing, and leak detection activities (while supporting other crews during emergencies). While implementation of these programs has started, the programs have not yet been formalized and PWSA is working to automate the associated data collection and reporting efforts. PWSA will also be analyzing the existing system to ensure ample valves through its Master Planning process. The Authority is on target to have these issues addressed within the timeframes specified in the Compliance Plan and Compliance Plan Supplement.

Q. PLEASE DESCRIBE THE ISSUE RAISED BY I&E REGARDING REPORTING UNDER SECTION 500 OF THE ANNUAL REPORT.

A. Mr. Cline explains I&E's view of the difference between the AWWA's definition of non-revenue water and the Commission's definition of unaccounted-for-water. I&E St. 3 (Cline) at 60-61. He then notes that Section 500 of Annual Report requires that a utility's submission detail its unaccounted-for-water. Mr. Fought, on behalf of OCA, also noted that PWSA should be prepared to provide and document the information on Section 500 of the PUC Annual forms, which PWSA agreed to file as part of the 2018 rate case settlement. OCA St. 5 (Fought) at 4.

Q. DO YOU HAVE A RESPONSE?

A. Yes. I do not see a compliance issue. PWSA agreed to submit a Section 500 form as part of its Annual Report to the Commission. Settlement at § III.C.2. PWSA also agreed to track "lost and unaccounted for water." Settlement at § III.H.7.i.xix. PWSA is also required to use the AWWA's Water Loss Control Methodology and free software, which evaluates non-revenue water.

That being said, I disagree with Mr. Cline's characterization of the AWWA definition and methodology as not including items such as fire-fighting, testing and

flushing. *See* I&E St. 3 (Cline) at 61. It is my understanding that non-revenue water typically includes such items under the heading of "unbilled authorized consumption."[6]

Q. DID MR. CLINE EXPRESS OTHER CONCERNS, ON BEHALF OF I&E, REGARDING NON-REVENUE WATER.

A. Yes. Mr. Cline addresses the adequacy of PWSA's plans regarding meter installations and the meter installation timeline, meter testing requirements, leak surveying, and leak surveying timeline in other sections of his direct testimony. I&E St. 3 (Cline) at 62. I will not separately respond to those concerns at this time, since I have addressed them in other sections of my rebuttal testimony.

L. 52 Pa. Code § 65.14 – Measurement

Q. DO THE OTHER PARTIES HAVE CONCERNS AND RECOMMENDATIONS REGARDING PWSA'S LTIIP?

A. Yes. Mr. Cline for I&E and Mr. Fought for OCA provided testimony regarding the water intake measurement requirement in 52 Pa. Code § 65.14.

Q. PLEASE DISCUSS MR. CLINE'S VIEWS ON BEHALF OF I&E.

A. Yes. He states that both the East and West intakes on the Allegheny River are unmetered. I&E St. 3 (Cline) at 30. Mr. Cline expressed concern that PWSA (a) will not be able to provide raw water information to the Commission until meters are installed and confirmed to be operating accurately; and (b) has not updated its plan or projected an in-service date for the necessary meters. I&E St. 3 (Cline) at 31, 33. Additionally, Mr.

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[6] See AWWA State of Water Loss Control (2016) at p. 4, which is available at https://cdn.ymaws.com/www.ims-awwa.org/resource/resmgr/Water_Loss/State_of_Water_Loss_Control_.pdf

See also https://www.awwa.org/Portals/0/AWWA/ETS/Resources/WLCwater-loss-control-terms-defined-awwa-updated.pdf?ver=2014-12-30-084848-790

Cline indicates that the related details and costs should be included in PWSA's capital improvement/investment plan just like any other capital project. I&E St. 3 (Cline) at 34.

Mr. Cline notes that, rather than measuring at the intake, PWSA proposed to measure water that passes through its two main pump stations: Aspinwall and Bruecken. However, those meters were not operational by the end of 2018. I&E St. 3 (Cline) at 30.

Additionally, Mr. Cline notes that PWSA proposed to install an additional meter at the Fox Chapel Pump Station, which will measure billed water sold and exported under the bulk water sales agreement to the Fox Chapel Authority. But, that meter was not operational at the end of 2018. I&E St. 3 (Cline) at 30.

Mr. Cline expressed concern that PWSA has provided no further notice of a plan or timeline for when the intake meter will be installed. I&E St. 3 (Cline) at 31.

Q. WHAT DOES MR. CLINE RECOMMEND?

A. Mr. Cline recommends that the Commission order PWSA to file a revised Compliance Plan including an adequate plan to come into compliance with 52 Pa. Code§ 65.14(a). I&E St. 3 (Cline) at 31. This is based on his recommendation that the Commission determine that PWSA's plans for complying with 52 Pa. Code§ 65.14 are unsatisfactory and that, in its revised Compliance Plan filing, PWSA should provide details and a timeline regarding how and when each of the meters listed on Table 4-3 of PWSA 40 year plan of 2012 will be operational and accurate. I&E St. 3 (Cline) at 34.

Q. HOW DO YOU RESPOND?

A. PWSA has installed meters at each source of supply and the Fox Chapel Station and is currently testing these meters to ensure accuracy. Further capital projects related to meter operability will be addressed in the Master Plan. This includes additional master meter

facilities at the Aspinwall Water Treatment Facility to monitor the total flows into the distribution system, as well as filter backwash volumes.

Q. PLEASE DISCUSS MR. FOUGHT'S VIEWS REGARDING WATER SUPPLY METERING.

A. Mr. Fought expressed concerns that the volume of water delivered to the distribution system is not metered. OCA St. 5 (Fought) at 4.

Q. PLEASE RESPOND.

A. At present, the outlet meters on the rapid sand filters provide the most accurate measurement of the flows to the Distribution System. PWSA is also refurbishing the existing flow meters in the Bruecken and Aspinwall pump stations to establish several points to measure water flows, and to assess water losses in the pump station suction lines. This testing proceeds and we will report when completed.

M. System Reliability, Emergencies, Service Disruptions

Q. PLEASE DESCRIBE I&E' S CONCERN REGARDING NOTIFICATION OF EMERGENCIES.

A. Mr. Gray expressed concern that PWSA may not have a procedure in place to assure that the Commission receive adequate notification of an emergency. I&E St. 4 (Gray) at 14-16.

Q. WHAT DOES MR. GRAY RECOMMEND?

A. In his direct testimony, Mr. Gray recommends that PWSA incorporate the following recommendations into its pending Emergency Response Plan: (1) provide additional information regarding whether PWSA has met its target of revising communication protocols to include notification to the Commission by the first quarter of 2019; and (2)

notify the Commission of any low pressure incident or other service interruption for which it notifies PA DEP. I&E St. 4 (Gray) at 17, 39.

Q. DO YOU HAVE A RESPONSE?

A. As explained in greater detail by Ms. Lestitian, PWSA is also working to update its emergency response plan to comply with the Commission's requirements, as well as to incorporate feedback from the Allegheny County Health Department and the PA DEP. This includes updating its emergency response plan to better adhere to the National Incident Management System's public information system.

PWSA has separate processes to notify the Commission during emergency and non-emergency periods of unscheduled service interruptions. While these processes are in place, PWSA currently lacks a formal, written SOP describing this activity, but anticipates having one completed within the next six months. As previously noted, the Authority plans to hire an Environmental Health and Safety professional in 2019, who will assist in developing and communicating this SOP.

N. Ownership of Wastewater Laterals

Q. PLEASE DESCRIBE OCA' S CONCERN REGARDING THE OWNERSHIP OF WASTEWATER LATERALS.

A. Mr. Fought expressed his opinion that customers should not be responsible for owning the sewer lateral within public rights-of-ways and easements. OCA St. 5 (Fought) at 8.

Q. WHAT DOES MR. FOUGHT RECOMMEND?

A. Mr. Fought opines that PWSA should study the feasibility of owning and maintaining sewer laterals within public rights-of-ways and easements, as is the norm for other wastewater utilities. OCA St. 5 (Fought) at 9. Ownership and maintenance of sewer laterals would then be similar to customer water service lines. See OCA St. 5 (Fought) at

8-9. He further recommends that the study be completed and provided to the Commission and the parties no later than January 15, 2020. OCA St. 5 (Fought) at 9.

Q. HOW DO YOU RESPOND?

A. While I understand Mr. Fought's proposal is designed to assist customers, this is an example of "too much too soon." PWSA should not be burdened with either studying or implementing this major responsibility (and added cost) prior to the time that it is able to successfully address other pressing matters (such as those discussed above).

VII. LEAD REMEDIATION

A. Orthophosphate; Corrosion Control Project

Q. WHAT DOES MR. GRAY RECOMMEND REGARDING THE CORROSION CONTROL PROJECT?

A. Mr. Gray recommends that PWSA keep the Commission updated on the progress of the Orthophosphate Program by providing quarterly reports to the Commission indicating the following: (1) whether orthophosphate treatment has begun and, if not, an explanation as to why the orthophosphate treatment has not begun, including whether there have been any permitting issues or other actions that inhibit PWSA's progress moving forward with orthophosphate treatment; (2) when PWSA started testing for lead levels; and (3) the results of the lead level testing. I&E St. 4 (Gray) at 8, 38.

Q. DO YOU HAVE A RESPONSE?

A. As I previously mentioned, PWSA began introduction of orthophosphate into its system at different points in March and April 2019. PWSA will provide the Commission quarterly reports on the progress of its orthophosphate program which are also required by the PA DEP (and as recommended by Mr. Gray), when PWSA started testing for lead levels, and the results of the lead level testing. While the Commission would not have a

basis to review, modify or supersede any directive to PWSA from the PA DEP relating to the orthophosphate program, PWSA is willing to adopt Mr. Gray's recommendation and update the Commission regarding the orthophosphate program on a quarterly basis.

B. Lead Service Line Replacement Project

Plan To Address Lead Levels In Water Supply And The Replacement Of Lead Service Lines

Q. WHAT DOES MR. GRAY RECOMMEND?

A. Mr. Gray recommends that PWSA provide an explanation, in this proceeding, of why PWSA has not met its lead replacement targets and identify any factors that impacted its ability to meet those targets. I&E St. 4 (Gray) at 27, 30, 40.

Q. DO YOU HAVE A RESPONSE?

A. PWSA has expended tremendous effort and expense (more than $40 Million) to meet and exceed its goal for the lead service line replacement program. In asserting that PWSA has not met its lead replacement targets, Mr. Gray cites to a sentence from the Compliance Plan that states that "*PWSA's Lead program is projected to replace roughly 15 to 20 lead service lines per day through year end.*" I&E St. 4 (Gray) at 25; CP at 120. This statement from the Compliance Plan filing originated from my July 2, 2018 direct testimony in PWSA's rate case proceeding. Unfortunately, my statement there was not sufficiently precise. Mr. Gray read that statement to mean that PWSA's target for 2018 was to complete at least 15-20 lead service line replacements for each of the 365 days in the year. However, neither my testimony nor the Compliance Plan suggest that PWSA planned to replace 5,475 to 7,300 lead service lines in 2018, nor does it include any reference to a retroactive replacement schedule from my July 2, 2018 direct testimony. The Compliance Plan and my July 2, 2018 testimony reflect that PWSA's target for 2018

was to meet the lead service line replacement requirements for the Consent Order and Agreement between PWSA and PA DEP. PWSA greatly exceeded the PA DEP COA replacement requirements in 2018 to replace 7% of the remaining LSL's each year of non-compliance with the Lead advisory level of 15 ppb.

Regardless, PWSA's lead service line replacement work in 2018 commenced in April 2018 and proceeded through the end of the year. From April to June 2018, PWSA only had two contractors completing LSLR work as compared to the five contractors that were working on LSLRs as of late June 2018 when my July 2, 2018 testimony was given. Over the 9 months of work activity (April to December 2018), there were 39 work weeks, or about 195 work days (our contractors work 5 days per week, not seven), with no allowance for holiday time off. In 2018, PWSA completed 3,374 public and private replacements, which clearly meets the 15-20 replacements per [work] day *through year end* that was described in the Compliance Plan and my testimony.

PWSA's Lead Service Line Replacement Program

Q. WHAT DOES MR. GRAY RECOMMEND?

A. Mr. Gray recommends that PWSA should take all necessary actions to ensure that if it transitions its LSLR program into its SDWMRP in the future, that the transition does not prolong lead line replacement timeframes or compromise replacement goals beyond 2026. I&E St. 4 (Gray) at 27, 30, 40.

Mr. Gray further recommends that PWSA's Board should issue a policy decision committing to continue to perform private-line replacements past 2019. I&E St. 4 (Gray) at 27, 30, 40.

Q. DO YOU HAVE A RESPONSE?

A. After 2019, PWSA will transition to a Small Diameter Water Main Replacement Program ("SDWMRP"). PWSA's Board is planning to review the Authority's LSLR Policy at its May 2019 Board meeting. The revised draft LSLR Policy that the Board will consider at its May 2019 meeting is attached as Exhibit RAW/C-31. The Board is reevaluating its LSLR Policy based on newly acquired information and factors such as: (1) the number of lead service lines; (2) where the lead service lines are located; (3) whether PWSA will continue to pay for the replacement of private side lines and if there should be an income based cost sharing; and (4) how many lines PWSA can afford to replace. At this present time, the SDWMRP is designed and budgeted to replace lead service lines including private side lines as encountered (i.e., whenever PWSA replaces a public-side line and encounters a private-side lead line). The ultimate number of lead lines removed will depend upon the available funding for this activity. As proposed, the LSLR program should enable those LSLs encountered during the SDWMRP to be replaced.

Q. WHAT DOES MR. RUBIN RECOMMEND?

A. Mr. Rubin recommends that PWSA provide the Commission and the parties with a long-term plan for addressing lead in its distribution system before it attempts to recover additional lead-related costs through rates. OCA St. 2 (Rubin) at 3-4, 14.

Q. DO YOU HAVE A RESPONSE?

A. PWSA's SDWMRP is expected to reach more than 21 miles per year, so long as the costs are able to be borne by the ratepayers, or subsidized by a third party foundation, Federal Government programs, or by State Financial Aid. PWSA is applying for grants and subsidized loans from any available source. We also intend to work with City officials to seek funds from other sources.

Q. WHAT DOES MR. KALCIC RECOMMEND?

A. Mr. Kalcic recommends that, if lead service lines are to be replaced because they are deemed a public health hazard, then all LSLs should be eligible for PWSA's LSL replacement program. OSBA St. 1 (Kalcic) at 5.

Q. HOW DO YOU RESPOND?

A. PWSA continues to balance the many needs of the water system in determining where scarce ratepayer funds are spent. Our top priorities will address the water supply and treatment systems, and our core water delivery infrastructure which is aged and needs immediate investments.

That said, our plan for lead remediation was developed to address the public health needs of our customers. PWSA committed to preventing partial lead service line replacements by funding full service line replacements where the public side of the service line is lead, while at the same time implementing a revised corrosion control method for our drinking water using orthophosphates. By conducting full service line replacements where lead is found on the portion we own, we are preventing the known health hazards of partial lead service line replacements. By introducing a proven and effective corrosion control program, we are mitigating the health concerns with non-PWSA owned private-only lead lines that may remain. Note that many cities are nominally using a corrosion control program as their sole response to the existence of lead service lines. PWSA's Board of Directors is committed to cost effective water supply for its ratepayers, and will address the existence of Lead Service Lines as quickly and efficiently as possible.

Q. WHAT ELSE DOES MR. KALCIC RECOMMEND?

Mr. Kalcic recommends that the Commission direct the Authority (i) to make all service lines eligible for its LSL replacement program, and (ii) to replace what would normally be classified as the "public-side" of such service lines (i.e., the portion of the service line that runs from the water main to the customer's curb stop) at no charge to the customer. OSBA St. 1 (Kalcic) at 5.

Mr. Kalcic further recommends that, to the extent that PWSA determines that it will continue to replace the "private-side" of LSLs post-2020, the Commission should order the Authority to expand the private-side replacement program to include larger residential and non-residential customers. OSBA St. 1 (Kalcic) at 5-6.

Q. DO YOU HAVE A RESPONSE?

A. PWSA does not own any portion of larger residential or non-residential service lines and does not have any responsibility for their replacement. Due to PWSA's current financial status, PWSA's primary focus must be to dedicate its financial and other resources to critical infrastructure repairs and replacements.

Mr. Kalcic admitted in discovery that he has not studied or identified the potential costs of his recommendation that PWSA be directed to expand its lead service line replacement program to include larger residential and non-residential customers. PWSA-OSBA-I-3. Moreover, Mr. Kalcic has not identified a specific funding source that he proposes PWSA utilize to recover the costs of his recommendation. PWSA-OSBA-I-4. PWSA cannot support Mr. Kalcic's recommendation due to cost considerations and the necessity that it commit its resources to critical infrastructure repairs and replacement.

In addition, PWSA has yet to perform its inventory of Commercial and Industrial service line materials of manufacture. PWSA is required under its Consent Order with the

PA DEP to make these service line determinations by the end of 2022. Once the extent of the issues are understood, PWSA will develop a program to address them.

Lead: Enrollment In Community Environmental Project

Q. WHAT DO MR. MILLER AND MR. LANPHEAR RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

A. Mr. Miller recommends that PWSA should take more proactive steps to enroll eligible customers in the Community Environmental Project ("CEP") to ensure that the full $1.8 million is spent on lead service line replacements before the program expires in November 2020 UNITED ST. C-1 (Miller) at 51.

Mr. Lanphear and Mr. Miller recommend that PWSA improve outreach efforts for the CEP, such as by canvassing eligible homes to educate customers about the program, encourage enrollment, and distribute tap water testing kits. UNITED St. C-3 (Lanphear) at 46; UNITED ST. C-1 (Miller) at 46. Mr. Miller suggests that PWSA discuss and develop new outreach efforts in coordination with both of its newly established committees – the LIAAC and the Community Lead Response Advisory Committee (CLRAC). UNITED ST. C-1 (Miller) at 46. Mr. Lanphear also recommends that (1) PWSA contract with local community groups or colleges to conduct this outreach. UNITED St. C-3 (Lanphear) at 40; and (2) PWSA also distribute tap water testing kits as part of these door-to-door visits. UNITED St. C-3 (Lanphear) at 40.

Q. DO YOU HAVE A RESPONSE?

A. Under the November 2017 COA, PA DEP allowed PWSA to apply $1.8 million of what would have otherwise been a civil penalty to a private lead line replacement program for low income households. The PA DEP specified certain requirements for the CEP in the November 17, 2017 Consent Order and Agreement between PA DEP and PWSA. The

CEP provides private-side lead line replacements for customers who are at or below 250% of the Federal Poverty Level. CP at 76. Pursuant to the Consent Order and Agreement, PWSA requested and obtained approval from PA DEP for its proposed CEP. PWSA has been complying with the directives of PA DEP regarding the CEP. While PA DEP has jurisdiction over water quality issues, the Commission does not.

PWSA has conducted extensive outreach for the CEP. PWSA has teamed up with Dollar Energy Fund, Inc. ("DEF") to administer the program and outreach efforts have included direct outreach to all customers who contact DEF about water and other utility assistance programs, targeted discussions by PWSA Lead Help representatives to customers who are not part of a LSLR program, press releases, social media outreach, discussion at all 2019 LSLR Community Meetings and targeted outreach to individuals participating in PWSA's bill discount program. In addition, PWSA has consulted with the Community Lead Response Advisory Committee ("CLRAC") regarding the CEP and its outreach efforts on a monthly basis. During the CLRAC meetings, PWSA has consulted with the CLRAC members regarding potential outreach opportunities with local community groups. As discussed at the CLRAC meeting held April 24, 2019, PWSA is planning the next CLRAC meeting in June 2019 to overlap with the Low Income Assistance Advisory Committee ("LIAAC"). The overlapping meetings will allow stakeholders participating in the meetings to coordinate efforts and recommendations to PWSA on the CEP and outreach efforts relating to the CEP.

PWSA finds canvassing efforts for a project of this nature to be an impractical approach. We understand that neither Mr. Miller nor Mr. Lanphear have studied or identified the potential costs of increased outreach efforts regarding the CEP. UNITED-

II-3(a). Based upon our efforts to date, we are concerned that disproportionate costs will be expended for this purpose. Canvassing efforts are time-consuming and expensive. PWSA does not anticipate that canvassing efforts would be an effective use of its time and resources, especially when only a fraction of the individuals in a neighborhood would be eligible for the CEP and approximately 65% of the properties are rental properties.

While PWSA has no current plans for canvassing low-income neighborhoods as part of its outreach efforts relating to the CEP, PWSA is committed to using as much of the $1.8 million in funds for the CEP as it possibly can, as funds that have not been used within three years from the execution of the Consent Order and Agreement must be paid to PA DEP as a civil penalty. Through the CEP, DEF and PWSA have each mailed over 1,200 targeted mailings to individuals contacting DEF, and PWSA CAP enrollees. DEF has received over 800 expressions of interest in the program, resulting in around 150 customers qualifying based on the income requirements. As of the date of this testimony, 101 agreements allowing CEP work to proceed have been signed by our customers, with approximately 56 agreements outstanding. The amount of interest in the program to-date is a testimony to PWSA and DEF's outreach efforts.

PWSA has joined the Equity Task Force, a national group established under the auspices of the US Water Alliance. As one of seven cities across the United States, PWSA will work collaboratively with these Alliance Members to capitalize on their strategic programs and approaches to facilitate equity for all customers, including outreach strategies to specified interest groups. If desired, PWSA will provide a more elaborate presentation of the goals and objectives of the Alliance, and its application to Pittsburgh.

Lead: Scope: Replacement of All Service Lines

Q. WHAT DO MR. MILLER, MR. LANPHEAR AND MR. WELTER RECOMMEND RELATING TO LEAD SERVICE LINE REPLACEMENTS?

A. They recommend that PWSA replace private-side lead service lines at no direct cost to customers as part of its lead service line replacement programs beyond 2020. UNITED ST. C-1 (Miller) at 49, 51; UNITED St. C-2 (Welter) at 4, 5, 13, 14, 15, 21; UNITED St. C-3 (Lanphear) at 4, 22, 43-44. Mr. Lanphear states that (1) PWSA should not conduct partial replacements; (2) to protect the health of its customers, PWSA should commit to replacing all private-side lead service lines under the same timeframe; (3) it should not be a question of whether to replace every lead service line, but when and how; and (4) PWSA should engage in aggressive and extensive community outreach—including town hall meetings, community events, and other creative outreach efforts—to ensure that PWSA obtains the necessary consent from property owners to conduct private-side replacements. UNITED St. C-3 (Lanphear) at 21, 23.

Mr. Welter states that PWSA should develop and implement a plan to remove all public- and private-side lead service lines as soon as possible. UNITED St. C-2 (Welter) at 4. Regardless of the time frame for accomplishment, Mr. Welter asserts that the methods used must leave no lead behind. UNITED St. C-2 (Welter) at 14. Mr. Welter further recommends that when PWSA replaces small diameter water mains between now and 2026, PWSA should replace any lead service line—public-side or private-side—connected to those mains.

Lastly, Mr. Lanphear and Mr. Welter recommend that if PWSA decides to only replace all public-side lead service lines, it should be explicit about that goal so as not to

mislead the public. UNITED St. C-3 (Lanphear) at 44; UNITED St. C-2 (Welter) at 15-16.

Q. DO YOU HAVE A RESPONSE?

A. PWSA has complied with all PA DEP directives on its lead service line replacements. As I mentioned previously, PWSA has undertaken its lead service line replacements pursuant to directives from the PA DEP and the Commission does not have jurisdiction over water quality issues.

PWSA continues to balance the many needs of the water system in determining where scarce ratepayer funds are spent. Our plan for lead remediation was developed to address the public health needs of our customers. PWSA committed to preventing partials by funding full service line replacements where the public side of the service line is lead, while at the same time implementing a revised corrosion control method for our drinking water using orthophosphate. By conducting full service line replacements where lead is found on the portion we own, we are preventing the known health hazards of partial lead service line replacements. By introducing a proven and effective corrosion control, we are mitigating the health concerns with non-PWSA owned private-only lead lines that may remain.

While PWSA's goal is to remove all lead service lines it owns, the reality is that the current policy of not replacing public lines at unresponsive addresses and not completing partials where the owner does not live at the address (per PWSA's rate case settlement terms), there will be lead remaining at some locations despite the best efforts of PWSA.

PWSA's Board is planning to review the Authority's LSLR Policy at its May 2019 Board meeting. The Board is reevaluating its LSLR Policy based on newly acquired

information and factors such as: (1) the number of lead service lines; (2) where the lead service lines are located; (3) whether PWSA will continue to pay for the full replacement of private side lines and if there should be an income based cost sharing; and (4) how many lines PWSA can afford to replace.

Regarding Mr. Lanphear's concern about outreach efforts to obtain approval to replace private service lines, PWSA has an agreement returned from almost 5,000 homeowners out of the 6,750 that were mailed – and we have identified another 530 locations that are vacant (and unresponsive). Clearly this accomplishment (which is still ongoing) was not possible without the extraordinary efforts of PWSA's Public Affairs and Community Lead Response teams who have worked tirelessly since the agreements were mailed in late 2018. A detailed Community Outreach Plan was presented to the first CLRAC in January 2019, and regular updates and CLRAC input have been provided at the CLRAC meetings held in January, February, March and April 2019. It should be noted that during this critical time in the 2019 LSLR process PWSA has been committed to providing information to and receiving input from the CLRAC by holding monthly meetings instead of the quarterly meetings required by the Rate Case Settlement. In addition, all of the information or material delivery timeframes called for in the Settlement have been met by PWSA, most of them far in advance of the given deadline. Finally, an updated chronological listing of the outreach efforts undertaken as part of the 2019 LSLR project (and many of these same efforts included CEP outreach) is included as Exhibit RAW/C-32. PWSA continues to welcome comments and proposals from all parties who participate in the Task Force activities.

PWSA's ongoing communications have stressed that its Board of Directors have approved the policy of replacing private side lead lines when encountered during PWSA replacement of public side service lines. The Policy is directed at removing a potential health impact caused by jostling the lead service during replacement of the public side service line and curb box. We also provide each impacted customer with Lead Test Kits and Water Pitcher filters with a 6 month supply of filters.

The Board Resolution regarding this policy is under review, and is expected to be reaffirmed, with some additional conditions, at the Board's May 24th meeting. In any published account, PWSA has indicated that it would remove any lead lines on the public side, as well as those private lead lines that are encountered during public side replacements. The issue of private lead lines which are not connected to public lead lines remain an undecided issue, and have never been included in the Lead Service Line program, as approved by the PA DEP and the PWSA Board.

That said, the PWSA Board intends to address this issue as it reviews its existing policy. As stated above, PWSA is considering how to fairly and equitably address those properties with only Private Side Lead Service Lines. Major factors in their decision will be the impact of costs to all ratepayers, the ability of the property owner to pay for its private line, and the total costs of the lines to be installed based upon the specific property circumstances.

Lead: New Program – Property Damage

Q. WHAT DOES MR. MILLER RECOMMEND REGARDING PROPERTY RESTORATION FOLLOWING A LEAD SERVICE LINE REPLACEMENT?

A. Mr. Miller recommends that PWSA develop a program, to be presented in PWSA's next base rate proceeding, to restore or pay for property damage caused by lead service line

replacements for low and moderate income customers, particularly property damage that interferes with customers' mobility or other basic needs. UNITED ST. C-1 (Miller) at 50, 51.

Q. DO YOU HAVE A RESPONSE?

A. Yes. PWSA and its contractors are striving to apply innovation and ingenuity to minimize private property impact while also replacing lines at a pace that complies with the PA DEP Consent Order and Agreement. Compliance Plan at 27. PWSA has completed 99 percent of the 2019 LSLRs using a trenchless method, most of which had no impact on private property. Any damage to public sidewalks are restored. At this time, PWSA believes that its limited funds should be directed at getting lead service lines out of service rather than replacing private landscaping, particularly in light of the inherent increased value of the property from the lead service line replacement. In addition, where our coordination appointments with homeowners identifies sanitary or structural concerns related to the ability of PWSA workers and contractors to work safely at a location, we provide information to the homeowner about United Way's 211 program and Pittsburgh's Urban Redevelopment Authority's assistance programs. In those locations where property owners are concerned about possible permanent impacts to their property, customers may opt out of a private side line replacement.

<u>Lead: Continuing the Neighborhood-Based Replacement Program</u>

Q. WHAT DO MR. LANPHEAR AND MR. WELTER RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

Mr. Lanphear recommends that PWSA maintain a neighborhood-based lead service line replacement program through 2026 to help ensure all lead service lines get removed, particularly for at-risk customers. UNITED St. C-3 (Lanphear) at 27, 44. Mr. Welter

agrees and also states that: (1) PWSA should extend its current neighborhood-based lead service line replacement program past 2020; (2) PWSA should engage in aggressive and extensive community outreach aimed at minimizing the number of customers who refuse to authorize PWSA to conduct free private-side lead service line replacements; and (3) PWSA should also offer financial assistance to customers who want to replace these lead service lines. UNITED St. C-2 (Welter) at 5, 14, 29.

Q. DO YOU HAVE A RESPONSE?

A. PWSA continues to balance the many needs of the water system in determining where available ratepayer funds are spent. Our plan for lead remediation was developed to address the public health needs of our customers. PWSA committed to preventing partial lead service line replacements by funding full service line replacements where the public side of the service line is lead. By conducting full service line replacements where lead is found on the portion we own, we are preventing the known health hazards of partial lead service line replacements. While PWSA conducts LSLR programs, we are implementing a PA DEP approved corrosion control method for our drinking water using orthophosphates. By introducing a proven and effective corrosion control program, we are mitigating the health concerns with non-PWSA owned private-only lead lines that may remain. We also will comply with the PA DEP and EPA drinking water quality standards for lead and copper. With orthophosphates, PWSA understands that the PA DEP and EPA believe that the health impacts related to lead and copper are acceptable. Once the orthophosphate consistently lowers water lead and copper levels, PWSA will no longer be mandated to accelerate its lead service line replacements per the terms of its COA with PA DEP. PWSA intends to implement a cost effective LSLR approach, which save funds and is more affordable to our ratepayers.

Therefore, after 2019, PWSA will transition its LSLRs to a Small Diameter Water Main Replacement Program. PWSA's Board is planning to review the Authority's LSLR Policy at its May 2019 Board meeting. The Board is reevaluating its LSLR Policy based on newly acquired information and factors such as: (1) the number of lead service lines; (2) where the lead service lines are located; (3) whether PWSA will continue to pay for the replacement of private side lines and if there should be an income based cost sharing; and (4) how many lines PWSA can afford to replace.

PWSA has developed and is engaged in aggressive and extensive community outreach as detailed above. PWSA has reported to the CLRAC on customers' reasons for rejecting service line replacements, as well as the number of customers who consented, failed to respond, or explicitly refused to consent to private-side lead service line replacements. As discussed during the CLRAC meetings, the majority of reasons given for rejecting service line replacements is because the customer has already replaced the private side. In these situations, PWSA proceeds to complete a verification excavation, and replace the public side if lead is found. For all other rejected agreements, PWSA provides additional outreach to discuss the program further and attempt to get the customer to agree to the service line program to allow work to proceed. Finally, PWSA is partnering with the Housing Authority City of Pittsburgh ("HACP") to provide a list of locations where an absentee landlord has rejected service line replacement. HACP is checking the list against locations where they approve Section 8 housing vouchers and sending a letter to landlords at those locations encouraging their participation in the LSLR program.

PWSA will continue to hold CLRAC meetings at whatever frequency is required (the rate case settlement requested quarterly, but monthly meetings have been held instead of quarterly), which demonstrates PWSA's sincere commitment to community outreach efforts.

Lead: PWSA Leak Response

Q. WHAT DOES MR. WELTER RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

A. Mr. Welter recommends that PWSA continue its current policies and practices for Operations Department replacements in order to efficiently remove the most lead infrastructure possible and to avoid the harmful health effects of partial lead service line replacements. UNITED St. C-2 (Welter) at 35.

Q. DO YOU HAVE A RESPONSE?

A. PWSA is complying with all applicable federal and state directives relating to lead service line replacements. PWSA's Board is planning to review the Authority's LSLR Policy at its May 2019 Board meeting. The Board is reevaluating its LSLR Policy based on newly acquired information and factors such as: (1) the number of lead service lines; (2) where the lead service lines are located; (3) whether PWSA will continue to pay for the replacement of private side lines and if there should be an income based cost sharing; and (4) how many lines PWSA can afford to replace. We will update the PUC and the intervenors of our LSLR policy upon Board approval.

Lead: Meter Replacement

Q. WHAT DOES MR. LANPHEAR RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

A. Mr. Lanphear recommends that PWSA coordinate its meter replacement program with its lead service line replacement program to ensure that it conducts meter replacements at

homes that have non-lead service lines or have already had their lead service lines removed. UNITED St. C-3 (Lanphear) at 41.

Q. HOW DO YOU RESPOND?

A. PWSA is (and has been) replacing meters at the same time as work is done under the LSLR program. However, based on PWSA's goal to complete 50,000 meter replacements over the next 5 years, the meter replacement program cannot be limited to LSLR sites only.

Q. WHAT ELSE DOES MR. LANPHEAR SAY REGARDING THE METER REPLACEMENT PROGRAM?

A. Mr. Lanphear asserts that if PWSA must conduct a meter replacement at a home with a lead service line, it should follow PWSA's post-service line replacement protocols and analyze tap water sampling results to determine whether and to what extent meter replacements cause spikes in water lead levels. He further recommends that PWSA ensure that new meters meet EPA's definition of "lead free." UNITED St. C-3 (Lanphear) at 46.

Q. WHAT IS YOUR RESPONSE TO MR. LANPHEAR'S ASSERTION?

A. Based upon available information, there remains a potential for additional particulate lead to be dislodged during meter installation, which can impact water quality for a period of time. PWSA's typical protocol requires flushing of the system following meter replacement to remove any vestiges of particulate lead. PWSA is not aware of any measureable lead impacts that would result, but will consider delaying meter replacements when we encounter lead service lines. We intend to use the existing meter program to identify lead service line locations for replacement, and would follow our protocols established for replacement.

Q. WHAT DOES MR. LANPHEAR RECOMMEND PWSA DO DURING PRIVATE-SIDE LEAD SERVICE LINE REPLACEMENTS AND WATER METER REPLACEMENTS?

A. Mr. Lanphear recommends that during private-side lead service line replacements and water meter replacements, PWSA conduct visual inspections for interior galvanized pipe at customers' residences. UNITED St. C-2 (Welter) at 36.

Q. DOES PWSA CURRENTLY CONDUCT VISUAL INSPECTIONS AS MR. LANPHEAR RECOMMENDS?

A. Yes, as part of the 2019 meter replacement program, PWSA began to record private side pipe materials.

Q. WHAT ELSE DOES MR. LANPHEAR RECOMMEND PWSA DO WHEN IT REPLACES A WATER METER IN A HOME WITH A LEAD SERVICE LINE OR VISIBLE GALVANIZED INTERIOR PIPES?

A. Mr. Lanphear recommends when PWSA replaces a water meter in a home with a lead service line or visible galvanized interior pipes, that it notify the customer and provide them with a water filter certified for lead reduction and replacement cartridges. UNITED St. C-2 (Welter) at 37. Mr. Lanphear also recommends that PWSA continue to provide cartridges until water sampling shows consistently low lead levels. UNITED St. C-2 (Welter) at 37.

Q. DO YOU HAVE A RESPONSE?

A. PWSA started to record the private side pipe material in 2019 as part of its meter replacement program and the record of the private side pipe material is available on PWSA's online Lead Map. In addition, PWSA is developing a material identification card that will be left with homeowners upon completion of the meter replacement to identify the materials observed by PWSA. PWSA is evaluating its protocols and procedures when meter replacements are proposed at properties that have lead service

lines. At this time, we will consider delaying meter replacement until such time as the lead service lines can be addressed.

PWSA provides water sample test kits to customers that request a kit to evaluate lead levels. If the results reveal that lead levels exceed 15 ppb, PWSA provides the customer a pitcher, filter and an additional water sample test kit at no charge.

Q. WHAT DOES MR. WELTER RECOMMEND REGARDING IDENTIFYING POTENTIAL SOURCES OF LEAD EXPOSURE?

A. Mr. Welter suggests that PWSA should assist residents with inspecting their interior plumbing and identifying potential sources of lead exposure, such as galvanized pipes, lead solder, or brass fixtures. UNITED St. C-2 (Welter) at 36-37.

Q. IS PWSA ALREADY IDENTIFYING POTENTIAL SOURCES OF LEAD EXPOSURE FOR CUSTOMERS AS MR. WELTER RECOMMENDS?

A. Yes. PWSA plumbers are inspecting interior plumbing and identifying potential sources of lead exposure for customers as part of the meter replacement program.

Lead: Post-replacement measures

Q. WHAT DOES MR. LANPHEAR RECOMMEND WITH REGARD TO POST-REPLACEMENT MEASURES?

A. Mr. Lanphear recommends that PWSA reconsider how it conducts post-replacement water sampling. UNITED St. C-3 (Lanphear) at 37. Mr. Lanphear states that PWSA should be making better efforts to get at least one post-replacement water sample from every household that has part or all of its service line replaced. At a minimum, PWSA should follow up with all customers by phone and/or in person in the days immediately after a replacement to encourage participation. He suggests that PWSA might also fund local, trusted community groups to help customers coordinate and collect samples, or

even collect the samples themselves (with customer permission). UNITED St. C-3 (Lanphear) at 37.

Q. DO YOU RESPOND TO MR. LANPHEAR'S RECOMMENDATIONS?

A. PWSA currently follows (and in fact exceeds) all federal and state requirements with regards to post-lead service line replacement water sampling. In compliance with the COA, PWSA has placed door hangers reminding customers to collect the sample at all locations where a partial line replacement has been completed when the customer does not return the sample. Also, since late 2018 and as detailed to the CLRAC, PWSA is making a follow-up phone call to all other customers that have received a service line replacement (that is not a partial) and who have not returned their sample, again exceeding all federal and state requirements for unreturned samples. It would be very difficult for anyone other than a homeowner to collect a post-replacement water sample as the sampling guidelines require that the water stagnate in the household plumbing for 6 hours prior to sample collection.

PWSA has a multi-step process to ensure customers are protected from lead exposure after replacement of a lead service line. Following a lead service line replacement, PWSA provides the household with a NSF-certified pitcher filter and six months of replacement cartridges at no cost. PWSA leaves an informational door hanger at a property after a line replacement to inform the resident of the work performed, instruct them how to flush their pipes and taps, and direct them to collect a post-replacement water sample. If a customer is available after the installation, PWSAs construction inspectors show them a video on how to properly flush their household plumbing (produced by PWSA as part of our LSLR Program), and provide direction to and answer questions regarding the flushing and sampling process. A follow-up door

hanger is hung if a customer received a partial replacement and did not return a water sample, and a follow-up phone call is made to all other customers who received a replacement and did not return a water sample. After a post-replacement water sample is analyzed, PWSA notifies the customer of the results of the sample. If a post-replacement sample shows water lead levels above 15 ppb, PWSA reaches out to the customer and asks them to collect an additional sample three months after the initial sample was taken. At the time this three-month water sample kit is sent to the customer, PWSA provides the customer with another six months' worth of water filter cartridges at no cost. If that subsequent sample kit shows water lead levels about 15 ppb, PWSA sends the customer another test kit and asks for a sample six months after the date of the line replacement. PWSA provides bottled water and assists customers with flushing their line if any post-replacement sample shows water lead levels above 100 ppb.

Q. WHAT THRESHOLD DOES MR. LANPHEAR RECOMMEND PWSA USE FOR ASKING CUSTOMERS TO COLLECT ADDITIONAL TAP WATER SAMPLES AND FOR PROVIDING CUSTOMERS WITH FLUSHING ASSISTANCE AND BOTTLED WATER?

A. Mr. Lanphear recommends that PWSA use thresholds much lower than 100 ppb for asking customers to collect additional tap water samples and for providing customers with flushing assistance and bottled water. UNITED St. C-3 (Lanphear) at 38.

Q. WHAT IS YOUR POSITION ON MR. LANPHEAR'S RECOMMENDATION?

PWSA is currently following and will continue to follow all federal and state requirements with regards to follow up water sampling post-lead service line replacement. PWSA currently provides bottled water and assists customers with flushing their line if any post-replacement sample shows water lead levels above 100 ppb, beyond any regulatory requirement. PWSA is willing to reduce this threshold from 100 ppb to 50

ppb, to advance its goals of protecting its customers' health and ensuring access to safe drinking water.

Q. WHAT DOES MR. LANPHEAR RECOMMEND REGARDING ADDITIONAL FOLLOW-UP WATER SAMPLES?

A. Mr. Lanphear recommends that PWSA ask customers to: (1) collect a three-month follow-up tap water sample when a prior tap water sample exceeds 5 ppb; and (2) collect a one-month follow-up tap water sample when a prior tap water sample exceeds 15 ppb. UNITED St. C-3 (Lanphear) at 46. In addition, he recommends taking measures to protect customers from additional lead exposure after a lead service line replacement, consistent with PWSA's post-replacement policies and the recommendations he had made, beyond 2020, until water lead levels are consistently below 5 ppb. UNITED St. C-3 (Lanphear) at 46.

Q. DO YOU HAVE A RESPONSE?

A. PWSA is currently following (and in fact exceeding) and will continue to follow all federal and state requirements with regards to post-lead service line replacement water sampling. If a post-replacement sample shows water lead levels above 15 ppb, PWSA reaches out to the customer and asks them to collect an additional sample three months after the initial sample was taken. At the time a second water sample kit is sent to the customer, PWSA provides the customer with another six months' worth of water filter cartridges at no cost. If that second sample kit shows water lead levels about 15 ppb, PWSA sends the customer a third test kit and asks for a sample six months after the date of the line replacement.

My understanding is that EPA will release draft revisions to the Lead and Copper Rule in the summer of 2019. Water quality issues such as water sampling procedures are

outside the Commission's jurisdiction and lie solely within PA DEP's jurisdiction. PWSA will comply with EPA's new standards for water sampling once they are effective.

Lead: Inventory of Service Line Materials

Q. WHAT DO MR. LANPHEAR AND MR. WELTER RECOMMEND REGARDING INVENTORY OF SERVICE LINE MATERIALS?

A. Mr. Lanphear and Mr. Welter recommend that PWSA develop a complete and accurate inventory of all lead service lines in the water system. UNITED St. C-3 (Lanphear) at 46; UNITED St. C-2 (Welter) at 5, 14.

Q. HOW DO YOU RESPOND?

A. PWSA is committed to developing an inventory of its service lines in accordance with federal and state law and regulations. This inventory will be available via a publicly accessible GIS mapping via PWSA's website.

Q. WHAT ELSE DOES MR. WELTER RECOMMEND REGARDING INVENTORY OF SERVICE LINES?

A. Mr. Welter also recommends that PWSA: (1) develop a plan for compiling a reliable inventory of the service line materials in its distribution system, including estimates of the number and location of public- and private-side lead service lines; and (2) promptly propose a strategy for completing its inventory so that it can be reviewed by the public and the Commission. UNITED St. C-2 (Welter) at 33.

Q. WHAT IS THE CURRENT STATUS OF PWSA'S PLAN FOR COMPLETING AN INVENTORY OF ITS SERVICE LINE MATERIALS?

A. PA DEP expects PWSA to inventory all residential service line connections and identify those that contain lead by December 31, 2020. To date, PWSA has used its Curb Box Inspection program to undertake this inventory. In June 2019, PWSA will present a

revised comprehensive plan to inventory the service line materials in its distribution system to PA DEP. PWSA plans to inventory all non-residential line connections and identify those that contain lead by December 31, 2022, per the November 17, 2017 Consent Order and Agreement with PA DEP.

Q. WHAT PROCESSES DOES MR. WELTER RECOMMEND PWSA USE TO VERIFY THE COMPOSITION OF SERVICE LINES?

A. Mr. Welter recommends that PWSA consider making broader use of hydro-excavation or vacuum excavation for verifying the composition of service lines. UNITED St. C-2 (Welter) at 32.

Q. DO YOU HAVE A RESPONSE?

A. PWSA currently uses various methods of excavation, including hydro-excavation, as part of its LSLR program. PWSA has extensively studied the methods used in Flint, Michigan, for service line material verification and has determined that the methods used there cannot be replicated in Pittsburgh because of the difference in physical site conditions. The cost of completing any verification via excavation in Pittsburgh is not driven by the particular excavation method, but rather the location of the curb boxes in sidewalks and other hardscapes. The cost for removing and replacing the existing concrete sidewalks and aggregate base materials make excavation verification extremely costly.

Lead: Selection and prioritization of homes for lead service line replacement

Q. WHAT DOES MR. LANPHEAR RECOMMEND WITH REGARD TO PRIORITIZATION OF LEAD SERVICE LINE REPLACEMENTS?

A. Mr. Lanphear recommends that PWSA prioritize lead service line replacements for children, pregnant women, black people, and low-income individuals—residents who are

particularly vulnerable to lead exposure—by analyzing blood lead levels in children, drinking water lead levels, water main ages, parcel ages, and demographic data, and selecting areas for replacement where the concentration of these factors is highest. UNITED St. C-3 (Lanphear) at 4. He recommends that aforementioned health-related factors be used to prioritize lead service line replacements for at-risk customers between 2020 and 2026. UNITED St. C-3 (Lanphear) at 26. He goes on to recommend that PWSA incorporate this data into its GIS database as part of its two-year upgrade and weigh them heavily in the small diameter water main prioritization model developed as part of the Water Distribution System Master Plan for 2021 to 2026. UNITED St. C-3 (Lanphear) at 26-27.

Mr. Lanphear also states that PWSA should clearly and publicly explain its prioritization models across all replacement programs. He further recommends that PWSA describe what factors it is using, how those factors are weighed against each other and any other relevant considerations, and how and why specific neighborhoods and work areas are chosen. UNITED St. C-3 (Lanphear) at 28.

Q. HOW DO YOU RESPOND?

A. Pursuant to the rate case settlement, PWSA is developing a plan, in consultation with the CLRAC, to determine the prioritization selection for LSLRs in 2019. Once completed, PWSA will inform the PA PUC.

Q. WHAT DOES MR. LANPHEAR RECOMMEND REGARDING THE PRIORITIZATION OF THE 2020 SMALL DIAMETER WATER MAIN REPLACEMENTS?

A. Mr. Lanphear states that although the areas for 2020 small diameter water main replacements have already been selected, PWSA should prioritize these replacements using the health-based factors he identified. UNITED St. C-3 (Lanphear) at 27.

Q. DO YOU HAVE A RESPONSE?

A. Yes. As previously described and as Mr. Lanphear indicates, the 2020 small diameter water main replacement areas have already been selected. As the design work has already begun, any attempt to further prioritize or change these replacement areas for 2020 will result in program delays.

Lead: Extend Term of CLRAC

Q. WHAT DO MR. LANPHEAR AND MR. WELTER RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

A. Mr. Lanphear and Mr. Welter recommend that PWSA extend the term of the CLRAC through at least 2026 and continue to consult with the CLRAC on critical components of PWSA's lead remediation program, including the prioritization of lead service line replacements for vulnerable populations, how to improve water sampling participation rates, and formulating a plan for completing an inventory of its service line materials. UNITED St. C-3 (Lanphear) at 27, 37-38, 44; UNITED St. C-2 (Welter) at 33.

Q. DO YOU HAVE A RESPONSE?

A. PWSA is willing to extend the term of the Community Lead Response Advisory Committee through at least 2026 and to continue to consult with the CLRAC on critical components of its lead remediation program, how to improve water sampling participation rates, and formulating a plan for completing an inventory of its service line materials, so long as the CLRAC members continue to believe that the Advisory Committee offers meaningful benefits to PWSA and our customers.

Q. WHAT DO MR. LANPHEAR AND MR. MILLER RECOMMEND ON BEHALF OF PITTSBURGH UNITED?

A. Mr. Miller recommends that PWSA continue to provide free water filters and replacement cartridges to low income customers with lead or unknown service lines beyond 2020 and until water lead levels reach consistently low levels. UNITED ST. C-1 (Miller) at 49, 51. He also believes that PWSA should seek input from its LIAAC and CLRAC to improve the reach of this program. UNITED ST. C-1 (Miller) at 49.

Q. HOW DO YOU RESPOND?

A. PWSA has committed to continuing the provision of free water filters and replacement cartridges to low income customers with lead or unknown service lines through the end of 2019 pursuant to the rate case settlement. While PWSA anticipates that it will see consistently low water lead levels in a few months' time due to the introduction of orthophosphate into its system, PWSA will seek input from the LIAAC and CLRAC regarding this program after the December round of compliance sampling is complete.

Q. WHAT DOES MR. MILLER RECOMMEND REGARDING PWSA'S POLICY FOR DISTRIBUTION OF POST-REPLACEMENT FILTERS?

A. Mr. Miller states that PWSA should continue to provide filters certified for effective lead reduction and replacement cartridges to all customers who receive lead service line replacements. UNITED St. C-2 (Welter) at 35-36.

Q. HOW DO YOU RESPOND?

A. Pursuant to the rate case settlement, PWSA has committed to continuing the provision of free water testing kits, NSF-certified filters, and six months of replacement cartridges to all customers who receive lead service line replacements through the end of 2019.

PWSA's Board will address this issue as they review and update the Lead Service Line Policy at its upcoming meeting.

Q. PLEASE DESCRIBE MR. LANPHEAR'S ADDITIONAL RECOMMENDATIONS REGARDING THE PROVISION OF FILTERS AND REPLACEMENT CARTRIDGES.

A. Mr. Lanphear recommends that PWSA provide filters and replacement cartridges to customers both prior to and after lead service line replacements until water lead levels are significantly reduced. UNITED St. C-3 (Lanphear) at 30, 35. He also states that filter programs should be as passive as possible and require as little effort from PWSA's customers as possible. UNITED St. C-3 (Lanphear) at 32.

Q. WHAT IS YOUR RESPONSE?

A. PWSA is following the directives in the Consent Order and Agreement it entered into with PA DEP with regard to the provision of water filters and replacement cartridges. PWSA is in compliance with all applicable state and federal regulatory requirements regarding the provision of water filters and replacement cartridges.

Q. WHAT DOES MR. LANPHEAR RECOMMEND REGARDING PWSA'S TEST KIT FILTER PROGRAM?

A. Mr. Lanphear recommends that PWSA use a threshold of 5 ppb instead of 15 ppb for its free test kit filter program. UNITED St. C-3 (Lanphear) at 32, 33, 45.

Q. DO YOU AGREE?

A. No. PWSA's current test kit filter program provides free filters to customers whose water lead levels are above 15 ppb. This program is fully compliant with all state and federal requirements and is consistent with the settlement reached in PWSA's rate case settlement.

Q. WHAT DOES MR. LANPHEAR RECOMMEND REGARDING FAUCET FILTERS?

A. Mr. Lanphear recommends that PWSA offer faucet filters to those customers who want them. UNITED St. C-3 (Lanphear) at 33. He also recommends that PWSA offer to install faucet filters for those customers who want them. UNITED St. C-3 (Lanphear) at 45.

Q. DO YOU AGREE WITH MR. LANPHEAR'S RECOMMENDATION?

A. No. First, once the full corrosion control benefits associated with the introduction of orthophosphate into its system are realized, PWSA expects that lead levels will be significantly reduced such that the filters would offer little benefit to customers. Second, the provision of faucet filters is unnecessary as PWSA is already providing an effective method for eligible customers to filter their water through the provision of water pitchers, filters and replacement cartridges. Third, PWSA's distribution of water pitchers, filters and replacement cartridges is the most cost effective and convenient approach for both PWSA and its customers. Lastly, PWSA is not in a position to install faucet filters for customers who want them. If PWSA were required to provide and install faucet filters, it would need to identify specific models that work for each customer's sink which would increase program costs, reducing the number of people who could be supplied a filter.

Q. WHAT DOES MR. LANPHEAR RECOMMEND REGARDING CONSUMER EDUCATION?

A. Mr. Lanphear states that PWSA should educate customers on how to use water filters and replacement cartridges and follow up with customers to ensure that they are doing so (UNITED St. C-3 (Lanphear) at 34). In addition, he recommends that PWSA run a public education campaign to teach customers how to use their filters and replacement cartridges properly. UNITED St. C-3 (Lanphear) at 34. He further recommends that

PWSA continue to consult with the CLRAC on additional education efforts and possible methods for collecting data on water filter use to determine whether PWSA's education efforts are successful. UNITED St. C-3 (Lanphear) at 34, 45.

Q. HOW DO YOU RESPOND TO MR. LANPHEAR'S SUGGESTIONS ON PUBLIC OUTREACH/EDUCATION EFFORTS?

A. PWSA already educates customers regarding the proper use of filter kits as clear instructions are provided with the filter kits when they are distributed. We also provide instructional videos on our website. Additional public outreach / education efforts would expend resources that PWSA does not have to spare. PWSA has kept the CLRAC apprised of the progress of its water filter distribution program.

Q. WHAT DOES MR. LANPHEAR SUGGEST REGARDING THE DISTRIBUTION OF TEST KIT FILTERS?

A. Mr. Lanphear suggests that PWSA deliver filters and replacement cartridges to eligible customers instead of using a voucher system and make clear that customers who request and return tap water sampling kits and have water lead levels above 15 ppb will receive a free filter and replacement cartridges. UNITED St. C-3 (Lanphear) at 45.

Q. HOW DO YOU RESPOND?

A. PWSA is attempting to balance the rate-payer dollars spent on all of its program with the benefits they provide. Mr. Lanphear's suggestion that PWSA deliver filters and replacement cartridges to customers instead of using a voucher system would increase costs associated with the program, reducing funds available for critical infrastructure projects. Moreover, the voucher system requires the customer to take the simple step of making a phone call or visiting a website, a minimal commitment on their side that will gauge their interest and likelihood of using a filter in the first place.

PWSA already informs customers who request and return tap water sampling kits and have water lead levels about 15 ppb that they will receive a free filter and replacement cartridges. This information is conveyed when the sample results are sent to and discussed with the customer.

Q. WHAT IS MR. LANPHEAR'S FINAL RECOMMENDATION REGARDING WATER FILTERS?

A. Mr. Lanphear recommends that PWSA continue providing filters and replacement cartridges, consistent with his aforementioned recommendations, beyond 2020, until water lead levels are consistently below 5 ppb. UNITED St. C-3 (Lanphear) at 45.

Q. DO YOU AGREE?

A. No, as stated herein, I do not agree with Mr. Lanphear's recommendations relating to PWSA's provision of water filters and replacement cartridges. PWSA is currently complying with (and exceeding) all applicable federal and state directives relating to the provision of water filters and replacement cartridges. PWSA will continue to follow all federal and state requirements with regards to filter distribution.

VIII. LTIIP

Q. DO THE OTHER PARTIES HAVE CONCERNS AND RECOMMENDATIONS REGARDING PWSA'S LTIIP?

A. Yes. Mr. Gray for I&E and Ms. Everette for OCA provided testimony regarding PWSA's LTIIP.

Q. PLEASE DISCUSS MR. GRAY'S VIEWS.

A. Mr. Gray expressed concerns about PWSA's metering plan. I&E St. 4 (Gray) at 32. He believes that the plan is that the timeline and funding for this project is too back-loaded. I&E St. 4 (Gray) at 33-34.

Mr. Gray also expressed his belief that PWSA's workforce management plan does not adequately address the size of the workforce needed. I&E St. 4 (Gray) at 34-35. He would like to see PWSA provide more detail as to how (a) PWSA will overcome its workforce challenges and (b) increased headcount will complete its projected capital spending projects. *Id.*; I&E St. 4 (Gray) at 36-37.

Mr. Gray further expresses the desire for more detail on how PWSA will refine its coordination efforts with other utilities and local government. I&E St. 4 (Gray) at 37-38.

Q. WHAT DOES MR. GRAY RECOMMEND?

A. In his direct testimony, Mr. Gray recommends that PWSA file a revised LTIIP including: (1) a plan to expedite metering, demonstrating why and how PWSA chose its expedited metering plan; (2) a timeline along which PWSA will address and propose solutions for each and every PWSA-identified workforce challenge factor as it relates to the LTIIP schedule; (3) further detail demonstrating how PWSA will build a workforce to meet the needs of increased capital spending, including how headcount projections were quantified and estimate of number of required contractors; and (4) detail on how PWSA will meet the need for increased coordination with local utilities and government. I&E St. 4 (Gray) at 34, 36, 37-38, 40-41.

Q. DO YOU HAVE A RESPONSE?

A. With respect to Mr. Gray's first recommendation ("plan to expedite metering, demonstrating why and how PWSA chose its expedited metering plan") I have discussed PWSA's plan and its justification at several places in this testimony. With respect to items 2 and 3 (a timeline to address workforce challenge factors and further detail demonstrating how PWSA will build the a workforce necessary to meet its needs considering its capital spending plans) my response is as follows: Mr. Gray's demand

that PWSA expedite specified task completion times recognizes that PWSA has many issues to address, in the context of a system that has experienced a long history of system disinvestment. PWSA's approach to implement the wide variety of improvements is based upon the following:

1. Continuing to restructure our resources, increase the number and expertise of Operations, Engineering Staff, as well as increase the number of available consultants and contractors.

a. Operations has been reorganized. Four experienced (From PAWC) Senior Managers have been hired to manage the Operations field services teams. Existing field service managers, one of whom is retiring, are being assigned to Valves, Hydrants and other related appurtenances management.

b. Operations is now realigning its resources to ensure that the key program metrics are being met, including meter installation rates. A number of plumbers have been assigned to these tasks, and have achieved a significant improvement in the meter install rate.

c. Operations continues to hire laborers to the extent that they are available. Plumbers, electricians and other trades candidates have become limited, and hiring is impacted by the current domicile requirement.

d. Engineering has been restructured under a full time Senior Program Manager, and a permanent Director of Engineering and Construction, as well as a Permanent Deputy Director, have been hired (most of these Senior Managers have been working for PWSA for several years as embedded consultants). Four new project managers have been hired, as well as several additional consultants to manage the outstanding critical projects. Additional Project Managers will be hired as temporary staff as they become available to manage the existing projects.

e. Consultants operate under On Call Services Agreements, which are about to expire. A new Request For Proposals has been prepared and will be advertised to engage consultants under new contracts by the end of July (when existing contracts start to expire).

f. Construction Contractor outreach is being implemented to solicit contractors from outside the Allegheny County area. As project sizes increase, the interest by out of state contracting firms will be evident.

g. Metering activities have been accelerated by restructuring the process, and we have now achieved a change out rate of more than 800 per month. We continue to optimize the process and expect that the 10,000 meter per year rate can be achieved.

h. The metering of unmetered buildings is now beginning the initial assessment phase, during which consultants (will determine what physical plumbing and other improvements are needed to install meters in unmetered public buildings. Once these initial studies are completed, PWSA will establish a formal schedule for the implementation of metering.

PWSA continues to increase its staff and consultant resources to increase the rate of project implementation, at all levels and departments. We are confident that the proposed schedules can be met, and possibly improved upon, dependent upon the ability of our Management Team to effectively add the additional resources. We anticipate that our Management Team restructuring for Engineering, Finance, Procurement, Operations, and Human Resources can implement the entire program, though some time to "ramp up" our capacity is needed. We are extremely sensitive to the need for our capacity increase to be sustainable, and are stressing the development of internal infrastructure and related systems to enable our growth in project execution and delivery. We intend to be deliberately cautious with the rate of personnel increase to ensure the sustainability and optimize performance of our organization.

PWSA will continue to update our project schedules based upon the availability and capability of our workforce, and the commitments of our Consultants and Contractors. All schedules will account for the larger issues related to other mandates from Federal

and State regulators, which could pre-empt some of PWSA's commitments to the PUC. I note that additional detail on workforce issues was provided in answer to TUS Data Request 12, which was included as an exhibit to my direct testimony (RAW/C-2).

As to item 4 (PWSA should detail how it will meet the need for increased coordination with local utilities and government), the Authority has developed a coordination team with the City and its other utility members. In addition, PWSA is developing a robust GIS based data layer to communicate our plans to other utilities. At present, the critical coordination appears to be with the City paving plan and the Gas Companies' piping improvements. Significant improvement is expected as a result of the City's hiring of a new Chief Engineer, and additional engineering staff, which has delayed coordination in the past. Additional detail on coordination with City/other local governments was included in answer to TUS Data Request 13, which was included as an exhibit to my direct testimony (RAW/C-2).

Q. PLEASE DISCUSS MS. EVERETTE'S VIEWS.

A. Ms. Everette notes that, in response to TUS data requests regarding the LTIIP, PWSA stated that it would be able to provide certain information in the future. OCA St. 1 (Everette) at 14-16. She notes that, based on current timeframes, PWSA should be able provide this information to the Commission and the OCA by March 31, 2021. OCA St. 1 (Everette) at 16, 18.

Q. WHAT DOES MS. EVERETTE RECOMMEND?

A. In her direct testimony, Ms. Everette (1) requests that PWSA provide the comprehensive materials report and updated information about the types and sizes of valves once the GIS

is updated and this information is available; and, (2) that PWSA notify the Commission and the OCA when the computerized maintenance management system (CMMS) project is implemented. OCA St. 1 (Everette) at 16, 18.

Q. DO YOU HAVE A RESPONSE?

A. PWSA continues to expand its GIS staffing and field crews to identify and document all its valves and their status. The last inventory of valves was compiled in 2009 to 2010 by Wach's Consultants. PWSA is now equipping its operations staff with Tablet systems that will allow continuous updating of the system data. At this time, PWSA is considering what our CMMS requirements are, and how to best address them. PWSA needs to update our enterprise resource planning ("ERP") system such that a comprehensive CMMS system can be optimized. Therefore, ERP system will need to be installed as PWSA develops its CMMS. It is possible that the system can be installed and functional by March 31, 2021, and PWSA will update our status on this program as it proceeds.

IX. CONCLUSION

Q. DOES THAT COMPLETE YOUR REBUTTAL TESTIMONY?

A. Yes.

Exhibit RAW/C-28

PWSA Compliance Plan

Progress Report

Executive Summary

On December 21, 2017, pursuant to Act 65 of 2017, the Pennsylvania Public Utility Commission (PUC) was granted jurisdiction over the provision of water, wastewater, and stormwater utility service by entities created by Pennsylvania cities of the second class under the Municipal Authorities Act. As a newly regulated utility, the Pittsburgh Water and Sewer Authority (PWSA or the Authority) filed a Compliance Plan on September 28, 2018 and on February 1, 2019 filed a Compliance Plan Supplement to fulfil a commitment in its Rate Case Settlement (filed on November 29, 2019) to complete and report on critical activities to the PUC and interested parties on a regular basis.

Over the last year, PWSA has focused intensely on improving all aspects of its operations. Every day, more than 500,000 people rely on PWSA for essential services, and the Authority has made considerable strides toward being a highly responsive and trusted public utility. The recently published 2018 Organizational Performance Report (Appendix A) highlights major successes, including:

- Reaching all of the lead service line replacement goals;
- Reducing the average customer wait time to speak to a representative from almost five minutes to less than one;
- Repairing or replacing more than 4,150 water meters;
- Reduced the average service disruptions by two hours; and,
- Handled 98% of the 178,000 customer calls that were received on first contact.

While these achievements are commendable, PWSA recognizes that some areas will require sustained focus in order to comply with the PUC's standards. In its Compliance Plan submission and again in the Compliance Plan Supplement, PWSA has affirmed areas where PUC standards are currently being met (Appendix B) and noted areas where performance enhancements are required by PWSA to achieve full compliance in operational areas.

As part of its reporting requirements, PWSA has prepared an update on each of the areas where it is required to provide information and compiled them in a standard format. These areas include Operations, Billing and Customer Service, Lead, Infrastructure/Engineering, Finance and Accounting, and Contractual/Other Issues. Each section is organized according to the requirements associated with the Compliance Plan Supplement and the Compliance Plan. PWSA intends to use this format to streamline the process of tracking progress toward meeting agreed to activities in the Rate Case Settlement and in the Compliance Plan and Supplement.

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Appendix A - Becoming the Best

Appendix B - Title 52 Sections where PWSA Believes it is Currently in Compliance

Appendix C - 20 Operating Metrics Identified in I&E St. No. 4, p. 5

Appendix D - Low Income Customer Billing Metrics

Appendix E - Call Center Metrics

1. Operations

Operations activities are those that involve operations and maintenance (O&M) in the water, wastewater and stormwater systems. This includes O&M activities at the Aspinwall Water Treatment Facility, as well as O&M activities in the water transmission, storage and distribution systems and the wastewater/stormwater collection and conveyance systems.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including hydrant replacement, leak detection, valve maintenance, metered service, meter testing/replacement, operational effectiveness, and an expanded use of mobile work, as shown in Table 1. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative

Table 1: Compliance Plan Supplement Requirements - Operations

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Replace one hundred hydrants per year.	2019 and 2020	On-Target
Develop a leak detection program and restructure staff to add more personnel for leak detection.	April 2019	On-Target
Record water used for flushing after main breaks by having crews record the time flushed and flow gauges to record water used.	October 2019	On-Target
Provide water meters for each DPW division and have them installed on hydrants.	October 2019	On-Target
Restructure to support delivery of formal valve operation, flushing, and leak detection programs.	April 2019	Restructuring is in progress; program formalization is underway.
Develop a plan to track age of customer meters and to test and/or replace meters over 20 years old.		On-target to replace 4,500-5,000 meters in 2019.
Install a new meter test station for testing 5/8" to 2" meters.	April 2019	Complete
Hire a private contractor to test meters that are 3" and above on site or at their facility.		The PWSA Board of Directors awarded this contract to Vanguard on April 26, 2019.
Track the 20 Operating Metrics identified in I&E St. No. 4, p. 5.		Initial metric definitions and data (as available) is included in Appendix C.

i) Replace 100 hydrants per year.

PWSA agreed to replace 100 hydrants per year in 2019 and 2020. The replacement program is focused on removing older models from service on larger diameter mains and is currently on-schedule for 2019. The work associated with this task is being completed using both contractors and in-house staff. In the future, hydrant replacements will be coordinated with the small diameter main replacement program so that new hydrants are installed on new mains that replace older 4- and 6-inch mains that provide inadequate flow and/or pressure.

ii) Develop a leak detection program and restructure staff to add more personnel for leak detection

PWSA has hired a manager with considerable utility expertise to oversee its leak detection program. The new manager has initiated weekly meetings with the other operations managers to start formalizing a program, and has initiated cross-training of crews, with the idea being that all crews have some leak detection capability, but that the two designated leak detection crews can focus their efforts on programmatic surveying and more difficult detections. The Authority has also upgraded its leak detection equipment with new correlators and ground microphones to facilitate faster and more accurate leak detection. PWSA will start reporting data on leaks (number, type, etc.) in future progress reports.

i) Record water used for flushing after main breaks

PWSA committed to recording water used for flushing by having crews record the time flushed and using flow gauges to record the water used. PWSA is in the process of shifting a manager to oversee its flushing program, and has developed a system-wide flushing plan, which has already been approved by the Pennsylvania DEP. This program is on track to be in place by October 2019 and will be more fully discussed in subsequent sections.

ii) Provide water meters for each Department of Public Works (DPW) division and have them installed on hydrants

The goal of this initiative is to record water use for street sweeping, and to help PWSA reduce its unaccounted-for water. PWSA has contacted the City of Pittsburgh's DPW to determine appropriate sites for meters for filling street sweeping vehicles. While meter installation has not yet started, PWSA anticipates that this task is on-schedule for completion by October 2019. However, there will need to be some training and culture change with City staff to get them accustomed to using the metered locations.

iii) Restructure to support delivery of formal valve operation, flushing, and leak detection programs

PWSA has assigned one of its operations managers to formalize its valve operation, flushing, and leak detection programs, and has hired three additional staff members to ensure that the programs are appropriately resourced. The Operations Department has also started a restructuring effort, which includes assigning designated crews to focus on programmatic valve operation, flushing, and leak detection activities (while supporting other crews during emergencies). While implementation of these programs has started, the programs have not yet been formalized and PWSA is working to automate the associated data collection and reporting efforts.

iv) Develop a plan to track age of customer meters and to test and/or replace meters over 20 years old

According to best available information, PWSA has as many as 50,000 meters that have exceeded the Commission's recommended testing schedule and will need to be tested and/or replaced. Unfortunately, much of the meter data including installation date was lost in a billing system transition, so this number cannot be validated. In its Compliance Plan, PWSA committed to increasing its plumbing staff and changing out 5,000-6,000 meters per year. PWSA currently has open advertisements for plumbers and has coupled its residential meter replacement program with its lead service line replacement program, which has decreased the number of individual appointments that need to be scheduled. Until PWSA is able to successfully recruit plumbers, it will struggle to achieve the desired change-out rates. Note that the recruitment of plumbers is tied directly to PWSA's domicile requirement. To date, PWSA has changed out just over 2,000 residential meters, and is on-track to change 4,500-5,000 meters in 2019.

v) Install a new meter test station for testing 5/8 inch to 2-inch meters

PWSA has procured and installed a new 24-meter test station for testing 5/8 inch to 2-inch meters. PWSA has also allocated funds for a large meter (greater than 2 inches) test station in its 2020 budget.

vi) Hire a private contractor to test meters that are 3" and above

PWSA committed to hiring a private contractor to test larger meters either on site or at their facilities. The contracting process for this effort has started (Invitation for Bids for 2019 Large Water Meter Tests PWSA Project No. PWSA115) and the PWSA Board of Directors awarded this contract to Vanguard on April 26, 2019.

vii) Track the 20 Operating Metrics identified in I&E St. No. 4, p. 5

PWSA is starting to track the 20 Operating Metrics identified in I&E St. No 4, p. 5. Preliminary results of these operating metrics are shown in Appendix C.

b. Compliance Plan Requirements

For PWSA's operational areas, the Compliance Plan addresses topics including metering unmetered accounts, residential and commercial meter change-outs and testing, flushing, and developing standard operating procedures for communications and emergency response (Table 2). Compliance tasks associated with PUC Section 65.8 (Meters – Change-outs) and 65.17 (Standards of Design – Flushing Program) have already been addressed in the Compliance Plan Supplement Requirements. As such, this section lays out each of the remaining operational requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 2: Compliance Plan Requirements - Operations

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.7 Hire a contractor to assist with inspecting, sizing, and installing meters for municipal and unmetered properties.	2024	Site inspections have started, and PWSA's Board of Directors approved a consulting contract on April 26. 2019.
65.8 Add additional plumbers to address 50,000 meters that are overdue for testing/change-out.	ASAP	Plumbing positions are currently advertised.
65.8 Develop a program to test 10-25% of commercial meters annually.	2022	On-Target
65.8 Develop criteria for when to test meters that have been pulled from service, prior to disposal.	Within 6 months of Compliance Plan Filing	On-Target
65.11 Develop SOPs, including communications protocols, for periods of mandatory conservation.	2020	On-Target
65.17 Implement a flushing program.	2020	On-Target
67.1 Develop an SOP to notify the Commission during periods of unscheduled service interruptions.	Within 6 months of Compliance Plan Filing	On-Target
69.16 Update Emergency Response Plan SOPs.	Within 6 months of Compliance Plan Filing	On-Target

i) 65.7 - Inspecting, sizing, and installing meters for municipal and unmetered properties

PWSA has committed to partnering with a contractor to inspect, size, and install meters for municipal and other unmetered accounts (PWSA estimates 200-400 of these accounts in its service area) within the next five years. PWSA developed and released an RFP for these services and has begun inspecting facilities for meter installations. PWSA's Board of Directors approved a consulting contract with the selected vendor on April 26, 2019.

ii) 65.8 - Develop criteria for when to test meters that have been pulled from service, prior to disposal

PWSA has installed a test bench and plans to test approximately 10% of the meters that have been pulled from service. These meters will not go back into service in the system. Operations staff have reached out to the Commission to clarify requirements for the meter testing and will then develop appropriate testing protocols based on the response. PWSA believes that the last sentence of Title 55 § 65.8. Meters (d) (2), which says "Meters permanently removed from service and replaced by new meters utilizing remote reading devices are exempt from this provision." permits PWSA to only test a fraction of the meters pulled from service when they no longer going to be used in the system. PWSA uses an AMI network for getting data from meters which qualifies as a "remote reading device."

iii) 65.11 - Develop SOPs, including communications protocols, for periods of mandatory conservation

PWSA has an abundant water supply and therefore has never experienced and is not likely to experience a period where there would be inadequate source water to meet demands. However, source contamination or a significant failure in the treatment or delivery system may necessitate periods of mandatory conservation. These are extremely rare, and as such, has not yet developed Standard Operating Procedures, including communications protocols, for periods of mandatory conservation. However, the Authority plans to hire an Environmental Health and Safety professional in 2019, who will be tasked with developing and communicating this SOP.

iv) 67.1 - Develop an SOP to notify the Commission during periods of unscheduled service interruptions

PWSA has separate processes to notify the Commission during emergency and non-emergency periods of unscheduled service interruptions. While these processes are in place, PWSA currently lacks a formal, written SOP describing this activity, but anticipates having one completed within the next six months.

v) 69.16 - Update Emergency Response Plan SOPs

PWSA is in the process of updating its emergency response plan and associated SOPs, and many divisions share responsibility for this development. As previously mentioned, the Authority plans to hire an Environmental Health and Safety professional in 2019, who will assist in developing and communicating this SOP.

2. Billing/Customer Service

Many of the PUC's requirements relating to Billing and Customer Service fall under Chapter 56 of Title 52, which was created to establish and enforce "uniform, fair, and equitable residential public utility service standards." PWSA has already taken considerable steps to ensure Billing and Customer Service compliance, and many of the initiatives agreed to in the Rate Case Settlement, Compliance Plan or the Compliance Plan Supplement have already been completed.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including informal complaints, bill changes, use of collection services, customer service metrics, and creating/working with the Low Income Assistance Advisory Committee as shown in Table 3. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area.

Table 3: Compliance Plan Supplement Requirements – Billing/Customer Service

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Conduct a regular review of informal complaint information to determine complaint trends and whether there is a need to implement additional or new internal training policies.		PWSA is regularly reviewing informal complaints to determine trends and the need for further training.
Work with the parties to determine an appropriate informal complaint tracking information review process.		Assessment scheduled completion June 3, 2019.
Track whether customer complaints are related to water, sewer, or stormwater.	Monthly	On Target
Provide interested parties and the Commission's Bureau of Consumer Services with a draft of the bill changes for feedback and recommendations.		The bill draft was provided on March 29, 2019. Responses were provided in April 2019 by OCA, I&E, and Pittsburgh UNITED.
Inform customers of the payment arrangement terms, based on the consumer's ability to pay upon contact with the customer, and offer payment arrangements as permitted by Chapter 14.		Informal practices in this area have been formalized to demonstrate compliance.
Make the changes identified in Paragraphs III.1.1 through III.10 of the Settlement consistent with the timeframes established by the final order in this proceeding and to provide a copy of the changes to the Low Income Assistance Advisory Committee.		On Target
Suspend the use of Jordan Tax Service.	With the Commission's final order approving the Settlement	PWSA's Chief Administrative Officer has signed a notice letter.
Collect and report on requested billing data (Appendix D).		On-Target to report data by May 2019.
Fund BDP program using revenues collected from approved rates in the rate case settlement.		On-Target

Form a Low Income Assistance Advisory Committee.	Meetings should occur at least quarterly	Completed
Revise Bill Discount Program rate to provide for a 75% discount on the minimum water and/or wastewater charge for customers with income at or below 150% of the federal poverty level.		Completed, and effective as of March 1, 2019.
Submit a detailed Plan that outlines the program parameters for each of its Low Income assistance programs.	Next Base Rate Proceeding	On-Target for completion by October 2019.
Track the following metrics: Abandon %, ACD handling time, average speed of answer, CSR attendance, Customer satisfaction, service level % (Appendix E).	Monthly	On-Target
Expand the use of SpryPoint Mobile Work.		On-Target

i) Conduct a regular review of informal complaint information to determine complaint trends and whether there is a need to implement additional or new internal training policies

PWSA began conducting regular reviews of informal complaint trends in 2018 and has worked to update its customer service training policies and materials since that time. Identified trends relate to catch-up consumption, high consumption, and meter testing.

ii) Work with the parties to determine an appropriate informal complaint tracking information review process

PWSA has scheduled time on June 3, 2019 to work with the parties to determine an appropriate informal complaint tracking information review process. Subsequently, the Authority will work to implement the parties' review process recommendations on an appropriate timeframe.

iii) Track whether customer complaints are related to water, sewer, or stormwater

PWSA categorizes customer complaints based on water, sewer, and stormwater on an ongoing basis. This information is used for analysis and program improvement.

iv) Provide interested parties and the Commission's Bureau of Consumer Services (BCS) with a draft of the bill changes for feedback and recommendations

PWSA is in the process of redesigning its bills. As part of the Compliance Plan Supplement, the Authority agreed to provide interested parties and BCS with a draft of the changes for feedback and recommendations. The draft bill changes were provided to the interested parties and BCS on March 29, 2019, and responses were provided in April 2019 by OCA, I&E, and Pittsburgh UNITED.

v) Inform customers of the payment arrangement terms, based on the consumer's ability to pay upon contact with the customer, and offer payment arrangements as permitted by Chapter 14

PWSA has always been in compliance with this requirement, but recently revised and formalized its practices in this area. An income based payment plan calculator is installed in PWSA's billing system, which automatically generates a letter addressed to the customer detailing the payment terms. Training materials reflect the responsibility of the Customer Service Representative to offer payment arrangements, and all customer calls to 412-255-2423 are recorded for quality assurance and training purposes.

vi) Make the changes identified in Paragraphs III.1.1 through III.10 of the Settlement consistent with the timeframes established by the final order in this proceeding and to provide a copy of the changes to the Low Income Assistance Advisory Committee

PWSA is in the process of making the changes identified in Paragraphs III.1.1 through III.10 of the Settlement, consistent with the timeframes established by the final order in this proceeding. Once the changes are made, PWSA intends to provide a copy of the changes to the Low Income Assistance Advisory Committee.

vii) Suspend the use of Jordan Tax Service

PWSA's Chief Administrative Officer signed a notice to sever ties letter to Jordan Tax Service on March 31, 2019. This notice officially severs ties according to the terms of PWSA's contract with Jordan Tax Service. Note that PWSA may be engaged with Jordan Tax Service for several months per the terms of the agreement, before the final separation occurs.

viii) Collect and report on the requested billing data

PWSA has started to gather data associated with the billing metrics identified in the Compliance Plan Supplement and plans to report on these metrics by May 2019. Appendix D contains the billing metrics, as well as baseline data where available.

ix) Fund Bill Discount Program (BDP) program using revenues collected from approved rates in the rate case settlement

PWSA is funding the BDP program using revenues collected from the approved rates in the rate case settlement, and as such, it is in compliance with this requirement.

x) Form a Low Income Assistance Advisory Committee

The Low Income Assistance Advisory Committee has been established, and consists of interested parties, the Bureau of Consumer Services, Dollar Energy Fund, and local community and social service representatives. The Low Income Assistance Advisory Committee met for the first time on March 4, 2019.

xi) Revise Bill Discount Program rate to provide for a 75% discount on the minimum water and/or wastewater charge for customers with income at or below 150% of the federal poverty level

PWSA revised its BDP rate to provide for a 75% discount on the minimum water and/or wastewater charge for customers with income at or below 150% of the federal poverty level. This change became effective on March 1, 2019.

xii) Submit a detailed Plan that outlines the program parameters for each of its Low Income assistance programs

PWSA has initiated development of this plan and is on-track to submit in October 2019.

xiii) Track the following metrics: Abandon %, ACD handling time, average speed of answer, CSR attendance, Customer satisfaction, service level %

The metrics listed have been tracked on a monthly basis since January 2019. Appendix E shows data by month for January – March.

xiv) Expand the use of SpryPoint Mobile Work

PWSA is expanding the use of SpryPoint Mobile Work platform, which is essentially functions as a Computerized Maintenance Management System (CMMS) when connected to the Cogsdale billing system. The platform has made

it easier to record field work performed on meters and curb boxes. PWSA is on track to extend the functionality of this app to water and wastewater services and assets in the treatment, distribution and collection systems by October 2019.

b. Compliance Plan Requirements

For PWSA's customer service and billing areas, the Compliance Plan addresses topics including the bill redesign, plain language requirements, and translation assistance for shut-offs (Table 4). This section lays out each of the remaining billing and customer service requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 4: Compliance Plan Requirements – Billing and Customer Service

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
56.11-56.25 and 56.261-56.275 - Complete bill redesign project.	By the end of 2019	On-Target
56.81-56.118 and 56.321-56.358 - Meet plain language requirements for shut-off notices.	March 2019	On-Target
56.81-56.118 and 56.321-56.358 - Include information in Spanish directing Spanish-speaking customers to numbers for translation assistance for shut-offs.	March 2019	On-Target

i) 56.11-56.25 and 56.261-56.275 - Complete bill redesign project

PWSA has drafted a bill redesign and has provided copies of the draft to interested parties and BCS for feedback and recommendations. The draft bill changes were provided to the interested parties and BCS on March 29, 2019.

ii) 56.81-56.118 and 56.321-56.358 - Meet plain language requirements for shut-off notices

PWSA made initial changes to revise its shut-off language to ensure compliance with the plain language requirements, and BCS has indicated that it will be requesting additional revisions. After all revisions, the shut-off notices should be at an 8th grade reading level.

iii) 56.81-56.118 and 56.321-56.358 - Include information in Spanish directing Spanish-speaking customers to numbers for translation assistance for shut-offs

PWSA went live with this service in April 2019. PWSA partnered with the United Language Group (ULG), to offer translation and interpretation services for customer calls and written communications. This new service provides non-English speaking customers the opportunity to talk to experienced, qualified interpreters of over 200 languages, transcending linguistic and cultural barriers to get the information they need about PWSA programs and services. Customers can be transferred to an interpreter by request or have a PWSA letter or notice converted to a language other than English.

3. Lead

One of the major focus areas of the Rate Case Settlement and Compliance Plan Supplement was PWSA's lead remediation program. The following sections lay out the requirements related to lead, as well as the actions that PWSA has already taken or are underway to address this issue.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including the Community Lead Response Advisory Committee (CLRAC), customer outreach and communication, feasibility analysis, and service line replacement practices as shown in Table 5. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area.

Table 5: Compliance Plan Supplement Requirements – Lead

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Form a Community Lead Response Advisory Committee (CLRAC).	Initiated within 30 days of Settlement Agreement	The first quarterly meeting was held January 8, 2019, and three meetings have been held subsequently. The next meeting is scheduled for June 3, 2019.
Develop and implement a plan to encourage greater participation in the lead line replacement program.	Plan developed within 90 days of effective date of rates; customer participation reported quarterly	The Community Outreach and Communication Plan was presented to CLRAC on January 8, 2019 for input and is currently being implemented. Updates are provided at each meeting.
Make all historical service line records available for public viewing on website.	Within 90 days of effective date of rates	This was completed in early January.
Make best efforts to send a letter notifying the resident and property owner of the results of a curb box inspection.	Within 90 days of the completion of the inspection, but no later than 120 days	On-Target
Analyze per-line costs for replacing lead service lines.	Within 90 days of effective date of rates	This information was presented to CLRAC on April 24, 2019.
Develop and implement a plan to encourage greater participation in the lead sampling program.	Within 90 days of effective date of rates	The Community Outreach and Communication Plan was presented to CLRAC for input and is currently being implemented. Updates are provided at each meeting.
Continue to provide NSF-certified filters/replacement cartridges free of charge until samples are below 15 ppb lead for two consecutive 6-month periods.	Within 90 days of effective date of rates	The existing program, which was developed in 2018, continues.
Develop an outreach program to notify customers of their eligibility for free filters, including at a minimum, a letter or bill insert.	Within 90 days of effective date of rates	Letters sent to all CAP customers in February 2019 with new CAP customers updated in April and every month hereafter.
Develop and implement a plan for prioritizing lead service line replacements where curb box inspections are completed in designated neighborhoods.	Within 90 days of effective date of rates	Plan was developed with CLRAC during March 4, 2019 meeting. During April 24, 2019 meeting

		CLRAC selected additional areas to be done during 2019 program with available PENNVEST funding.
Analyze the feasibility of including all lead service lines, including private-side-only lead service lines, in PWSA's 2019 lead service line replacement program and 2020 - 2026 small diameter water main replacement program.	Within 90 days of effective date of rates	This information was presented to CLRAC on March 4, 2019.
Maintain the current outreach procedures for obtaining customer consent, and the current post-partial lead service line replacement sampling and filter-provision measures.	Through 2019	These programs are continuing.
Consult with the CLRAC regarding whether and how to seek authorization from the City of Pittsburgh to compel private-side lead service line replacements when a property owner who does not reside at the property declines a free private-side lead service line replacement.	For 2019 program	Initial discussion was held during the January 8, 2019 meeting and will continue at the June 3, 2019 meeting.
Consult with the CLRAC regarding whether to ask the City of Pittsburgh to establish a process through which partial lead service line replacements conducted by PWSA are documented in the property record for the relevant address.	For 2019 program	Initial discussion was held during the January 8, 2019 meeting and will continue at the June 3, 2019 meeting.
Record and make publicly available on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders.	Update on a monthly basis	Online web mapping has been updated by the first of each month since the beginning of 2019.
Continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.	For 2019 program	Program is continuing.
Continue to make a good-faith effort to secure an agreement with PennVEST enabling it to obtain customer consent for private-side lead service line replacements at any point before PWSA completes lead service line replacements for the work order covering the customer's property.	For 2019 program	Approval obtained from PENNVEST.
Continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost.	Immediately after replacement	Existing program developed in 2018 continues.

i) Form a Community Lead Response Advisory Committee (CLRAC)

The CLRAC was formed in early 2019 and has had four meetings since its formation. All meeting minutes have been posted on PWSA's website. The CLRAC has received regular updates on current lead remediation program costs, plans for neighborhood selection and prioritization for service line removal, and the community outreach efforts.

ii) Develop and implement a plan to encourage greater participation in the lead line replacement program

PWSA presented a Community Outreach and Communication Plan to the CLRAC on January 8, 2019. Following incorporation of the CLRAC's input, PWSA began implementing the outreach activities, and reports the efforts undertaken during the prior period at each meeting. PWSA continues to report to the CLRAC on customers' reasons

for rejecting service line replacements, as well as the number of customers who consented, failed to respond, or explicitly refused to consent to the replacements.

iii) Make all historical service line records available for public viewing on website

PWSA made all historical service line records available for public viewing on its website map in early January 2019. This map can be accessed at: http://lead.pgh2o.com/your-water-service-line/planned-water-service-line-replacement-map/. The map has been updated each month by the first of the month since January.

iv) Make best efforts to send a letter notifying the resident and property owner of the results of a curb box inspection

PWSA is making best efforts to send a letter notifying the resident and property owner of the results of curb box inspections within 90 days, but no later than 120 days. The existing notification letter used by PWSA was shared with the CLRAC in January.

v) Analyze per-line costs for replacing lead service lines

Analysis of per-line costs for replacing lead service lines, including discussion of cost differences between work conducted by outside contractors vs. PWSA, the frequency of trenchless methods, and any cost information in PWSA's possession or that can be obtained from other utilities that have implemented service line replacement programs, is currently underway. PWSA presented the analysis to the CLRAC at the April 24, 2019 meeting.

vi) Develop and implement a plan to encourage greater participation in the lead sampling program

PWSA is evaluating alternatives and supplemental activities for additional outreach and intends to present a plan within the required timeframe.

vii) Continue to provide NSF-certified filters/replacement cartridges free of charge until samples are below 15 ppb lead for two consecutive 6-month periods

This program is underway, and additional outreach has occurred to ensure that Winter Moratorium customers and Customer Assistance Program (CAP) participants are aware of this program.

viii) Develop an outreach program to notify customers of their eligibility for free filters, including at a minimum, a letter or bill insert

PWSA is collaborating with the CLRAC on developing this outreach program and presented the CLRAC with its methodology for identifying eligible customers and a draft letter notifying customers of their eligibility on at the January 8, 2019 meeting. The initial batch of letters went out on February 1, 2019, and PWSA has a plan in place and is notifying any new CAP participants on a monthly basis.

ix) Develop and implement a plan for prioritizing lead service line replacements where curb box inspections are completed in designated neighborhoods

At the first CLRAC meeting, PWSA presented several maps of the work orders, showing Blood Lead Levels and population data by census tract, with an objective of focusing the agenda of the second CLRAC meeting (February 6, 2019) on this issue. Discussion continued at the February 6 and March 4 meetings where PWSA presented analysis of the criteria applied to the 2019 work order areas, along with criteria applied to remaining areas of the city to select locations where surplus PENNVEST funds can be applied. CLARC provided direction to PWSA for the 2019 work order areas at the March 4, 2019 meeting, which is currently being implemented as part of the 2019 LSLR Program construction. At the April 24, 2019 meeting CLRAC provided direction for additional areas of the city where it wants to apply the additional funding.

x) Analyze the feasibility of including all lead service lines, including private-side-only lead service lines, in PWSA's 2019 lead service line replacement program and 2020 - 2026 small diameter water main replacement program

PWSA presented this report to CLRAC at the March 4, 2019 meeting.

xi) Maintain the current outreach procedures for obtaining customer consent, and the current post-partial lead service line replacement sampling and filter-provision measures.

PWSA is maintaining its outreach procedures for customer consent and the current post-partial lead service line replacement sampling and filter-provision measures. This task is on-going.

xii) Consult with the CLRAC regarding whether and how to seek authorization from the City of Pittsburgh to compel private-side lead service line replacements when a property owner who does not reside at the property declines a free private-side lead service line replacement.

This issue was discussed at the January 8 CLRAC meeting, with follow-up anticipated at the June 3, 2019 meeting.

xiii) Consult with the CLRAC regarding whether to ask the City of Pittsburgh to establish a process through which partial lead service line replacements conducted by PWSA are documented in the property record for the relevant address

This issue was discussed at the January 8 CLRAC meeting, with follow-up anticipated at the June 3, 2019 meeting.

xiv) Record and make publicly available on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders.

PWSA recorded and made publicly available (at the beginning of January 2019) on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders. PWSA's web map has been and will continue to be updated on a monthly basis by the first of each month.

xv) Continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.

PWSA will continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.

xvi) Continue to make a good-faith effort to secure an agreement with PennVEST enabling it to obtain customer consent for private-side lead service line replacements at any point before PWSA completes lead service line replacements for the work order covering the customer's property.

At the first CLRAC meeting, PWSA reported that it was successful in securing an agreement with PENNVEST that enables PWSA to obtain customer consent for private-side lead service line replacements at any point before PWSA completes lead service line replacements for the work order covering the customer's property.

xvii) Continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost

PWSA will continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost immediately after replacement.

b. Compliance Plan Requirements

The Compliance Plan requirements associated with PWSA's lead remediation program were addressed through the Rate Case Settlement and Compliance Plan Settlement document.

4. Infrastructure

Infrastructure activities are those that involve capital planning, investment, and installation/renewal in the water, wastewater and stormwater systems. This includes distribution system master planning, meter installations, capital project cost/projection effectiveness, record keeping, pressure assurance, and design/construction standards updates.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including development of a distribution system master plan, a district metering program, the Highland Membrane Filtration Plant (HMFP)/Highland No. 1 Reservoir, and the cost effectiveness of PWSA's projections, as shown in Table 6. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area.

Table 6: Compliance Plan Supplement Requirements - Operations

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Develop a Water Distribution System Master Plan, to address master metering, non-revenue water, and include an AWWA Water Audit.	2019	PWSA's Board of Directors has approved this project and it is in progress.
Develop and implement district metering program.	2020	On-Target
Provide a detailed cost breakdown of actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP.	Starting within 30 days of the signature date of the Settlement and quarterly thereafter	On-Target, first provided on January 23, 2019.
A cost/benefit analysis comparing continuing to operate the HMFP instead of covering and placing a physical barrier around Highland No. 1 Reservoir.	With the next base rate filing	On-Target
Develop a plan to track cost effectiveness and cost reporting relative to projections.	With future filings	PWSA has begun monitoring several metrics related to the effectiveness of its cost projections through its eBuilder project management software.

i) Develop a Water Distribution System Master Plan, to address master metering, non-revenue water, and include an AWWA Water Audit.

PWSA's Board of Directors has approved the Water Distribution System Master Plan, with a targeted completion date of late 2019. The Master Plan will address master metering and non-revenue water and will include a water audit that follows AWWA guidance using available data. This plan will also recommend locations for implementation of the district metering program, which is discussed in the next section.

ii) Develop and implement district metering program

PWSA's plan includes metering devices at each of its intakes on the Allegheny River, and at two of the main pump stations serving the City (the Aspinwall and Bruecken Pump Stations). In addition, the plan includes master meter

locations recommended by the Water Distribution System Master Plan at key locations within the distribution system. This is on schedule to be completed in 2020.

iii) Provide a detailed cost breakdown of actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP

PWSA shared the following cost breakdown with all settlement parties on January 23, 2019:

- Actual and projected operating and capital costs to date incurred and estimated to be incurred as a result of the October 25, 2017 Department of Environmental Protection Administrative Order with regard to the HMFP; and
- Actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP.

PWSA and will continue to share these cost breakdowns on a quarterly basis, as well as upon completion of repairs to the HMFP.

iv) A cost/benefit analysis comparing continuing to operate the HMFP instead of covering and placing a physical barrier around Highland No. 1 Reservoir

PWSA is on schedule to provide a cost/benefit analysis of the relevant legal, technical, and policy considerations, as well as a cost comparison, of operating the HMFP instead of covering and placing a physical barrier around the Highland No. 1 Reservoir. Note that the HMFP is still not fully operational and operating under DEP consent, so operations and maintenance cost projections cannot be verified until the system is fully on line.

v) Develop a plan to track cost effectiveness and cost reporting relative to projections

PWSA has begun to monitor several metrics related to cost effectiveness and cost reporting relative to its projected capital spending. It is using the eBuilder project management software to track project costs and progress, which allows advanced calculation of performance metrics. Currently, PWSA is tracking project total costs and cash flow relative to budget. PWSA working on defining additional metrics such as Estimated Cost at Completion (ECAC), schedule variance, change order volume and percentage of total project, etc.

b. Compliance Plan Requirements

For PWSA's infrastructure area, the Compliance Plan addresses topics including records management, meeting pressure requirements, metering municipal and flat rate customers, metering all sources of supply, ensuring appropriately sized mains and sufficient operable valves, and incorporating the PUC's design requirements into a formalized design manual (Table 7). Compliance tasks associated with PUC Section 65.8 (Meters – Change-outs) and 65.17 (Standards of Design – Flushing Program) have already been addressed in the Compliance Plan Supplement Requirements. As such, this section lays out each of the remaining infrastructure requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 7: Compliance Plan Requirements - Infrastructure

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.4 Develop a series of SOPs for records filing, records updates in GIS, and records retrieval.	Within 6 months	On-Target
65.4 Update GIS with main installation date and material.	by 2021	On-Target

65.4 Update GIS with hydrant and valve status.		On-Target
65.4 Organize, store, and input current records backlog into GIS.		On-Target
65.6 Install additional monitoring stations for areas of low pressure.	by 2020	On-Target, to be addressed by Master Plan.
65.6 Develop an SOP to address areas of high pressure.	by the end of 2019	On-Target, to be addressed by Master Plan.
65.7 Secure a contractor to assist with inspection, sizing, and installation of meters and associated equipment for municipal buildings and flat rate customers.	2024	Site inspections have started, and PWSA's Board of Directors approved a consulting contract on April 26. 2019.
65.14 Reestablish operability of meters at each source of supply and install an additional meter at Fox Chapel Station.	2019	On-Target, to be addressed by Master Plan.
65.17 Continue to work on replacing all 4" water mains.		On-Target, to be addressed by Master Plan.
65.17 Incorporate the PUC's design requirements, specifications, and standard details into a formalized design manual.	2019 and 2020	On-Target
65.18 Complete the development of a comprehensive flushing program.	Starts in 2018	On-Target
65.18 Review the existing system to ensure ample valves.	Starts in 2018	On-Target, to be addressed by Master Plan.
65.18 Increase the number of valves inspected and operated per year.	2019	On-Target, to be addressed by Master Plan.

i) 65.4 - Records

Section 65.4 of Chapter 65 stipulates that utilities must keep complete maps, plans, or records of their entire distribution systems that show the size, character, and location of each main, street valve, and service line. To address these requirements, PWSA is committed to developing SOPs for records filing, updates, and retrieval; updating its GIS system with main installation dates and materials; updating its GIS system with hydrant and valve status; and organizing, storing, and inputting the current records backlog into GIS. This effort is currently underway, and PWSA anticipates completion within the projected timeframes.

ii) 65.6 - Pressures

PWSA is aware of locations within its system where pressure falls below 25 psi. In accordance with Part 4 of the PA DEP October 25, 2017 Administrative Order, PWSA has installed 24 pressure monitoring stations, which monitor and record pressures every 15 minutes, and report on low or loss of pressure by text and email alert. PWSA is also aware of areas where pressure exceeds 150 psi and is in the process of developing an SOP to address this issue. Capital projects associated with areas of high and low pressure will be addressed in the Distribution System Master Plan, and PWSA is on-target to meet the projected timeframes.

iii) 65.7 - Secure a contractor to assist with inspection, sizing, and installation of meters and associated equipment for municipal buildings and flat rate customers

PWSA has committed to partnering with a contractor to inspect, size, and install meters for municipal and other unmetered accounts (PWSA estimates 200-400 of these accounts in its service area) within the next five years. PWSA developed and released an RFP for these services and has begun inspecting facilities for meter installations. PWSA's Board of Directors approved a consulting contract with the selected vendor on April 26. 2019.

iv) 65.14 - Reestablish operability of meters at each source of supply and install an additional meter at Fox Chapel Station

PWSA has installed meters at each source of supply and the Fox Chapel Station and is currently testing these meters to ensure accuracy. Further capital projects related to meter operability will be addressed in the Master Plan. This includes additional master meter facilities at the Aspinwall Water Treatment Facility to monitor the total flows into the distribution system.

v) 65.17 – Standards of Design

In accordance with the PUC's standards of design, PWSA is focused on continuing to replace all 4" water mains, which will be addressed in the Master Plan, and incorporating the PUC's design requirements, specifications, and standard details into a formalized design manual. PWSA is on target to address these issues within the specified timeline.

vi) 65.18 – Standards of Construction

As discussed in the Operations section, PWSA is in the process of developing and implementing a comprehensive flushing program and increasing the number of valves inspected and operated each year. PWSA will also be analyzing the existing system to ensure ample valves through its Master Planning process. The Authority is on target to have these issues addressed within the specified timeframes.

5. Finance, Contractual, and Other Issues

PWSA has already made considerable effort to ensure compliance regarding financial, contractual, and other issues, and many of the initiatives agreed to in the Rate Case Settlement, Compliance Plan or the Compliance Plan Supplement have already been completed. The following sections focus on identifying the remaining requirements and highlighting PWSA's progress in each of these areas.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including negotiations with the City of Pittsburgh and ALCOSAN, rates for public fire hydrant service, flat rates for unmetered customers, the discount for Pennsylvania American Water Customers, as shown in Table 8. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area.

Table 8: Compliance Plan Supplement Requirements – Finance, Contractual, and Other Issues

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Renegotiate the Cooperation Agreement with the City of Pittsburgh.	Quarterly Updates, beginning 4/30	This negotiation is in progress
Formally notify the City of Pittsburgh of the record and outcome of this case that the Cooperation Agreement is being reviewed by the PUC in the Compliance Filing proceeding, and that PWSA's LTIIP Filing is pending with the Commission.		Complete
Serve the City with a copy of Final Commission Orders and file a certificate of service with the Commission verifying that such service was made.	Issued in this matter within 10 days of their issuance	Complete
Notify all parties to the Settlement proceeding if the City of Pittsburgh and PWSA reach an agreement for an Amended Cooperation Agreement, and provide each with a copy of the renegotiated Cooperation Agreement.	Within 15 calendar days of its execution	On Target
Consider the timeframe for developing a separate rate for public fire hydrant service.	Next Base Rate Case	On Target
Consider assessing the City of Pittsburgh a separate rate for public fire hydrant service.	Next Base Rate Case	On Target
Consider the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties or buildings served by PWSA.	Next Base Rate Case	On Target
Analyze the feasibility of assessing a flat rate to the unmetered customers.	Next Base Rate Case	On Target
Investigate the allocation of flows to ALCOSAN and other municipalities to determine the feasibility of measuring stormwater separately from wastewater.		On Target

Propose a plan or method for developing separate cost of service studies for wastewater and stormwater for the development of stormwater rates.		On Target
Evaluate the potential ways to address PWSA's contract with ALCOSAN, including renegotiation of the contract.		On Target
Investigate the City of Pittsburgh discount for PAWC water customers as originated under the terms of the 1973 Agreement between the City of Pittsburgh and Western Pennsylvania Water Company.		Complete

i) Renegotiate the Cooperation Agreement with the City of Pittsburgh

PWSA is in the process of renegotiating the Cooperation Agreement with the City of Pittsburgh and plans to begin providing quarterly updates to the parties on April 30, 2019. Note that PWSA has given notice that it is terminating the existing Cooperation Agreement within the timeframes specific in the agreement. Even though PWSA has given termination notice to the City, the Authority's Board of Directors extended the Cooperation Agreement by two months on April 26, 2019. Prior to agreement on a new Cooperation Agreement fees for any service provided to or received from the City will be done on an actual cost basis.

ii) Formally notify the City of Pittsburgh of the record and outcome of the Rate Case Proceeding, that the Cooperation Agreement is being reviewed by the PUC in the Compliance Filing proceeding, and that PWSA's LTIIP Filing is pending with the Commission

PWSA formally notified the City of Pittsburgh of the record and outcome of the rate case proceeding that the Cooperation Agreement is being reviewed by the PUC in the Compliance Filing proceeding, and that PWSA's LTIIP Filing is pending with the Commission.

iii) Serve the City with a copy of Final Commission Orders and file a certificate of service with the Commission verifying that such service was made

PWSA served the City with a copy of Final Commission Orders and filed a certificate of service with the Commission verifying that the service was made.

iv) Notify all parties to the Settlement proceeding if the City of Pittsburgh and PWSA reach an agreement for an Amended Cooperation Agreement, and provide each with a copy of the renegotiated Cooperation Agreement

PWSA plans to notify all parties to the Settlement proceeding if the City of Pittsburgh and PWSA reach an agreement for an Amended Cooperation Agreement, and to provide each with a copy of the renegotiated Cooperation Agreement.

v) Consider the timeframe for developing a separate rate for public fire hydrant service

PWSA has committed to developing a separate, cost-justified rate for public fire hydrant service, to be presented as part of the next base rate case filing. This process is underway, and a formal rate will be proposed in the next base rate case.

vi) Consider assessing the City of Pittsburgh a separate rate for public fire hydrant service

PWSA plans to assess the City of Pittsburgh with a separate rate for public fire hydrant service. Implementation timing and approach regarding this rate will be in the context of, and dependent on, larger negotiations with the City, and will only occur once the cost-justified rate has been developed.

vii) Consider the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties or buildings served by PWSA

The Authority plans to conduct its analysis before the next rate case.

viii) Analyze the feasibility of assessing a flat rate to the unmetered customers

The Authority plans to conduct its analysis before the next rate case.

ix) Investigate the allocation of flows to ALCOSAN and other municipalities to determine the feasibility of measuring stormwater separately from wastewater

Approximately 70% of PWSA's collection system is combined, which prevents the Authority from accurately measuring stormwater and wastewater separately.

x) Propose a plan or method for developing separate cost of service studies for wastewater and stormwater for the development of stormwater rates

PWSA has initiated the development of separate cost of service studies for wastewater and stormwater, with the goal of proposing stormwater rates. This effort will be completed by the next rate case filing.

xi) Evaluate the potential ways to address PWSA's contract with ALCOSAN, including renegotiation of the contract

PWSA is not a party to the ALCOSAN contract, which is between the City and ALCOSAN.

xii) Investigate the City of Pittsburgh discount for PAWC water customers as originated under the terms of the 1973 Agreement between the City of Pittsburgh and Western Pennsylvania Water Company

The City of Pittsburgh entered into an arrangement with PAWC in 1973 whereby the City pays a rate subsidy directly to PAWC that offsets PAWC's water rates for about 27,000 of PWSA's sewer only customers. As this contract is between the City and PAWC, PWSA cannot commit to the elimination of the subsidy in the next base rate case. However, depending on the level of the next rate increase, it is possible that the subsidy will be eliminated at that time. Even if it is fully eliminated during the next rate case, it is not feasible for PWSA to establish a date certain by which the subsidy will be eliminated.

b. Compliance Plan Requirements

For PWSA's financial, contractual, and other areas, the Compliance Plan addresses topics including the system of accounts, annual financial reporting requirements, a workforce diversity policy, and emergency response planning and self-certification requirements, as shown in Table 9). This section lays out each of the remaining financial, contractual, and other requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 9: Compliance Plan Requirements – Finance, Contractual, and Other Issues

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.16 System of Accounts.	FY 2020	On-Target

65.19 Filing of Annual Financial Reports.	2019	On-Target
69.801 Develop a formal policy to improve diversity in the workforce.	By the end of 2019	On-Target
69.16 Update emergency response plan with updated SOPs.	March, 2019	Anticipated October 2019
73.3 Annual Depreciation Reports.	April 2020 (Partial Report) April 2024 (Compliance)	On-Target
73.5 Service Life Study Report.	April 1, 2022	On-Target
101.3 Plan Requirements.	March, 2019	Anticipated October 2019
101.4 File a Self-Certification Form.	April 30, 2019	Anticipated October 2019

i) 65.16 - System of Accounts

Section 65.16 mandates that a public utility, having an annual operating revenue of $750,000 or more shall keep its accounts in conformity with the most recent Uniform System of Accounts for Class A Water Utilities, as prescribed by the National Association of Regulatory Utility Commissioners (NARUC). PWSA has completed its effort to map its current chart of accounts to the NARUC chart of accounts in order to identify existing gaps. PWSA is prepared to file all required reports in 2019.

ii) 65.19 - Filing of Annual Financial Reports

PWSA filed its first Annual Reports with the Commission in 2019.

iii) 69.801 - Develop a formal policy to improve diversity in the workforce

PWSA is in the process of developing a formal policy to improve diversity in the workforce. A policy has been drafted and will be presented to the Board of Directors in the next 90 days.

iv) 69.16 - Update emergency response plan with updated SOPs

PWSA is in the process of updating its emergency response plan to better adhere to the National Incident Management System's public information system and including updated standard operating procedures.

v) 73.3 - Annual Depreciation Reports

PWSA operates on the cash basis and does not use depreciation in its ratemaking methodology. PWSA proposes to come into full compliance by April 2024, with a report for FY 2023. PWSA proposes to begin the internal efforts to perform a fixed asset study, which would be completed in 2021, and plans to file a partial depreciation report by 2020. .

vi) 73.5 - Service Life Study Report

Section 73.5 stipulates that public utilities with intrastate gross revenues in excess of $20 million per year shall file a service life study report with the Office of Special Assistants every five years. PWSA plans to meet this requirement and file a service life study report by April 1, 2022.

vii) 101.3 – Plan Requirements

PWSA is in the process of developing a physical security plan, based on its recently completed security assessment. Similarly, a cyber security assessment was completed in 2018, and PWSA anticipates securing a consultant to develop a cyber security plan, but this effort was delayed by the departure of the Authority's Information Technology Director. PWSA is also working to update its emergency response plan to comply with the Commission's requirements, as well as to incorporate feedback from the Allegheny County Health Department and the PA Department of Environmental Protection.

viii) 101.4 - File a Self-Certification Form

PWSA anticipates filing a self-certification form once it meets the plan requirements. Note that under 101.3 PWSA indicates that it is working on the plan and there is an estimated completion date of October 2019.

Appendix A: Becoming the Best

Appendix B – Title 52 Sections where PWSA Believes it is currently in Compliance

Section	Subchapter	Currently in Compliance
56.1	Preliminary Provisions for Utilities and Customers Subject to Chapter 14 of the Public Utility Code	X
56.31 – 56.58	Credit and Deposits Standards Policy (Water)	X
56.71 – 56.72	Interruption and Discontinuance of Service (Water)	X
56.14 – 56.174	Disputes; Termination Disputes; Informal and Formal Complaints (Water)	X
56.191	Restoration of Service (Water)	X
56.251 – 56.252	Provisions for Wastewater, Steam Heat and Small Natural Gas Distribution Utilities and Victims of Domestic Violence with a Protection from Abuse Order	X
56.281 – 56.307	Credit and Deposits Standards Policy (Wastewater)	X
56.311 – 56.312	Interruption and Discontinuance of Service (Wastewater)	X
56.371 – 56.411	Disputes; Termination Disputes; Informal and Formal Complaints (Wastewater)	X
56.421 – 56.422	Restoration of Service (Wastewater)	X
56.441	Informal Complaints (Wastewater)	X
65.3.	Complaints.	X
65.5.	Interruptions of service.	X
65.9.	Adjustment of bills for meter error.	X
65.10.	Disputed bills.	X
65.12.	Notice of desire to have service discontinued.	X
65.13.	Temporary service.	X
65.15.	Refusal to serve applicants.	X
69.51 – 69.85	Inclusion of State Taxes and Gross Receipts Taxes in Base Rates	X
69.169	Policy Statement Interpreting Terms Included In 66 Pa.C.S. § 1326	X
69.261 – 69.267	Policy Statement On Customer Assistance Programs	X
69.351	Implementation Of SFAS 106	X
73.7.	Capital investment plan report	X
121.3.	LTIIP.	X
121.4.	Filing and Commission review procedures.	X

Appendix C – 20 Operating Metrics Identified in I&E St. No. 4, p. 5

Metric	April 2019**	July 2019	October 2019
Pipeline Materials (% of pipe segments with materials listed in GIS)			
Pipeline Age (% of pipe segments with age listed in GIS)			
Leak History per Mile (number of leaks per 100 miles of pipe per year)*			
Pipeline Pressures (distribution pressure devices recording pressure outside minimum and maximum for more than 10 minutes)			
Installation Year (% of pipe segments with installation year listed in GIS)			
Pipeline Diameter (% of pipe segments with pipeline diameter listed in GIS)			
Pipeline Mileage (miles of active and retired pipe in the distribution system)			
Addition/Retirements of Plant (GIS or CMMS field denoting active or inactive assets)			
Materials and Supplies (Value of materials and supplies on-hand)			
Leak Repair (number of leaks repaired – distribution main)			
Leak Repair (number of leaks repaired – service line)			
Pipeline Damages from Excavation (GIS or CMMS field denoting suspected cause of leak)			
Plant in Service (Asset inventory)			
Corrosion Protection Programs (pipe segments protected by cathodic protection)			
Lead Levels (Lead and copper action level, current period)			
Miles of Lead Pipeline			
Cost of Lead Pipeline Replacement for PWSA Work Crews (average pipeline replacement cost per period)			
Cost of Lead Pipeline Replacement for PWSA Contractors (average pipeline replacement cost per period)			
Sanitary Flow Reduction (Number of reportable SSOs per year)			
Sanitary Flow Reduction (Volume of reportable SSOs per year)			
Miles of Combined Sewer Separation (per year)			
Unaccounted for Water (% of finished water that is unaccounted for)			
Non-revenue Water (% of finished water that is non-revenue)			

*Leaks will be geotagged to the segments in which they occur

** The April data will not be collated until the end of May 2019.

Appendix D – Low Income Customer Billing Metrics

Billing Metrics	April 30, 2019**	July 31, 2019	October 31, 2019
Billed revenue			
Receipts actually collected			
Number of accounts in arrears			
Dollars of arrears			
Number of accounts disconnected for nonpayment			
Number of accounts receiving a notice of disconnection for nonpayment			
Number of bill discount participants who entered the bill discount program with unpaid account balances			
Dollars of unpaid account balances for bill discount program participants at the time those participants entered the bill discount program			
Number of bill discount participants by agreed-upon poverty ranges			
Average usage			
Average bills, including ALCOSAN charges in wastewater bills			
Number of PWSA customers receiving a PWSA hardship grant			
Average amount of PWSA hardship grants			
Average arrearage of PWSA customers receiving a PWSA hardship grant.			

** The April data will not be collated until the end of May 2019.

Appendix E – Call Center Metrics

Metric	January, 2019	February, 2019	March, 2019
Abandoned Calls (% of total calls)	2.4%	3.0%	4.4%
Automatic Call Distributor (ACD) Handling Time (minutes)	4:15	3:48	4:15
Average Speed of Answer (minutes)	1:02	1:01	1:46
Customer Service Representative Staffing (FTE – Full Time Equivalents)	13 FTEs	11.5 FTEs	12 FTEs
Customer Satisfaction (customer survey)	96.7%	97.5%	98.8%
Service Level %	82.6%	83.7%	73.3%

Exhibit RAW/C-29

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2019 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A	N/A
2020 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A	N/A
2021 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A	N/A
2022 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A	N/A
CMMS (Computerized Maintenance Management System)	Acquire, install, develop, and implement a Computerized Maintenance Management System, including training staff to assist with capital investment prioritization.	The CMMS will be used by field and engineering staff to record, house, track, and identify short-term and long-term asset investment needs. A properly developed CMMS can identify efficiency imp798528]rovements, increase levels of asset renewal, and reduce operation, maintenance, and capital costs. The CMMS will communicate with the GIS system and be able to coordinate with eBuilder as well as the Authority's finance system.	$10,000,000	Borrowed	July 2019	December 2026	N/A
2018 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units, stormwater control reliability, and minimize disturbance to the community.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$10,392,500	Borrowed	August 2018	August 2019	A. Folino & Independent Eneterprises
2019 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,320,000	Borrowed	August 2019	August 2020	N/A
2020 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,660,000	Borrowed	August 2020	August 2021	N/A
2021 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,030,000	Borrowed	August 2021	August 2022	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2022 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,380,000	Borrowed	August 2022	August 2023	N/A
2023 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,720,000	Borrowed	August 2023	August 2024	N/A
MS4 Compliance Projects	Four stormwater BMP projects that will reduce pollutants to impaired waters, which include stream restoration and inlet inserts at various sites.	These projects are required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection.	$1,955,000	Borrowed	October 2018	August 2020	N/A
Saw Mill Run MS4 & CSO Compliance Projects	Multiple projects that will reduce pollutants to impaired waters and reduce CSO volume, which includes stream restoration, green stormwater infrastructure, and other BMPs at various sites.	These projects are required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed. Project also required to address PADEP Consent Order for CSO compliance.	$8,500,000	Borrowed	June 2021	December 2023	N/A
Maytide Storm and Sanitary Sewer System Improvements	Reconstruction of storm infrastructure from Merritt Avenue to the storm interceptor on Ravilla Avenue, the realignment of the sanitary sewer on Maytide (Sanderson to Valline), and the rehabilitation and/or reconstruction of the sanitary sewer mains on the undeveloped right-of-ways in the vicinity. .	Localized property and street flooding has been well-documented for several years at this location and the undeveloped right-of-way of Sanderson has significantly deteriorated. Additionally, inspections of the sanitary sewers in the vicinity revealed structural and construction defects	$6,520,000	Borrowed	March 2018	March 2020	Wade Trim
2019 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$3,580,000	Borrowed	June 2019	July 2020	GHD & Wade Trim
2020 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$3,960,000	Borrowed	August 2019	July 2021	N/A
2021 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,045,000	Borrowed	August 2020	July 2022	N/A
2022 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,230,000	Borrowed	August 2021	July 2023	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2023 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,375,000	Borrowed	August 2022	July 2024	N/A
2024 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,490,000	Borrowed	August 2023	July 2025	N/A
Saw Mill Run Stream Bank Restoration	Stream restoration of approximately 1,500 linear feet of the Saw Mill Run Creeks to reduce pollutants in the impaired waterway.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,385,000	Borrowed	October 2018	December 2019	Johnson, Mirmiran, Thompson, Inc.
Volunteer's Field Storm Water Management	Installation of BMPs to reduce sediment, other pollutant loads, stormwater volume, and peak flows to the Saw Mill Run watershed.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,465,000	Borrowed	October 2018	December 2019	Johnson, Mirmiran, Thompson, Inc.
Saw Mill Run Watershed Water Quality Improvement Project (formally known as Overbrook Pollution and Flood Reduction)	Implementation of stormwater treatment and reconnection of streams to vegetated floodplains to help mitigate stormwater peak flows, reduce flooding, reduce sediment, other pollutant loads, and reduce CSO volume	This project will demonstrate the effectiveness of green infrastructure in reducing pollutants, controlling CSO/SSOs, and restoring the health of the aquatic ecosystems in the Saw Mill Run watershed to comply with MS4 NPDES permit and PADEP CO regulatory obligations.	$6,500,000	Borrowed	May 2019	June 2021	N/A
Tide Gate Installations	Installation of tide gates at 44 combined sewer overflow diversion chamber locations to assist in preventing river water intrusion. Construction for this project is anticipated to occur in multiple phases.	This project is required to reduce CSO volume to address PADEP Consent Order for CSO compliance. Project to be completed in multiple phases and construction contracts.	$4,500,000	Borrowed	May 2019	June 2023	N/A
EPA 308/City of Pittsburgh Source Reduction Response	Modeling of the remaining priority combined sewersheds within the City of Pittsburgh, as well as the separate sewersheds within the City in order to meet an EPA submission requirements.	This project is required to comply with regulatory obligations.	$750,000	Borrowed	June 2017	December 2019	Mott MacDonald
Wightman Park Green Infrastructure	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Squirrel Hill neighborhood of the City of Pittsburgh, which is tributary to the M-29 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,365,000	Borrowed	March 2018	September 2020	Ethos Collaborative

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Woods Run Stream Removal -Phase 1	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently discharging directly into a 36-inch diameter combined sewer on Mairdale Avenue.	This project area was identified in the PWSA Green First Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,296,000	Borrowed	October 2017	June 2020	Civil & Environmental Consultants, Inc.
Woods Run Stream Removal -Phase 2		This project area was identified in the PWSA Green First Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,405,000	Borrowed			N/A
Woods Run Stream Removal -Phase 3		This project area was identified in the PWSA Green First Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,775,000	Borrowed			N/A
Panther Hollow/Four Mile Green/Stormwater Infrastructure	Sewer separation, stream restoration, stream daylighting, bioretention, and underground storage to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in M-29.	This project area was identified in the PWSA Green First Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$41,100,000	Borrowed	May 2018	August 2021	Civil & Environmental Consultants, Inc.
Spring Garden Stream Removal	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-60.	This project area was identified in the PWSA Green First Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$10,710,000	Borrowed	April 2019	July 2021	Wade Trim
MLK Field Green Infrastructure	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Hill District/Uptown area of the City of Pittsburgh, which is tributary to the M-19 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,402,000	Borrowed	March 2019	September 2020	Michael Baker
Woodland Drive Green Infrastructure	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets and steeply sloping hillside within Chatham University, which is Tributary to the A-22 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,195,000	Borrowed	October 2018	November 2019	Civil & Environmental Consultants, Inc

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Thomas and McPherson Green Infrastructure	Installation of roadside bioretention features to capture and detain impervious road runoff in the North Point Breeze neighborhood of the City of Pittsburgh, which is tributary to the A-42 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,650,000	Borrowed	October 2018	September 2020	Wade Trim
Homewood Park Green/Stormwater Infrastructure	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the City of Pittsburgh, which is tributary to the M-29 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,720,000	Borrowed	April 2019	October 2020	N/A
Bus Rapid Transit (BRT) Green Stormwater Infrastructure	Installation of stormwater management features to capture and detain impervious acres from 5th Avenue and Forbes Ave in the City of Pittsburgh, which is tributary to multiple CSO outfalls. Project being coordinated with and constructed in phases with City road reconstruction project of 5th Avenue and Forbes Ave.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$6,050,000	Borrowed	January 2020	December 2022	N/A
Negley Run/Washington Boulevard Green Stormwater Infrastructure	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-42.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$15,390,000	Borrowed	January 2019	January 2020	N/A
Lawn and Ophelia Green Infrastructure	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the South Oakland neighborhood, which is tributary to the M-19B combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$785,000	Borrowed	May 2018	November 2019	Ethos Collaborative
South Side Green/Stormwater Infrastructure	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently within the Park and downstream adjacent streets tributary to the M-16 combined sewer outfall.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$8,694,000	Borrowed	December 2018	July 2021	Ethos Collaborative
Maryland Avenue Green Infrastructure	Installation of stormwater management features to capture and detain impervious acres from Maryland Ave and the adjacent streets which is tributary to the A-22 combined sewer outfall. Project being split into 3 primary phases.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$9,384,000	Borrowed	January 2018	September 2021	Buchart Horn, Inc.

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Shamrock Way Green/Stormwater Infrastructure	Preliminary design of stormwater management features to capture and detain impervious acres from Shamrock Way and the adjacent streets which is tributary to the A-22 combined sewer outfall. Design and construction will be through a future project to be developed after preliminary design is complete.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$40,000	Borrowed			N/A
St. Johns Green/Stormwater Infrastructure	Preliminary design of stormwater management features to capture and detain impervious acres tributary to the former St. John's hospital site now scheduled to be green space, which is tributary to the O-27 combined sewer outfall. Design and construction will be through a future project to be developed after preliminary design is complete.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$75,000	Borrowed	December 2018	September 2020	Ethos Collaborative
Heth's Run/A-41 Green/Stormwater Infrastructure	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-41 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$600.000	Borrowed	May 2019	January 2020	Reviewing Proposals Obtained
M-29 Green/Stormwater Infrastructure	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the M-29 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	December 2019	N/A
A-42 Green/Stormwater Infrastructure	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-42 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	December 2019	Reviewing Proposals Obtained

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Smallman Street Reconstruction	The installation of approximately 2,500 linear feet of new storm sewer piping ranging in size from 24-inch to 54-inch, 2,000 linear feet of new sanitary sewer piping ranging in size from 18-inch to 48-inch, 2,000 linear feet of new 12-inch water main, and 1,500 linear feet of new 36-inch water transmission main.	Sewer separation and water main replacement due to the redevelopment of the Produce Terminal Building, realignment of the streetscape, and the location of the existing combined sewer infrastructure, which is located under the existing building.	$16,867,000	Borrowed	September 2017	May 2019	Hatch, Inc/Independence Excavating
Sewer Master Plan	Comprehensive plan of the sewer system, including risked based prioritization for internal inspection purposes and assessment of the four pump stations.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$500,000	Borrowed	March 2019	September 2019	N/A
2018 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,470,000	Borrowed	January 2018	March 2019	Independent Enterprises Inc.
2019 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	March 2019	March 2020	Independent Enterprises Inc.
2020 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2020	March 2021	N/A
2021 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2021	March 2022	N/A
2022 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2022	March 2023	N/A
2023 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	March 2023	March 2024	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2018 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following four sites have been identified: Ellsworth Avenue (695 linear feet of 20-inch vitrified clay, combined sewer main located 5135 Ellsworth Avenue), Oakwood Bridge (215 linear feet of 24-inch vitrified clay, combined sewer main located adjacent to the Oakwood Road Bridge), South 16th Street (700 linear feet of 20 and 24-inch vitrified clay, combined sewer main located under the Union Supply Company building, CSX railroad tracks, and the Three Rivers Heritage Trail), and Centre Avenue (575 linear feet of 15-inch vitrified clay, combined sewer main located under a 20-inch water main that serves UPMC Shadyside and a telecommunications duct bank.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$6,680,000	Borrowed	March 2018	December 2020	Michael Baker
2019 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following three sites have been identified: Flemington Street (740 linear feet of 15-inch and 20-inch vitrified clay, combined sewer main. located under 1075 Flemington Street and on an inaccesible steep slope (>35 percent) to Beechwood Boulevard), Washington Landing River Crossing (282 linear feet of 8-inch ductile iron, sanitary sewer main located under the Allegheny River), an Seaton Avenue (402 linear feet of 8-inch vitrified clay, sanitary sewer main. located under a building addition and swimming pool).	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,120,000	Borrowed	April 2019	June 2021	Issuing RFP for Consultant Selection
2020 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,400,000	Borrowed	August 2019	February 2022	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2021 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,415,000	Borrowed	August 2020	February 2023	N/A
2022 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,795,000	Borrowed	August 2021	February 2024	N/A
2023 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$8,055,000	Borrowed	August 2022	February 2025	N/A
2024 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$8,325,000	Borrowed	August 2023	February 2026	N/A
2019 Wastewater System Improvements	Reconstruction of existing structurally deficient sewer mains on Wiese Street, Wilbur Street, Creedmoor Avenue, Ornament Way, Cooperfield Avenue, N. Sheridan Avenue, Port Way, and Swimburne Street.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$5,350,000	Borrowed	August 2018	January 2021	N/A
2018 Sewer Rehabilitation (Annual IDIQ Contract)	Trenchless rehabilitation of less than 24-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$1,910,000	Borrowed	September 2018	September 2019	Insituform
2019 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,260,000	Borrowed	January 2019	April 2020	Wade Trim

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2020 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,500,000	Borrowed	June 2019	December 2020	N/A
2021 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$14,690,000	Borrowed	March 2020	September 2021	N/A
2022 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,090,000	Borrowed	March 2021	September 2022	N/A
2023 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,600,000	Borrowed	March 2022	September 2023	N/A
2024 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,820,000	Borrowed	March 2023	September 2024	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2020 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$3,800,000	Borrowed	February 2019	May 2020	Issuing RFP for Consultant Selection
2021 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,200,000	Borrowed	January 2020	April 2021	N/A
2022 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,310,000	Borrowed	January 2021	April 2022	N/A
2023 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,440,000	Borrowed	January 2022	April 2023	N/A
2024 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,570,000	Borrowed	January 2023	April 2024	N/A
31st Ward Sewer System Improvements	Evaluation to identify and locate the source(s) of the infiltration and inflow (I/I), removal of public I/I sources, and rehabilitation/replacement of the Rogers Street and Mifflin Road Pump Station and force main. Project will be designed and constructed in a minimum of two phases to ensure the pump stations are properly sized and the flow conveyed will not negatively impact the downstream sewer subshed.	Both sewage pump stations and the force main that convey flow to the Streets Run Sanitary Trunk Sewer were constructed in the late 1940's and are reaching the end of their useful life. Additionally, studies suggest this sewershed is significantly impacted by high levels of infiltration/inflow.	$13,700,000	Borrowed	March 2017	February 2021	Buchart Horn

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Larimer Avenue Sewer and 28th Street Stabilization	Evaluation of rerouting storm laterals, sewer televising, geotechnical investigations, and slope stabalization to address a structurally deficient 18-inch combined sewer that has severely eroded the ground surface on the slope below Brereton Street and above the Port Authority of Allegheny County's East Busway.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$695,901	Borrowed	January 2018	October 2019	Wood
Ivyglen and Odette Sewer Reconstruction and Separation Project	The installation of a new sanitary sewer and storm sewer on Odette and Ivyglen, which will eliminate the combined sewer outfall and a sewer on an unstable slope.	During the weekend of June 23, 2018, PGH2O was informed of a landslide that occurred in the hillside in rear of 2604 Ivyglen, which collapsed a manhole and potentially compromised the 8-inch sanitary sewer that exists on the slope. Considering the current steepness of the slope, the presence of Saw Mill Run at the toe of the slope, and the unknown location of the sewer, it does not appear that there is an expeditious and safe way to readily repair the sewer and/or protect the sewer from damage due to additional slope movements. Further disturbance of the slope with construction equipment could cause additional movements that could impact both the residential structure(s) at the crest and Saw Mill Run below. Additionally, the Odette Street sewer main is single combined sewer segment that overflows into the creek during wet weather events.	$1,900,000	Borrowed	July 2018	June 2019	Johnson, Mirmiran, Thompson, Inc./A. Merante
M-29 Outfall Improvements	Structural improvements and rehabilitation of the the M-29 combined sewer outfall diversion structure. Repairs to the diversion structure include lowering of the weir wall height and safety improvements for maintenance of the structure. The outfall pipeline requires extensive repairs and installation of a new flap gate to the outfall on the Monongahela River.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure.	$1,845,000	Borrowed	November 2018	November 2019	Johnson, Mirmiran, Thompson, Inc
2019 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,335,000	Borrowed	January 2019	April 2020	Independent Enterprises Inc.
2020 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,430,000	Borrowed	September 2019	April 2021	N/A
2021 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2020	April 2022	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2022 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2021	April 2023	N/A
2023 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,575,000	Borrowed	September 2022	April 2024	N/A
2019 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,565,000	Borrowed	January 2019	April 2020	Independent Enterprises Inc.
2020 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,805,000	Borrowed	September 2019	April 2021	N/A
2021 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,920,000	Borrowed	September 2020	April 2022	N/A
2022 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,150,000	Borrowed	September 2021	April 2023	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2023 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,400,000	Borrowed	September 2022	April 2024	N/A
2018 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	May 2018	September 2019	Michael Facchiano Contracting
2019 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2019	October 2020	N/A
2020 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,720,000	Borrowed	June 2020	October 2021	N/A
2021 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2021	October 2022	N/A
2022 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2022	October 2023	N/A
2023 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2023	October 2024	N/A
2018 Small Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. In 2018, the following mains have been selected for replacement: Hamilton Avenue from N. Dallas Avenue to N. Homewood Avenue; Railroad Street from 25th Street to 32nd Street; and S. Millvale Avenue from Liberty Avenue to Friendship Avenue.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,680,000	Borrowed	December 2017	December 2019	Johnson, Mirmiran, Thompson, Inc./ Frank J. Zottola, Inc.

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2019 Small Diameter Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,880,000	Borrowed	FMarch 2019	December 2020	Johnson, Mirmiran, Thompson, Inc.
2020 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$54,340,000	Borrowed	March 2019	December 2020	Buchart Horn & GAI Consultants, Inc.
2021 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$114,770,000	Borrowed	January 2020	December 2021	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2022 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$120,060,000	Borrowed	Janurary 2021	December 2022	N/A
2023 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$58,860,000	Borrowed	January 2022	December 2023	N/A
2024 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$60,700,000	Borrowed	January 2023	December 2024	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
District Water and Pressure Meters	Installation of water meters and pressure monitors in the distribution system to determine water usage and loss, and pressure loss.	Pressure Monitors are required per PUC. District Metering will be used for water auditing and leak detection.	$2,705,000	Borrowed	January 2019	October 2020	N/A
Ft. Duquesne Bridge Water Air Release	Perform transient analysis along existing 30-inch water main that is suspended from the Fort Duquesne Bridge. Design and construct new pipe supports, couplings, and thrust restraint based on the results of the analysis. Includes the replacement of the existing air-release valve on the 30-inch water main, including insulation or heat tracing to reduce potential for freezing and cracking of the valve.	A recent PENNDOT inspection of the Fort Duquesne Bridge identified priority code 1 defects in the support of the existing 30-inch diameter water main. Additionally, the existing 2-inch diameter air-release valve located on the main has a history of failure. The water main is located below the lower deck of the Fort Duquesne Bridge and serves as an emergency interconnection between pressure gradients and is a vital component to the system operation.	$2,850,000	Borrowed	January 2017	December 2019	GAI Consultants, Inc./ Advantage Steel & Construction, LLC
Washout Disconnection	Investigation and, if necessary, disconnection of large water main washouts from the sewer system.	A number of older washouts on larger mains were directly connected to sewers with a closed valve during construction. These washouts (cross connections) must be completely disconnected from the sewer.	$13,140,000	Borrowed	October 2018	September 2023	Awaiting Proposals to Award
2019 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,840,000	Borrowed	March 2019	March 2020	Buchart Horn
2020 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,975,000	Borrowed	March 2020	March 2021	N/A
2021 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,100,000	Borrowed	March 2021	March 2022	N/A
2022 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,245,000	Borrowed	March 2023	March 2024	N/A
2023 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,360,000	Borrowed	March 2024	March 2025	N/A
2019 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019	N/A
2020 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020	N/A
2021 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021	N/A
2022 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022	N/A
2023 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023	N/A
2019 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019	N/A
2020 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020	N/A
2021 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2022 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022	N/A
2023 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023	N/A
2018 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$43,300,000	Borrowed	March 2018	February 2019	A.Folino, A. Merante, Independent Enterprises, Petrakis, Frank A Zottola
2019 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$49,128,403	Borrowed/Grant	October 2018	February 2020	Independent Enterprises, Petrakis, Frank A Zottola
2018 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$2,980,134	Borrowed	December 2017	March 2019	Michael Baker
2019 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	April 2020	March 2020	N/A
2020 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	February 2019	March 2021	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2019 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections. In 2019, Rising Mains 3 and 4 from the Bruecken Pump Station have been selected for improvements, which is approximatly 2.3 miles of main.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Rising Mains 3 and 4 from Bruecken Pump Station to Highland 2 Reservoir were chosen for the 2019 Large Diameter Water Main Improvements Program due to their criticality when the clearwell is being rebuilt.	$23,550,000	Borrowed	February 2019	March 2022	N/A
2020 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$11,940,000	Borrowed	January 2019	August 2022	N/A
2021 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,170,000	Borrowed	January 2020	August 2023	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
2022 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,430,000	Borrowed	January 2021	August 2024	N/A
2023 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$26,410,000	Borrowed	January 2022	August 2025	N/A
Aspinwall Pump Station to Lanpher Reservoir Rising Main	Construction of a new, redundant rising main from Aspinwall Pump Station to Lanpher Reservoir.	The existing 60-inch rising main that supplies the Lanpher Reservoir is a 150 year old riveted steel pipe, has several tap connections to critical and bulk customers, and has experienced recent pipe failures. The proposed rising main would serve as a primary supply source for Lanpher Reservoir during the Clearwell Replacement Project and a redundant supply line in case of a failure or planned cleaning and rehabilitation of the existing 60-inch supply main.	$49,454,000	Borrowed	September 2018	September 2022	Michael Baker
Aspinwall Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The current pump station was constructed in 1914 and many of the components were installed in 1958.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff.	$29,690,000	Borrowed	May 2019	March 2023	N/A
Bruecken Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The pump station was constructed in 1931.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff. This project is a critical component of the clearwell replacement project.	$24,990,000	Borrowed	April 2019	February 2023	N/A

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Aspinwall Water Treatment Plant High Service Pump Station	In lieu of Aspinwall and Bruecken Pump Stations, a new high service pump station may be constructed to service Highland Reservoir 1, Highland Reservoir 2, Lanpher Reservoir, and Fox Chapel.	If this project moves forward, the Aspinwall Pump Station Imrpvements and Bruecken Pump Station Improvements Project would be reduced to only what is necessary to keep the stations operational until the new station is online. This project is a critical component of the clearwell replacement project.	$53,620,000	Borrowed	October 2018	February 2023	ARCADIS, Inc.
Ross Pump Station Improvements	Replacement of aged pump and valve equipment, meters, SCADA, electrical equipment, HVAC, and auxiliary systems and the rehabilitation of the building architectural and energy management systems.	The Ross Pump Station is the only feed to the water treatment plant. This station is in need of renewal.	$43,000,000	Borrowed	August 2018	TBD	ARCADIS, Inc.
Chlorine Booster Station Improvements	Rehabilitation or replacement of the existing sodium hypochlorite booster stations in the distribution system, excluding Lanpher and Herron Hill. Includes installation of flow meters, if necessary.	Existing chlorine injections systems at satellite storage facilities are in need of renewal. Without upgrade of these facilities, the system would be in violation of residual chlorine levels required by PA DEP.	$10,090,000	Borrowed	December 2018	December 2021	Issuing RFP for Consultant Selection
Garfield Tank Improvements	Perform a comprehensive inspection of the existing elevated storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional storage tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,050,000	Borrowed	September 2018	April 2021	N/A
Lincoln Tank Improvements	Perform a comprehensive inspection of the existing storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,195,000	Borrowed	September 2018	April 2021	N/A
Herron Hill Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Reservoir liner and cover is close to the end of its design life where patching and regular maintenance will no longer be effective.	$5,520,000	Borrowed	October 2018	December 2020	Awaiting Proposals to Award

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Lanpher Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Work required as a result of a failure of the reservoir floating cover in September 2017. Sodium hypochlorite feed system is reaching the end of its design life.	$29,643,000	Borrowed	September 2017	June 2019	ARCADIS Inc./Layfield, Frank J. Zottola
Highland No. 2 Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including new outlet piping for Highland Pump Station and Rising Main, Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Upgrade of outlet structure to allow increased capacity for the Highland Reservoir Pump Station. Replace liner and cover.	$27,510,000	Borrowed	March 2019	March 2022	N/A
Highland Reservoir Pump Station and Rising Main	Construction of a new finished water pump station and transmission main to supply water to the Highland No.1 Service Area from Highland No. 2 Reservoir	All compliant water supply for the Highland No. 1 Service Area currently flows through the Highland No. 1 Reservoir and the Membrane Filtration Plant (MFP) or directly into the system. There is no online storage for the system, and there is no other source water supply for the Highland No. 1 Service Area. In addition to providing alternate supply, this project will temporarily provide finished water that meets the chlorine disinfection rules to the Highland No. 1 Service Area during the Clearwell Replacement Project. Additionally, this new facility will also be designed to service the Garfield pressure district, thus eliminating the need to rehabilitate the (New) Highland Pump Station.	$37,130,000	Borrowed	March 2017	June 2022	Mott MacDonald
Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	Inspection and rehabilitation and/or replacement of the fiberglass reinforced plastic chemical tanks.		$294,000	Borrowed	April 2017	June 2019	Advanced Fiberglass Services
Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	Improvements to pretreatment chemical systems, clarifiers, sedimenation, and associated systems to provide enhanced water treatment.	Chemical treatment systems are a critical component to producing safe drinking water. Components of the chemical treatment systems can no longer be operated in a safe, effective, or reliable manner to meet water quality requirements. Many bulk water treatment chemicals present safety hazards to staff. The storage and pumping systems associated with these chemicals have reached the end of their useful life. Failures resulting in dust creation and chemical spills can place operators in unsafe working conditions and can cause physical damage to equipment and structures, as well as environmental contamination.	$27,310,000	Borrowed	March 2017	February 2023	ARCADIS, Inc./Wayne Crouse

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
Aspinwall Water Treatment Plant Electrical and Backup Power Improvements	Improvements to electrical systems at Aspinwall Water Treatment Plant, including provisions for backup power systems, upgrades to existing electrical distribution system, and replacement of motor control centers.	Electrical systems at the Aspinwall Water Treatment Plant have generally met the end of their useful lives and spare/replacement parts are unavailable. Electrical panels do not meet current safety standards, including lack of arc flash protection. Additionally, the Aspinwall Water Treatment Plant does not have redundant power systems or a means for stand-by power for critical pumping and treatment systems.	$26,520,000	Borrowed	March 2017	February 2023	Wood
Aspinwall Water Treatment Plant Raw Water Intakes	Project will include renewing or replacing the existing West and East Raw Water Intake Gate House buildings and associated systems, including gates, screens, and associated mechanical equipment as well as the addition of SCADA. Influent piping through the Ross Pump Station will also be addressed.	Only one intake is currently operable. Both intakes are in need of renewal.	$45,000,000	Borrowed	August 2018	TBD	ARCADIS, Inc.
Clearwell Emergency Response Project	Construction of piping, suction wells, if necessary, and appurtenances to bypass the existing clearwell.	This project will provide a means to bypass the existing clearwell. Note: Disinfection requirements will not be achieved while bypassing is occurring. Additionally, this infrastructure will be required to maintain water supply to PWSA's customers for the rehabilitation or replacement of the existing clearwell.	$27,670,000	Borrowed	March 2017	April 2022	Mott MacDonald, GAI Consultants Inc.
Clearwell Improvements	Replacement of the existing 108 year old, single cell clearwell (finished water structure). The clearwell was constructed in 1908 and has not undergone any major modifications or upgrades since. It has two main functions: providing equalization storage that allows the filters to operate independently of potential fluctuations in system demands and providing sufficient retention contact time for disinfection to meet the requirements of the Federal Surface Water Treatment Rule and Long-Term 2 Enhanced Surface Water Treatment Rule.	Considering the age and condition of the clearwell, it is the water system's weakest link as there are no practical means to deliver water by bypassing the clearwell, while maintaining the required volume, quality, and contact time.	$67,810,000	Borrowed	April 2019	March 2024	N/A
Corrosion Control Chemical Storage and Feed Systems	Installation of phosphoric acid storage and feed systems located at Aspinwall Pump Station, Bruecken Pump Station, and near the Membrane Filtration Plant to provide corrosion control in the distribution system.	Addition of a new corrosion control chemical was required per PA DEP Consent Order.	$3,960,000	Borrowed	May 2018	March 2019	Mott MacDonald/TEC
Highland Park Membrane Filtration Module Replacement Program	Replace membrane modules, which includes a total of 10 racks each with 80 modules. Note: Four racks were replaced in 2017.	Replacement necessary to maintain operation of the MFP.	$21,717,711	Borrowed	May 2017	January 2020	Pall Corporation
Highland Park Membrane Filtration Plant UV System	Installation of a UV treatment system and appurtenances at the Highland Park Membrane Filtration Plant (MFP).	To comply with the 1 log inactivation of Giardia cysts and the PADEP Administrative Order dated October 25, 2017.	$5,855,000	Borrowed	October 2017	April 2019	ARCADIS/Wayne Crouse

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service	Consultant/ Contractor
MFP Assessment and Critical Process Improvements	Complete a condition assessment of systems supporting the treatment process and perform critical improvements to maintain water treatment and allow full warranty of replacement modules. Improvements may include electrical, chemical feed, strainers, and other support systems.		$1,755,500	Borrowed	March 2017	December 2018	Pall Corporation
Water System GIS Improvements	Rescan Water Record Books, Input material and pipe age into GIS. Update valve layer.	GIS upgrade required in order to prioritize mains for renewal.	$1,200,000	Borrowed	May 2019	May 2021	N/A
Water Master Plan	Comprehensive plan, including analysis of demands, future demands, capacities, and pipe condition based assessment.	Master Plan required to prioritize water mains, pump stations, and storage for renewal, identify and refine future CIP projects.	$500,000	Borrowed	March 2019	October 2019	Mott MacDonald
Low Pressure Area Remediation	Fix chronically low pressure areas by either extending neighboring higher pressure districts into the area, booster pump stations, or household booster pumps.	This project is in response to the low pressure monitors required by the October 2017 Administrative Order.	$2,000,000	Borrowed	January 2019	January 2021	N/A

Notes:

Required per November 17, 2017 Consent Order and Agreement with PA DEP
Required per October 25, 2017 PA DEP Administrative Order
Projects noted in October 25, 2017 PA DEP Administrative Order

1. Pressure Sensors, as required by October 25, 2017 PA DEP Administrative Order purchased under Highland Park Membrane Filtration Plant UV System.
2. Bruecken Pump Station improvements required per October 25, 2017 PA DEP Administrative Order covered under existing project, Bruecken Pump Station Improvements, not listed on this table.

Exhibit RAW/C-30

MOTT MACDONALD

PGH2O

Alternatives Evaluation – Clearwell Redundancy Project

March 2017

Pittsburgh Water and Sewer Authority
ProjectWise/352812/Documents/Alternatives Evaluations Report/03-03-17 (Final)

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Alternatives Evaluation – Clearwell Redundancy Project

March 2017

Pittsburgh Water and Sewer Authority
ProjectWise/352812/Documents/Alternatives Evaluations Report/03-03-17 (Final)

Acknowledgement

This evaluation study could not have been developed or completed without the continuous support and contributions of the Pittsburgh Water and Sewer Authority staff. They provided unlimited access to the daily operational procedures and historical data necessary to prepare for this study. The PWSA staff contributed to the development of the meaningful criteria that was crucial for the final evaluation of the alternatives.

The Mott MacDonald project team also expresses a great appreciation to JA Cost Engineers and Advisors for their valuable and constructive suggestions during the development of the estimated planning level costs for each alternative.

Finally, on behalf of the project team and the PWSA staff, we express sincere gratitude to the representatives of the Safe Drinking Water Department of the Southwest Regional Office of the Pennsylvania Department of Environmental Protection for their valuable input and suggestions during the development of this study.

Issue and revision record

Revision	Date	Originator	Checkout	Approver	Descriptor

Information class: Standard

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Executive summary

Pittsburgh Water and Sewer Authority (PWSA) owns and operates a Drinking Water Treatment Plant (WTP) located along Freeport Road, just outside of Borough of Aspinwall. The WTP is a conventional surface treatment plant that draws water from the Allegheny River. The WTP facilities include raw water intake structures, the Ross Raw Water Pumping Station and Chemical Building, clarifier building, sedimentation basins, filtration building, fluoridation building, clearwell, the Aspinwall and Bruecken Pumping Stations, maintenance facilities, and the operations and laboratory building.

The clearwell was constructed in 1908 and has not undergone any major modifications or upgrades since then. The clearwell is located at the west end of the WTP and has two (2) main functions; providing equalization storage that allows the filters to operate independently of potential fluctuations in system demand and providing sufficient contact time for disinfection agent to meet the requirements of the Surface Water Treatment Rule (SWTR) and Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The clearwell feeds two (2) main pumping stations; the Bruecken Pumping Station that supplies water to the Highland No. 1 and Highland No. 2 Reservoirs and the Aspinwall Pumping Station that feeds Lanpher Reservoir and Fox Chapel area.

Since the clearwell has only one compartment, the entire plant must be shutdown to perform inspection and maintenance of the clearwell. The clearwell is the only component of the plant without any redundancy. PWSA is planning to upgrade the clearwell to:

- Provide two (2) separate compartments for redundancy.
- Rehabilitate the clearwell to correct structural deficiencies.

The rehabilitation work is anticipated to last approximately two (2) years at which time the clearwell will be out of service. With the clearwell out of service, additional improvements are necessary to provide the equalization storage and meet the disinfection requirements.

The main objective of this study is to develop conceptual solutions for the necessary improvements to the existing facilities and the addition of new facilities that would allow for a safe, reliable, and redundant water supply system without the functioning existing clearwell. This study includes an analysis and selection of the most viable and cost effective alternative.

Each alternative was evaluated based on economic and non-economic criteria. The final selection of the most viable alternative was a cooperative process among the report authors and PWSA's engineering, managing, water quality control, and operating groups that resulted in the selection of alternative with the highest ranking score.

The alternatives evaluated in this report include activities, upgrades, and new construction that will result in a mix of temporary and permanent facilities. However, this report does not discuss the rehabilitation and future use of the existing clearwell. There have been attempts in previous reports to evaluate condition of the existing clearwell and recommend generic rehabilitation activities. These reports make several assumptions, based on historical data, partial underwater inspection and generic industry proven activities in rehabilitation of the similar structures. This report strongly supports a detailed evaluation of the condition of the clearwell structure and mechanical condition of the associated equipment followed by

recommendations, design, and construction of the upgrades. The improvements to the existing clearwell can only be done after the new facilities are constructed and the existing clearwell emptied which will allow undisturbed access to the facilities.

This report presents six (6) alternatives for maintaining water supply to the PWSA's customers in the event that the existing clearwell is taken out of service for an extended period of time for repairs or replacement. The alternatives are described by their method of achieving the disinfection requirements and are as follows:

- Alternative 1 – Obtain Disinfection CT in Secondary Sedimentation Basins
- Alternative 2 – Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine
- Alternative 3 – Obtain Disinfection CT in New Filtered Water Clearwell at Sedimentation Basin
- Alternative 4 – Obtain Disinfection CT in Lanpher Reservoir and Highland No. 2 Reservoir
- Alternative 5 – Obtain Full System Disinfection CT in Lanpher Reservoir
- Alternative 6 – Obtain Full System Disinfection CT in Highland No. 2 Reservoir

As each of the above alternatives is presented, the following will be presented and discussed to assist in the final evaluation of each alternative:

- Disinfection method
- Storage and distribution
- Project implementation
- Cost estimate

Evaluation methodology

The evaluation and selection process will be based on a cost benefit analysis. Capital cost will be used as a primary economic factor due to the temporary nature of the majority of the proposed alternatives. The non-economic benefits for each alternative will also be determined using the ranking procedure described below. The economic and non-economic score will be combined into a cost benefit score. The maximum total score for the combined criteria is 100. The cost benefit score for each option will be compared and be used to select the most acceptable alternative.

Capital cost

For each alternative, capital costs were prepared. The capital costs were based on the development of a conceptual design for each alternative. The conceptual design is based on providing a maximum treated water capacity of 117 MGD and delivering the following peak flows:

- Lanpher Reservoir Supply System: 28 MGD
- Highland No. 1 Reservoir Supply System: 56 MGD
- Highland No. 2 Reservoir Supply System: 32 MGD

The capital costs were developed in accordance with the American Association of Cost Engineers International (AACEI) Recommended Practice No. 18R-97 "COST ESTIMATE CLASSIFICATION SYSTEM. AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES." These estimates are considered to be "Class 4, Feasibility Level." In accordance the AACEI 18R-97 a 40 percent contingency was applied to each estimate.

The estimates were based on the following criteria:

- Division 0 costs were based on 5 percent of the total estimated construction cost without the contingency.
- Division 2 site work costs were based on takeoffs for site piping and earthwork.
- Division 3 concrete costs were based on takeoffs using a unit concrete price of $1,000 per cubic yard.
- Divisions 4 through 10 superstructure were based on the building area and a unit price of $100 per square foot.
- Division 11 equipment was based on:
  - Vendor equipment quotes.
  - Labor for installation based on 70 percent of the equipment quote.
  - Overhead and profit based on 15 percent of the equipment.
  - Interior piping was estimated based on piping take offs and unit pricing from similar projects.
- Division 13 instrumentation and control was based on 15 percent of the total of Division 11.
- Division 15 HVAC and plumbing was based on 5 percent of the total of Divisions 3 through 11.
- Division 16 electrical was based on:
  - Vendor equipment quotes.
  - Cost data from similar projects. The electrical cost does not include any upgrades to the existing emergency generators.
- The contingency was estimated based on 40 percent of the total of Division 0 through 16.
- Design Engineering, Construction Management, Legal, Project Management Costs were estimated at 25 percent of Division 0 through 16 plus the contingency.

Operation and maintenance costs and life cycle cost

Standard practice in evaluation of economic factors for a multiple-alternative type of project includes evaluation of operation and maintenance costs and summarizing final values in life cycle cost values for each alternative. Typically a present worth cost is used for the lifecycle cost. The present worth cost converts the annual O&M cost to a current cost and that adds this to the capital cost. The annual O&M cost for the alternatives ranges between $50,000 and $450,000 and as all of the alternatives will be in service for approximately two (2) years, the present worth of the O&M costs will be less than $1 million whereas the capital cost of all the six (6) alternatives will be much higher. Since the capital cost for each alternative is by far the greatest portion of the total life cycle cost that even for alternatives with proposed long-term new facilities, the impact of annual operation and maintenance cost and its life cycle value would impact overall economic ranking.

Non-economic criteria

Non-economic criteria will include factors that have a significant impact on efficiency, productivity, ease of operation, etc. All alternatives must completely meet the rudimentary requirements such as flow and water quality standards.

The non-economic criteria is as follows:

- Permitting and implementation schedule
- Water quality impact
- Operation and maintenance
- Sustainability
- Long-term benefits and infrastructure renewal
- Constructability
- Operations risk

List of alternatives

1. Alternative 1

For this alternative, the detention volume in the water treatment plant's existing secondary sedimentation process would be used to achieve the plant's required disinfection using free chlorine for one-log Giardia and two-log virus inactivation. This method of achieving disinfection would be used on a temporary basis during clearwell rehabilitation or replacement.

For the purposes of this evaluation, it is proposed that this alternative will require the following improvements for implementation of the alternate disinfection method:

- Bench testing/demonstration testing to determine chlorine demand and DBP formation impacts.
- Tracer testing to confirm appropriate baffling factors for sedimentation basins.
- New sodium hypochlorite feed pumps, located in the Sodium Hypochlorite Building, for new clarifier effluent feed point.
- New sodium hypochlorite injection point at clarifier effluent flume outlet including chemical piping and diffusers.
- Sample pump and piping system and chlorine residual and pH analyzers for the Central Receiving Basin inlet and effluent and the East and West Sedimentation Basin effluents. Equipment could be located in the Old Administration Building.
- Cleaning of the sedimentation basins
- Sedimentation basin covers; floating covers were used for the cost estimate

a. Description of storage and distribution

In order to provide an uninterrupted, safe, and reliable water supply throughout the system during the clearwell rehabilitation/replacement work, changes to the current pumping operation and distribution would have to be made.

The Aspinwall Pump Station must maintain its capacity at the established maximum demand, estimated at 19,440 gpm (28 MGD). Under this scenario, Pump Nos. 3 and 4 would be equipped with new motors and variable frequency drives (VFD) to allow for the safe and timely operation of the pumps. The pump synchronous type motors will be replaced with induction-type rated for inverter duty. The existing breakers should be used to feed the variable frequency drives, thereby using the existing 2400 volt switchgear merely as a means of disconnect and feeder protection. In the event that the size of the motors are changed, the disconnects and the electrical feeders will have to be evaluated to determine if they are compatible with the new motors' rating. The pumps' speed would be automatically adjusted to maintain a narrow level band in the suction well. The average demand in the Lanpher Reservoir supply

district is estimated at 17.6 MGD. For the majority of time this demand will be met by only one (1) pump in service; however, the peak or the extreme demand conditions (even in case of a failure of Pump No. 4), can be met by utilizing any combination of the four (4) pumps.

The suction well should be sized to allow for the change in the elevation span to occur in no sooner than 5 to 10 minutes. This would require a minimum pumping volume of 95,000 gallons for a 4-foot operating band. An approximately 25-foot deep suction well with an emergency overflow line would be constructed at the best available location, either west or east of the pump station. For this arrangement, a common suction well supply line for both Bruecken and Aspinwall Pump Stations sites would be constructed with minimum interruption of the ongoing operations.

A new 84-inch by-pass line would be constructed between the existing clearwells influent and effluent gate house, which would connect to the existing pair of 72-inch Bruecken Pump Station supply pipes under the Allegheny River. In order to provide an uninterrupted and reliable operation of pumps at the Bruecken Pump Station, a suction well would be constructed in the yard next to the pump station. A pumping volume of 300,000 gallons would be needed to allow for a smooth pumping operation, maintaining the level in the suction well between approximate elevations of 743 and 747 feet. This would require the construction of, at minimum, 10,000 sq. ft. structure along with an emergency overflow and associated equipment and instrumentation.

Pump Nos. 2, 3, 5, and 6 would be equipped with variable frequency drives. This would allow for tight control of continuous pumping operations while delivering the required system demands. The pump synchronous type motors will be replaced with an induction type rated for inverter duty. The existing starters should be replaced with variable frequency drives using the existing 2400-volt switchgear merely as a means of disconnect and feeder protection.

The peak flow to the Highland No. 2 Reservoir would be delivered by Pump Nos. 5 and 6 while Pump Nos. 2 and 3 would be used to pump the peak demand to Highland No. 1 Reservoir.

This report acknowledges that the existing pumps, motors and ancillary equipment are rapidly approaching the end of its useful life. Although this report is focusing on clearwell rehabilitation, it is important to acknowledge that an upgrade or replacement of other equipment would improve efficiency, reliability and cost of future operations.

b. Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefit of the temporary facilities; including reservoirs, pipes, process equipment, electrical equipment, and all other facilities. The additions to the treatment process (additional chemical feed locations and equipment) will remain in place and could potentially be reused in the future if needed. The upgrade of Aspinwall and Bruecken Pump Stations consisting of the replacement of the motors and addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied structure should be considered. For example, at the Bruecken Pump Station site, the suction well could potentially be built to allow for the future addition of some type of super structure that could be used in day to day operations.

c. Cost estimate

The estimated capital cost for the implementation of Alternative 1 is $50,360,000.

2. Alternative 2

For this alternative, ultraviolet (UV) disinfection would be used to achieve credit for one-log Giardia inactivation and free chlorine would be used in a new, smaller clearwell to achieve two-log virus inactivation. This method of achieving disinfection would be required on a temporary basis during clearwell rehabilitation or replacement but would involve the installation of a permanent UV facility that may provide added long-term treatment benefits. New pump suction equalization well and pump modifications for the Aspinwall and Bruecken Pump Stations' pumps would be required.

In addition to the disinfection requirements, the new 1.1-million-gallon clearwell will have the extra volume necessary to provide for continuous pumping utilizing pumps driven by VFDs. A 25-foot deep suction well/clearwell with an emergency overflow line would be constructed east of the pump station. The new clearwell would receive the filtered water after passing through the new UV facility. The suction well would be configured with a system of baffle walls to provide short circuiting and ensure required CT.

New feeders to power the UV reactors would be provided. The UV equipment would be supplied power from the 480-volt secondary system motor control center. New circuit breakers would need to be installed in the motor control center (MCC) to protect the new feeders. In the event that no space is available, an additional cubicle would need to be added or an available power panel could be used or added to the system for this purpose.

a. Long-term benefits

The addition of the UV facility to the treatment process would be a permanent upgrade that would result in enhanced water quality. The 44-million-gallon existing clearwell could be rehabilitated, reconfigured, or used in the future as an additional storage for the system. An upgrade of the Aspinwall and Bruecken Pump Stations consisting of the replacement of the motors and addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied structure should be considered.

b. Cost estimate

Estimated capital cost for the implementation of Alternative 2 is $38,500,000.

3. Alternative 3

For this alternative, either the west sedimentation basin or the central receiving basin structures would be modified and converted to a finished water clearwell to achieve the plant's required disinfection for one-log Giardia and two-log virus inactivation using free chlorine. This method of achieving disinfection would be used on a temporary basis during clearwell rehabilitation or replacement. A new, permanent or temporary, filtered water pump station, sized for the full plant capacity (117 MGD) along with conveyance lines to and from the sedimentation basin area would be required.

a. Description of disinfection method

This disinfection alternative would use a modified sedimentation basin structure as a finished water clearwell to achieve the plant's disinfection requirements while maintaining the plant's existing target effluent free chlorine concentration of approximately 0.7 mg/L. Either the west sedimentation basin or the central receiving basin could be modified and converted into a clearwell. Both options would require that the converted sedimentation basin be lined and covered.

Even with the reduced sedimentation volume, there is still significant detention time available, greater than 24 hours of detention during average conditions. This detention time will still provide significant mitigation of water quality impacts due to clarifier upsets or poor raw water quality events. Should the PWSA have concerns related to the reduced sedimentation volume, options such as installing tube settlers in the clarifiers or sludge removal systems in the sedimentation basins may be considered to enhance the performance of those systems. However, these enhancements are not a requirement of this alternative and therefore, are not included as part of the proposed improvements for this alternative.

It is proposed that this alternative will require the following improvements for its implementation:

- New 117 MGD low lift filtered water pump station with force main to the new clearwell in Sedimentation Basin Area.
- New finished water gravity mains from Sedimentation Basin Area to Aspinwall and Bruecken Pump Station suction lines.
- Clearwell options:
  - Cleaning, covering/lining, and converting west sedimentation basin to finished water clearwell. This would require modifications to the basin inlet and outlet piping configurations.
  - Cleaning, covering/lining, baffling, and converting central receiving basin to finished water clearwell. This would require modifications to the basin inlet and outlet piping configurations.

b. Description of storage and distribution

The report reviewed three (3) options based on the similar concept as laid out in this alternative; the use of the west sedimentation basin as the temporary clearwell; the use of the west sedimentation basin as the permanent clearwell; and the use of the central sedimentation basin as the permanent clearwell. Each of the three (3) options would require construction of a permanent or temporary pumping station designed to lift the maximum capacity flow (117 MGD) from the filter effluent to the high water elevation of the existing sedimentation basins (future temporary or permanent clearwell). As shown in Figure 3.12, the low service pump station would be located in the general location between the filters and the Aspinwall Pump Station and would house four (4) vertical either turbine or axial flow low head high flow pumps, three (3) duty and one (1) stand-by, each with the design capacity of 27,000 gpm at 42-foot TDH. All the flow would be conveyed through a new 60-inch force main. Flow from the clearwell would be conveyed via a 96-inch gravity line back to the Aspinwall Pump Station general area where it would be split and connected to suction lines feeding the Aspinwall and Bruecken Pump Stations. Both the force main and the feedback gravity line will be constructed in the same corridor, within the right of way of Delafield Avenue.

This alternative would require a completely new electrical design; from the interface with the power utility's transformer's secondary to new main and secondary voltage systems. This would entail a design of the main medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/volts. The secondary voltage system would supply power for the low lift pumping station's auxiliary equipment including lighting, ventilation, and low voltage process equipment.

For a temporary solution, the pump station would be established as a temporary facility with the series of rental pumps capable of delivering the required flow.

The existing sedimentation basins are 19 feet deep, with the bottom elevation at 751 feet. The assumed maximum water elevation in the new clearwell would be 768 feet. This elevation would have an impact on pumping capacity and characteristics of the Aspinwall and Bruecken Pump Stations. In both cases,

the average suction head would increase by approximately 15 feet. This may result in an increased pumping capacity; however, due to the uncertainty of the available data and the age and condition of the existing pumps, this could also result in unfavorable hydraulic conditions, with pumps operating outside of the preferred operating range. As a solution, the pumps could be equipped with the new induction motors and variable frequency drives which would allow operators to mitigate these unfavorable hydraulic conditions.

The conversion of the sedimentation basins into a finished water clearwell would also impact the future utilization of the existing clearwell. The existing clearwell (after the rehabilitation) would be hydraulically disconnected from the system since the hydraulic grade is approximately 20 feet below the grade of the new clearwell (converted sedimentation basin), making it unusable for storage except in case of the emergency.

c. Long-term benefits

The conversion of the sedimentation basin to the new finished water clearwell will have an impact on future operations. The permanent conversion would reduce the secondary sedimentation volume but is not anticipated to have an impact on future water quality. The construction of a new clearwell would allow the PWSA to have multiple options related to the utilization of the existing clearwell, from the emergency (or primary) finished water clearwell to an altogether different use of the available location.

d. Cost estimate

The estimated capital cost for the implementation of Alternative 3 (permanent conversion of west sedimentation basin) is $72,010,000.

4. Alternative 4

For this alternative, the required disinfection CT would be obtained at Lanpher Reservoir and at Highland No. 2 Reservoir. This use of the reservoirs to achieve required disinfection would be a temporary solution while the rehabilitation or replacement of the existing clearwell takes place.

a. Description of disinfection method

This disinfection alternative would use both the Lanpher Reservoir and rising main and the Highland No. 2 Reservoir to achieve the full system disinfection CT requirements. The Lanpher Rising Main and two (2) compartment Lanpher Reservoir would be used to achieve the required CT for the Lanpher and Fox Chapel service areas. Highland No. 2 Reservoir would be used to achieve the required CT for the Highland No. 1 Reservoir and Highland No. 2 Reservoir service areas. For the Lanpher Reservoir and Fox Chapel service areas, the water would not be potable until after it has travelled through the rising main and reservoir for disinfection. Since the Lanpher Reservoir's existing single rising main serves customers prior to the reservoir, a second redundant rising main is proposed. With a second redundant rising main, one (1) of the two (2) rising mains would operate in rising mode with the sole function of filling the reservoir. The second rising main would operate in return mode to serve potable water to the customers that are currently served by the existing single rising main.

The existing and proposed new Lanpher Rising Mains are each approximately 22,000 feet long. The existing rising main is 60-inch diameter. The size of the proposed new rising main is yet to be determined but would be a minimum of 48-inch diameter, as detailed in the Aspinwall – Lanpher Rising Main Report. The executive summary of the report is presented in Appendix C of this report

Implementation of primary disinfection at the two (2) reservoirs would require several infrastructure improvements. The first step in the implementation of this alternative at Lanpher Reservoir would be the construction of a new Lanpher Reservoir Rising Main.

The most substantial infrastructure improvement required at this reservoir is a new pump station to transfer finished water from Highland No. 2 to the Highland No. 1 service area to meet the demands of the Highland No. 1 system. The new pump station would house the new booster chlorination facilities.

In summary, it is proposed that this alternative will require the following improvements:

- Lanpher Reservoir
  - New rising main.
  - New booster chlorination facilities, housed in a new structure, with a 6,000 gallon bulk storage tank, a day tank, feed pumps for 12.5 percent sodium hypochlorite.
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines
- Highland 2 Reservoir
  - New transfer pump station between Highland No. 1 and Highland No. 2 service areas.
  - Condition assessment and rehabilitation of the Highland 2 Reservoirs two rising mains.
  - New booster chlorination facilities, housed in the new pump station, with two (2) 6,000 gallon bulk storage tanks, a day tank, feed pumps for 12.5 percent sodium hypochlorite
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines

b. Description of storage and distribution

A new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would be constructed.

Similar to Alternatives 1 and 2, a suction well would be constructed at one of the proposed locations to provide for an adequate pumping volume. Depending on the selected size of the new rising main, there may be a need to install new pumps that would pump at a higher total dynamic head due to the selected smaller diameter of the new rising main. At this stage of planning, it will be assumed that new pumps, motors, and drives will be installed. Preliminary evaluations indicate that limited structural improvements would be made to accommodate the installation of the new drives.

The pumping operation for the Fox Chapel service areas would remain the same, utilizing the existing pumps with new variable speed drives as booster pumps. Slight adjustments (using multiple pumps) in operations may be required on a temporary basis if available pressure in the Lanpher service areas falls below certain set points due to high demands.

An 84-inch bypass line around the clearwell would be connected to the pair of 72-inch Bruecken Pump Station suction feed lines. The maximum demand at the Bruecken Pump Station is estimated to be around 61,000 gpm. The entire volume under this alternative would be pumped to the Highland No. 2 Reservoir through a pair of 48-inch rising mains. The increase in flow would result in higher head loss. A preliminary hydraulic analysis indicates that the total dynamic head (TDH) at the maximum flow to Highland No. 2 Reservoir is 252 feet. The design capacity of each of the three (3) existing pumps (5, 6, and 7) according to the manufacturer's data is 19,450 gpm at 365 feet for Pump No. 5 and 16,670 gpm at 272 feet of TDH for Pump Nos. 6 and 7. The lack of exact operating data (flow and corresponding system head) prevents a confirmation of the preliminary hydraulic analysis. For cost estimating purposes, this report will assume that three (3) new pumps would replace the existing Pump Nos. 5, 6, and 7; however, it may be prudent to conduct a flow/pressure monitoring test during the early design phase to

confirm that the pumps operate at the design conditions. If the test shows that the existing pumps put out flow in excess of the design capacity, the existing pumps could be utilized.

The new pumps would be driven by VFDs to allow for future operation at decreased capacity (after the rehabilitation of the existing clearwell). The new motors are slightly larger than the existing motors. In all cases, the existing synchronous motors would be replaced with inverter duty-rated induction motors with variable frequency drives and new switchgear and feeders. The proposed size of the motors will require a new electrical service for this facility. It is recommended that this service be provided at 4160 volts. The new switchgear could then be permanently connected to the standby generator/generators.

In order to provide a smooth and reliable operation of pumps at the pump station, a suction well of sufficient pumping volume would be constructed in the yard next to the pump station. The pumping volume would be determined to allow for a smooth pumping operation, maintaining the level in the suction well between 743 and 747 feet. This would require the construction of, at a minimum, a 10,000 sq. ft. structure as shown in Figure 3.16.

As discussed earlier, the Highland No. 2 Reservoir would be used to obtain the required disinfection contact time. In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer required volume from Highland No. 2 to Highland No. 1 Reservoir via a newly constructed pump station as shown in Figure 3.20. Two (2) alternative locations and supply transmission main alignments are selected. Both locations' properties are owned by the City of Pittsburgh, easily accessible, and close to all needed utilities. The final location and the alignment should be selected during the early phase of the project design. The pump station would match the maximum capacity of the existing Highland No. 1 distribution system. It will house three (3) 1,000 HP pumps capable of delivering a total of 38,000 gpm at approximately 120 TDH via a new 48-inch supply main. The pumps would be equipped with VFDs and controlled via a pressure indicating control system. The new force main will connect with the two (2) 48-inch rising mains that currently supply the Highland No. 1 Reservoir.

The Highland No. 2 Pump Station would require a completely new electrical service for the facility. This would include new main and secondary voltage systems switchgear. This would entail the installation of a new medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/208 volts. The secondary voltage system would supply power for all pumping station's auxiliary equipment including lighting, ventilation, and low voltage process equipment. The design would incorporate induction motors rated for inverter duty, controlled by VFDs to provide optimized pump performance not available with soft starters. The system would incorporate means to provide a second source of power to ensure redundancy.

c. Long-term benefits

An upgrade of the Aspinwall and Bruecken Pump Stations that would consist of the replacement of the pumps, motors, and the addition of variable speed drives is timely considering the age and condition of the existing equipment and should be carefully selected to account for future inevitable upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied space should be considered. For example, at the Bruecken Pump Station, the suction well could potentially be built to allow for the future addition of some type of super structure that could be used in day to day operations.

The addition of the new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would have a significant impact on reliability and efficiency of the water supply within the Lanpher Reservoir supply district.

The construction of a new Highland No. 2 Pump Station would also improve the system's reliability, provide redundancy in supply (in case of a micro filtration plant failure), and allow for more control over the demand and supply balance.

d. Cost estimate

Estimated capital cost for the implementation of Alternative 4 is $152,730,000.

5. Alternative 5

Under this alternative, the full system required disinfection CT would be obtained at Lanpher Reservoir. This is a temporary solution while the rehabilitation or replacement of the existing clearwell takes place. The Highland No. 2 Reservoir would float off of the Lanpher Reservoir with a new main in conjunction with an existing main below the Allegheny River. The Lanpher Reservoir would require a new dedicated rising main and a new transfer pump station from Highland No. 2 Reservoir to Highland No. 1 Reservoir would be required to supply disinfected water to the Highland No. 1 service area.

a. Description of disinfection method

This disinfection alternative would use the two (2) compartment Lanpher Reservoir to achieve the full system disinfection CT requirements.

Implementation of primary disinfection at Lanpher Reservoir would require several infrastructure improvements. The first step in the implementation of this alternative at Lanpher Reservoir would be the construction of a new Lanpher Reservoir rising main. Additional required infrastructure for implementing primary disinfection at the Lanpher Reservoir include a water quality sampling system at the inlet and outlet of the Lanpher Reservoir that includes chlorine residual and pH analyzers. Also required are new automated booster chlorination facilities with new sodium hypochlorite storage facilities and metering pumps that can supplement the residual entering or leaving the reservoir as needed to maintain disinfection CT and desired distribution system chlorine residual. Required infrastructure improvements related to conveying potable water from Lanpher to the Highland Nos. 1 and 2 areas, including a new main below the Allegheny River and a new Highland No. 2 Pump Station are discussed.

It is proposed that this alternative will require the following improvements for implementation of this reservoir primary disinfection alternative:

- Lanpher Reservoir
  - New rising main.
  - New booster chlorination facilities, housed in a new structure, with two (2) 6,000-gallon bulk storage tanks, a day tank, and feed pumps for 12.5 percent sodium hypochlorite. The use of two (2) bulk tanks instead of one (1) larger tank would provide additional operational flexibility.
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines.

- Highland No. 2 Reservoir
  - New transfer pump station between Highland No. 2 and Highland No. 1 service areas.
  - New booster chlorination facilities, housed in the new pump station, with two (2) 6,000-gallon bulk storage tanks, a day tank, feed pumps for 12.5 percent sodium hypochlorite.
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines.

b. Description of storage and distribution

A new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would be constructed.

Under this scenario, the Highland No. 2 Reservoir would be floated off of Lanpher Reservoir via the existing 48-inch connection under the Allegheny River. According to the PWSA staff, this connection was used in the past on an emergency basis. An alternative approach would be to construct a new pipe across the Allegheny River. Prior to any design work, the existing 48-inch connection must be inspected.

In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer the required volume from the Highland No. 2 to the Highland No. 1 Reservoir via a newly constructed pump station. The capacity of this pump station would match the maximum capacity of the existing Highland No. 1 distribution system.

c. Long-term benefits

An upgrade of the Aspinwall Pump Station consisting of the replacement of the pumps and motors and addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facility will primarily be a temporary structure.

The addition of a new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would have a significant impact on the reliability and efficiency of water supply within the Lanpher Reservoir supply district. It would provide redundancy in the water supply for that area thus, significantly lowering risks in the current supply operations due to the age and conditions of the existing 60-inch rising main.

The construction of the new Highland No. 2 Pump Station will also improve the system's reliability, provide redundancy in the water supply (micro filtration plant failure), and allow for more control over the demand and supply.

d. Cost estimate

Estimated capital cost for the implementation of Alternative 5 is $147,860,000.

6. Alternative 6

Under this alternative, the full system required disinfection CT would be obtained at Highland No. 2 Reservoir. Lanpher Reservoir would be floated off of Highland No. 2 Reservoir via either the existing 48-inch connection or a new connection across the Allegheny River. The Aspinwall Pump Station pumps that feed the Lanpher Reservoir rising main would not be operated under this alternative, and the rising main would be back-fed from the Lanpher Reservoir service area to serve the customers along the rising main and supply the Fox Chapel Pumps at the Aspinwall Pump Station. Prior to any work, the conditions of the existing dual 48-inch rising main must be evaluated and subsequent rehabilitation conducted due to the significant increase in pressure. A new transfer pump station from Highland No. 2 to Highland No. 1 would be required to supply disinfected water to the Highland No. 1 service area. Like Alternatives 4 and 5, the infrastructure improvements that are required to make this alternative viable hydraulically will have

permanent benefits with respect to the reliability and redundancy of the PWSA's distribution system infrastructure.

a. Description of disinfection method

This disinfection alternative would use the Highland No. 2 Reservoir to achieve the full system disinfection CT requirements.

Implementation of primary disinfection at Highland No. 2 Reservoir would require infrastructure improvements. The most substantial infrastructure improvement required at this reservoir is a new pump station to transfer the demands of the Highland No. 1 system from the Highland No. 2 Reservoir to the Highland No. 1 service area. The new pump station would house the new booster chlorination facilities.

In summary, it is proposed that this alternative will require the following improvements for implementation of this reservoir primary disinfection alternative:

- Highland No. 2 Reservoir
  - Rehabilitation of a pair of 48-inch rising mains from the Bruecken Pump Station to Highland No. 2 Reservoir.
  - New transfer pump station between Highland No. 2 and Highland No. 1 service areas.
  - New booster chlorination facilities, housed in the new pump station, with two (2) 6,000-gallon bulk storage tanks, a day tank, and feed pumps for 12.5 percent sodium hypochlorite
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines.

b. Description of storage and distribution

This disinfection alternative would use the Highland No. 2 Reservoir to achieve the full system CT. The Lanpher Reservoir would float off of the Highland No. 2 Reservoir with the existing 48-inch interconnecting main below the Allegheny River or a newly constructed parallel connection. A new transfer pump station from Highland No. 2 to Highland No. 1 would be required to supply disinfected water to the Highland No. 1 service area.

In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer the required volume from Highland No. 2 to Highland No. 1 reservoir via a newly constructed pump station. The capacity of this pump station would match the maximum capacity of the existing Highland No. 1 distribution system.

Under this scenario, the Lanpher Reservoir would be floated off of the Highland No. 2 Reservoir via the new or existing 48-inch connection under the Allegheny River. The existing 48-inch main must be inspected prior to any design work.

c. Long-term benefits

An upgrade of the Bruecken Pump Stations consisting of a replacement of the Highland No. 2 designated pumps, motors, and the addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades.

The construction of the new Highland No. 2 Pump Station would also improve system's reliability, provide redundancy in supply (micro filtration plant failure), and allow for more control over the demand and supply.

d. Cost estimate

Estimated capital cost for the implementation of Alternative 6 is $83,660,000.

Alternatives evaluation

The selected alternatives will be based on a cost benefit analysis which will include analysis of economic and non-economic factors.

Economic factors

The economic factors used in evaluation of each alternative are capital (project construction costs and operation and maintenance cost (O&M)). Standard industry practice is to convert these costs to a present-worth values applying a 20-year project-life and certain percentage interest rate. Due to the mix of temporary and permanent solutions needed to achieve the project objectives and the limited time of their utilization (until the rehabilitation of the existing clearwell is completed), the 20-year present worth evaluation would not provide beneficial input to the decision making process.

Non-economic factors

The first step in the evaluation of the alternatives based on non-economic criteria was to assess the degree of importance of each non-economic criterion which would result in assigning the maximum point value to each of them. This was a collaborative process that included all groups within the PWSA staff; management, water quality and operations, and maintenance.

The maximum number of points allocated to the non-economic scores is 55. The criterion with the highest number of points is Long-Term Benefits and Infrastructure Renewal. The majority of the equipment and infrastructure directly affected by the activities in the proposed alternatives are approaching the end of their designed life. Pumps, motors, electrical equipment, and other ancillary equipment have become increasingly more difficult to maintain in designed conditions and spare parts are not readily available, exposing the day-to-day operation to a greater risk of failing or underperforming. In addition, some of the proposed new infrastructure items, such as new rising mains, pumping stations, etc., would have a significant, long-term positive impact on the security and efficiency of the City of Pittsburgh's water supply system and may be necessary and long needed regardless of the need for the clearwell rehabilitation.

Alternative rankings

As per the methodology described in Section 3 and throughout Section 4 and based on the assignment of points for economic and non-economic factors, Table 4.12 presents the initial matrix of values for each alternative.

Table 37: Alternative operations risk ranking

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Economic						
Project cost	50.3	38.5	72	152.7	147.9	83.7
Economic score	**34**	**45**	**24**	**11**	**12**	**21**
Non-economic						
Permitting and implementation schedule	1	2	2	3	2	3
Water quality impact	1	5	2	4	3	3
Operation and maintenance	4	2	3	2	2	2
Sustainability	5	3	1	3	3	3
Long-term benefits and infrastructure renewal	3	7	10	25	25	14
Constructability	5	5	3	1	1	2
Operations risk	4	4	5	3	3	2
Total non-economic score	**23**	**28**	**26**	**41**	**39**	**29**
Total score	**57**	**73**	**50**	**52**	**51**	**50**

Conclusions and recommendations

The ranking of alternatives followed criteria and ranking procedures set by an initial screening process based on similar project evaluations. However, each project has its own set of conditions, circumstances, and specific requirements. The ranking matrix shows that for the set of initially assumed values for each ranking criteria, Alternative 2 – Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine has the highest score and may be considered as the selected alternative. It is apparent that this alternative highest score derives from the significantly lower capital construction cost than any other alternative. However, the capital cost needed to implement other alternatives also includes the cost associated with either items that could be considered regular maintenance such as in the case of Alternatives 1 and 3, cleaning and deposing of sludge sediment at an estimated cost of nearly $15,000,000 or items that could be considered long-term assets that are needed to ensure the reliability and redundancy of the City of Pittsburgh's water supply system. An example of such items are the construction of a new Aspinwall – Lanpher Rising Main (Alternatives 4 and 5) which would ensure the much needed reliability of the aging water supply system at the Lanpher Reservoir supply area (estimated planning level value of $55 million) and the construction of the new Highland No. 2 Pump Station and the transmission main, which would increase the reliability of the Highland No. 1 Reservoir supply area at an estimated planning value of $29 million (Alternatives 4, 5, 6).

Since these items are not only needed during the clearwell rehabilitation but also would significantly improve the reliability and efficiency of the entire water supply system, the following pages present a discussion of the alternatives' ranking evaluation and decision making process when a higher importance is assigned to the long-term benefits and infrastructure improvements.

A sensitivity analysis was performed to determine the rankings of the alternatives when more points are assigned to the long-term system benefits and infrastructure renewal factors.

Table 40 shows that assigning the Long-Term Benefits and Infrastructure Renewal criteria a total of 40 points and decreasing the economic factors to a total of 30 points brings Alternatives 4 and 5 to the top of ranking with the highest assigned score of 64 points for Alternative 4.

In conclusion, this analysis shows that if the economic factor (construction capital cost) is deemed the most important factor, Alternative 2 appears as the highest ranking alternative. If the decision-making process considers the water supply system's long-term benefits and infrastructure renewal factor as significant or even more significant, other alternatives, especially Alternatives 4 and 6, emerge as the highest ranking alternatives.

Finally, Table 41 compares the costs for each alternative, provides a breakdown of costs for long-term system beneficial infrastructure improvements, and highlights some tangible and intangible benefits for each alternative.

Table 40: Alternative ranking sensitivity analysis 30 to 70 non-economic to economic ratio

ECONOMIC SCORE		max	30				
			Economic Score				
	1	**2**	**3**	**4**	**5**	**6**	
Project cost	50.3	38.5	72	153	148	84	
Economic score	**23**	**30**	**16**	**8**	**8**	**14**	
NON ECONOMIC SCORE							max points
			Permitting and implementation				3
			Water quality impact				5
			Operation and maintenance				5
			Sustainability				5
			Long-term benefits and infrastructure renewal				40
			Constructability				5
			Operations risk				7
						TOTAL	70
			Factor of max points				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	0.33	0.67	0.67	1.00	0.67	1.00	
Water quality impact	0.20	1.00	0.40	0.80	0.60	0.60	
Operation and maintenance	0.80	0.40	0.60	0.40	0.40	0.40	
Sustainability	1.00	0.60	0.20	0.60	0.60	0.60	
Long-term benefits and infrastructure renewal	0.12	0.28	0.40	1.00	1.00	0.56	
Constructability	1.00	1.00	0.60	0.20	0.20	0.40	
Operations risk	0.57	0.57	0.71	0.43	0.43	0.29	
			Non-economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	1	2	2	3	2	3	
Water quality impact	1	5	2	4	3	3	
Operation and maintenance	4	2	3	2	2	2	
Sustainability	5	3	1	3	3	3	
Long-term benefits and infrastructure renewal	5	11	16	40	40	22	
Constructability	5	5	3	1	1	2	
Operations risk	4	4	5	3	3	2	
TOTAL Non-economic score	**25**	**32**	**32**	**56**	**54**	**37**	
TOTAL SCORE	**48**	**62**	**48**	**64**	**62**	**51**	

Table 41: Alternatives overview – comparison of costs and intangible factors

Alternative	1	2	3	4	5	6
Alternative Description	Obtain Disinfection CT in Sedimentation Basins	Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine	Obtain Disinfection CT in New Filtered Water Clearwell at Sedimentation Basin	Obtain Disinfection CT in Lanpher Reservoir and Highland 2 Reservoir	Obtain Disinfection CT in Lanpher Reservoir	Obtain Disinfection CT in Highland 2 Reservoir
Estimated Project Cost	**$50.3 M**	**$38.5 M**	**$72 M**	**$153 M**	**$148 M**	**$84 M**
Temporary Facilities Estimated Cost These are the type of facilities that have to be done but won't be used continuously after the Clearwell rehabilitation.	**19.7 M**	**$35 M** It is assumed that UV will be part of the treatment process that will include the reuse of the clearwell.	**$0** All facilities permanent. No need for clearwell rehabilitation.	**$21 M** Work associated with temporary wet wells both at the Aspinwall PS and Bruecken PS including emergency by-pass lines.	**$21.9 M** Work associated with temporary wet well at Aspinwall, including emergency by-pass lines.	**$18.5 M** Work associated with the temporary wet well at Bruecken PS, including emergency by-pass lines.
Clearwell Rehabilitation The rehabilitation of the clearwell is not covered in this report. The limited inspections conducted in 1998 indicated that the clearwell is structurally sound; however, the rehabilitation of the clearwell is estimated to be around $30 M. Alternatives 2 and 3, if implemented, would reduce if not eliminate importance of the clearwell in disinfection process. However, the 44-million-gallon clearwell provides reliability in the system's operation in case of extreme changes in system demand.						
Estimated Future Clearwell Rehabilitation Cost	**$30**	**$30**	**Not priority**	**$30**	**$30**	**$30**
OVERVIEW OF THE PROPOSED LONG-TERM BENEFITIAL, PERMANENT FACILITIES WITH HIGH IMPACT ON PWSA WATER SUPPLY SYSTEM RELIABILITY AND ITS REDUNDANCY						
New Aspinwall-Lanpher Rising Main: The construction of a new 48-inch (or 60-foot) Aspinwall Lanpher Rising Main would provide much needed redundancy and reliability in supply of Lanpher Reservoir. The existing rising in current years shows signs of significant deterioration due to age and corrosive conditions.						
New Aspinwall-Lanpher Rising Main Estimated Cost	**$55 M** Not Included	**$55 M** Not Included	**$55** Not Included	**$55 M**	**$70 M** The rising main will be larger in size to accommodate delivering maximum capacity of 100 MGD.	**$55 M** Not Included

Alternative	1	2	3	4	5	6
Aspinwall and Bruecken Pump Station Upgrades Aspinwall and Bruecken Pump Stations are 60 and 80 years old respectively. The operation of these two (2) pump stations are crucial for the system operation. A limited inspection indicates that the pumps and associated equipment is near the end of their useful life expectancy and their replacement with new equipment should be a priority. The improvements to the pump stations in this report are limited to only the equipment needed for the rehabilitation of the clearwell. However, these improvements and upgrades are designed to be permanent.						
Aspinwall and Bruecken Pump Stations Upgrade Estimated Cost The cost includes the upgrades needed to accommodate clearwell rehabilitation phase. The complete upgrade of both pump stations is not presented in this report.	**$6M** Aspinwall PS: Pumps 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,5, and 6 and add VFDs and ancillary equipment.	**$6M** Aspinwall PS: Pumps 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,5, and 6 and, add VFDs and ancillary equipment.	**$11.4M** Aspinwall PS: Pumps 1,2, 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,4, 5,6, 7 and associated motors, add VFDs and ancillary equipment	**$38.1M** Aspinwall PS: Total replacement of all four (4) pumps including electrical equipment to accommodate new rising main Bruecken PS: Complete replacement of Pumps 5, 6, 7 that pump to Highland 2 reservoir including electrical equipment due to increased flow.	**$24.1M** Aspinwall PS: Complete upgrade with new pumps motors and associated electrical equipment to accommodate pumping maximum flow to Lanpher Reservoir.	**$23.8M** Bruecken PS: Upgrade includes new pumps 5, 6, and 7 including motors and associated electrical equipment.
New Highland Transfer Pump Station and Rising Main New Highland Transfer Pump Station is needed to provide the redundant source of supply to the Highland No. 1 Reservoir supply area. It is evident that there are many issues related to reliability of Highland No. 2 Reservoir as an open water reservoir. The limited capacity of the Micro Filtration Plant, unfavourable hydraulic conditions at the reservoir, and age of the distribution system are some of the reasons that the construction of the Highland Transfer Pump Station and the rising main should be one of the priorities to ensure sound and reliable water supply system.						
New Highland 2 Transfer Pump Station and Rising Main Estimated Cost	**$29 M** Not Included	**$29 M** Not Included	**$29 M** Not Included	**$29 M**	**$29 M**	**$29 M**
Rehabilitation of Two (2) 48-Inch Rising Mains Bruecken PS to Highland No. 2 Reservoir The two (2) 48-inch rising mains that supply water to Highland No. 2 Reservoir is another example of a crucial piece of water supply system's infrastructure that is showing signs of deterioration due to age and corrosive environment. Considering its importance in current operations and the operation during the clearwell rehabilitation as explained in each alternative, the rising mains must be at minimum thoroughly inspected and rehabilitated as required for the alternatives where the supply to Highland No. 2 Reservoir is crucial.						
Rehabilitation of Two (2) 48-Inch Rising Mains Bruecken PS to Highland No. 2 Estimated Cost	**$8.8 M** Not Included	**$8.8 M** Not Included	**$8.8 M** Not Included	**$8.8 M**	**$8.8 M** Not Included	**$8.8M**

Alternative	1	2	3	4	5	6
Stand-By Power The cost for the stand-by emergency power has not been evaluated in this report. However, it must be noted that the emergency power generation for all key components of the water supply system must be thoroughly evaluated.						
Standby Power Estimated Cost	Not Included	Not Included	Not Included	Not Included	Not Included	Not Included
48-Inch New River Crossing In order to ensure the redundant supply to all three (3) of the major reservoirs, it is necessary to periodically supply Lanpher and Highland No. 2 Reservoirs "floating them off" of each other via the existing 48-inch river crossing connections. The condition of the existing river crossing pipes and ability to direct the flow in each direction have become increasingly a risk factor in the system's strategic operation plans. A new crossing in this report is considered only for the alternatives where supplying Lanpher and Highland No. 2 Reservoirs off of each other is part of the plan.						
48-Inch New River Crossing Estimated Cost	**$4 M** Not Included	**$4 M** Not Included	**$4 M** Not Included	**$4 M** Not Included	**$4 M**	**$4 M**
Sedimentation Basins Rehabilitation It has been reported that the sedimentation basins have not been cleaned in over 25 years. It is assumed that a large portion of the 123 million gallons of available volume has been significantly reduced due to the accumulated sludge. In addition, a serious consideration should be given to covering these reservoirs due to proximity of State Route 28 and its vulnerability to potential spill from State Route 28. Only Alternatives 1 and 3 are directly impacted by the current conditions. Both alternatives will require cleaning/dredging and covering of the reservoirs, while Alternative 3 would only require upgrades to western and central basin.						
Sedimentation Basins Rehabilitation Estimated Cost	**$22 M** Includes dredging and PPE covers.	**$22 M** Not Included	**$16 M** Includes dredging only. The cost for the conversion of the existing sedimentation basin to clearwell, lining and covering not included in this cost.	**$22 M** Not Included	**$22 M** Not Included	**$22 M** Not Included
Total Cost Comparison						
Long-Term Beneficial Infrastructure (LTBI) Estimated Cost	**$28 M**	**$6 M**	**$11.4 M**	**$131 M**	**$127.1 M**	**$65.6 M**
Percentage of Cost of LTBI vs the Total Project Cost	**55.7%**	**15.6%**	**15.8%**	**85.6%**	**85.9%**	**78%**
Total Cost of the Project + All Recognized LTBIs* Estimated Cost	$50.3 M+ $128.8 M **$179.1 M**	$38.5 M+ $150.9 M **$189.4 M**	$72 M+ $129.5 M **$201.5 M**	$153 M+ $26 M **$179 M**	$148 M+ $54.8 M **$202.8 M**	$84 M+ $91.4 M **$175.4 M**
*Assuming Pumps 5,6,7 at Bruecken PS and 1,2,3,4 at Aspinwall PS are replaced along with VFDs and Electrical Equipment at cost of $38M if applicable)						

Alternative	1	2	3	4	5	6
Review of Intangibles						
Intangible Benefits	Low constructability and management risks. Lowest impact on community.	Low constructability and management risk. Enhanced water quality with double barrier treatment.	New clearwell allows for different use of the current clearwell utility.	Long-term benefits, fastest to address current operations risks.	Addresses current operations risks.	Similar to addressing the operations risks, but not as good as Alternatives 4 or 5.
Intangible Disadvantages	Water quality risks through change in disinfection process. Permitting uncertainties.	Additional operation and maintenance of UV facilities. Learning curve in O&M.	Low score on sustainable practices rankings.	Multiple contracts. Management and constructability risks.	Multiple contracts. Management and constructability risks.	Multiple contracts. Management and constructability risks.
Permitting and Implementation Schedule	Clearwell risk addressed. Intermediate (pending on water quality permitting process)	Clearwell risk addressed. Intermediate	Clearwell risk addressed. Intermediate	Clearwell risk addressed. Longer	Clearwell risk addressed. Longer	Clearwell risk addressed. Intermediate

1 INTRODUCTION

1.1 Project background

The Pittsburgh Water and Sewer Authority (PWSA) owns and operates a drinking water treatment plant (WTP) located along Freeport Road, just outside of Borough of Aspinwall. The WTP is a conventional surface treatment plant that draws water from the Allegheny River. The treatment process consists of raw water screening, flocculation and clarification, secondary sedimentation, rapid sand filtration, fluoridation, and disinfection. The WTP facilities include raw water intake structures, the Ross Raw Water Pumping Station and Chemical Building, clarifier building, sedimentation basins, filtration building, fluoridation building, clearwell, the Aspinwall and Bruecken Pumping Stations, maintenance facilities, and the operations and laboratory building.

The clearwell was constructed in 1908 and has not undergone any major modifications or upgrades since then. The clearwell is located at the west end of the WTP and has two (2) main functions; providing equalization storage that allows the filters to operate independently of potential fluctuations in system demand and providing sufficient contact time for disinfection agent to meet the requirements of the Surface Water Treatment Rule (SWTR) and Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The clearwell feeds two (2) main pumping stations; the Bruecken Pumping Station that supplies water to the Highland No. 1 and Highland No. 2 reservoirs and the Aspinwall Pumping Station that feeds Lanpher Reservoir and Fox Chapel area. The clearwell is an underground concrete structure about 1,200 feet long with width that varies from 170 feet at the inlet east end to about 300 feet at the outlet west end. The structure is approximately 25 feet deep and has no internal compartments.

Since the clearwell has only one compartment, the entire plant must be shutdown to perform inspection and maintenance of the clearwell. The clearwell is the only component of the plant without any redundancy. The PWSA is planning to upgrade the clearwell to:

- Provide two (2) separate compartments for redundancy
- Rehabilitate the clearwell to correct structural deficiencies

The rehabilitation work is anticipated to last approximately two (2) years at which time the clearwell will be out of service. With the clearwell out of service, additional improvements are necessary to provide the equalization storage and meet the disinfection requirements.

1.2 Purpose and goals of evaluation

The main objective of this study is to develop conceptual solutions for the necessary improvements to the existing facilities and the addition of new facilities that would allow for a safe, reliable, and redundant water supply system without the functioning existing clearwell. This study includes an analysis and selection of the most viable and cost effective alternative. The following assumptions and conditions are used in development of these alternatives:

- The water treatment plant production must be uninterrupted at all times.
- Existing clearwell cannot be taken out of service until a fully operable and tested temporary or permanent system is in place.

- Appropriate contact times (CT) must be maintained and adequate disinfection must be provided throughout the water supply system.
- All alternatives in this study are developed to ensure a safe and reliable water supply to Lanpher, Highland No. 1 and Highland No. 2 Reservoirs at the following maximum capacity as defined in this report:
  - Lanpher Reservoir at 28 MGD
  - Highland No. 1 Reservoir at 56 MGD
  - Highland No. 2 Reservoir at 32 MGD

Each alternative was evaluated based on economic and non-economic criteria. The final selection of the most viable alternative was a cooperative process among the report authors and the PWSA's engineering, managing, water quality control, and operating groups that resulted in the selection of alternative with the highest ranking score. A conceptual design is presented for the recommended alternative. Prior to moving forward with the final design, a more detailed Basis of Design Report should be prepared.

The alternatives evaluated in this report include activities, upgrades, and new construction that will result in a mix of temporary and permanent facilities. However, this report does not discuss the rehabilitation and future use of the existing clearwell. There have been attempts in previous reports[1] to evaluate condition of the existing clearwell and recommend generic rehabilitation activities. These reports make several assumptions, based on historical data, partial underwater inspection and generic industry proven activities in rehabilitation of the similar structures. This report strongly supports a detailed evaluation of the condition of the clearwell structure and mechanical condition of the associated equipment followed by recommendations, design, and construction of the upgrades. The improvements to the existing clearwell can only be done after the new facilities are constructed and the existing clearwell emptied which will allow undisturbed access to the facilities.

[1] 2008 HDR Engineering: Pittsburgh Water Treatment Plant Clearwell Improvements Phase 1 - Study

2 EXISTING FACILITIES AND OPERATION

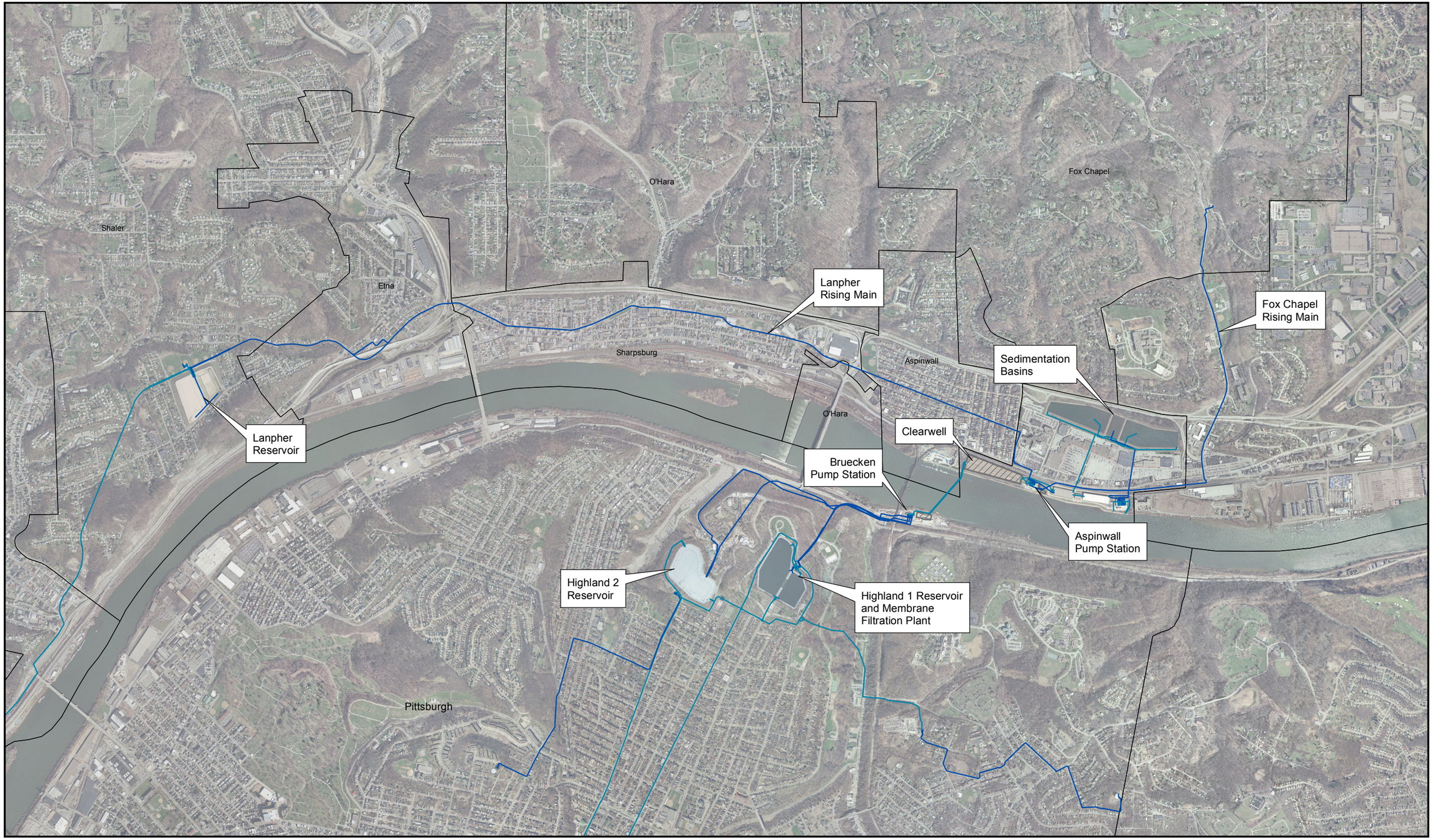
2.1 Overview of existing facilities

The PWSA owns and operates a water supply system that includes a main water treatment plant, a membrane filtration plant, pump stations, and a network of reservoirs, transmission and distribution mains that deliver potable water to the customers in the City of Pittsburgh and surrounding communities. Figure 2.1 is an aerial location plan, and Figure 2.2 is a schematic of the PWSA's water treatment plant (WTP) and primary reservoirs. At the center of this system is the PWSA's WTP, which is a surface water treatment plant that takes its source water from the Allegheny River and reportedly has a maximum capacity of 117 MGD. This section of the report provides a description of the existing treatment facilities, pump stations, and primary reservoirs. The information in Section 2 forms the basis for the evaluation of alternatives presented in Section 3.

2.2 Water treatment plant

The PWSA's WTP is a conventional surface treatment plant that draws water from the Allegheny River. The sole source of water for the water system is the Allegheny River. The Pennsylvania Department of Environmental Resources, now the Department of Environmental Protection (PADEP), issued a Water Allocation Permit to the Authority in March 1989, which allows for water withdrawal of up to 100 MGD from the river. The treatment process consists of raw water screening, flocculation and clarification, secondary sedimentation, rapid sand filtration, fluoridation, and disinfection. Figure 2.3 is a process flow schematic for the existing water treatment plant. The plant reportedly has a maximum capacity of 117 MGD but on average produces 62 MGD with peaks as high as 103 MGD.

In accordance with the Surface Water Treatment Rule (SWTR), the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and PADEP regulations, the treatment plant must achieve 99.9 percent or three-log removal/inactivation of Giardia cysts and 99.99 percent or four-log removal/inactivation of viruses. Credit for two-log removal of Giardia and two-log removal of viruses is achieved through the conventional treatment process of flocculation, clarification, and filtration that are employed at the plant provided that the clarifiers and filters are meeting the treatment technique requirements of the SWTR and LT2ESWTR. The remaining required one-log inactivation of Giardia and two-log inactivation of viruses must be achieved through disinfection using the existing clearwell. At the WTP, this disinfection is achieved using a free chlorine residual in accordance with the Concentration-Time (CT) requirements established by the United States Environmental Protection Agency (USEPA). With the promulgation of the LT2ESWTR in 2006, removal of Cryptosporidium oocysts is also required. The level of removal depends on the source water quality. According to information received through the interviews with the PWSA staff, the source water has been classified by the PADEP as Bin 1 and, therefore, no additional removal/inactivation for pathogens is required. At the WTP, sufficient removal credit is achieved through the existing conventional treatment process. In order to rehabilitate the clearwell, the clearwell will be removed from service and one-log inactivation of Giardia and two-log inactivation of viruses must be provided by another method.



Legend

- Rising Main
- Supply Main

N W E S

0 2,000 4,000 Feet

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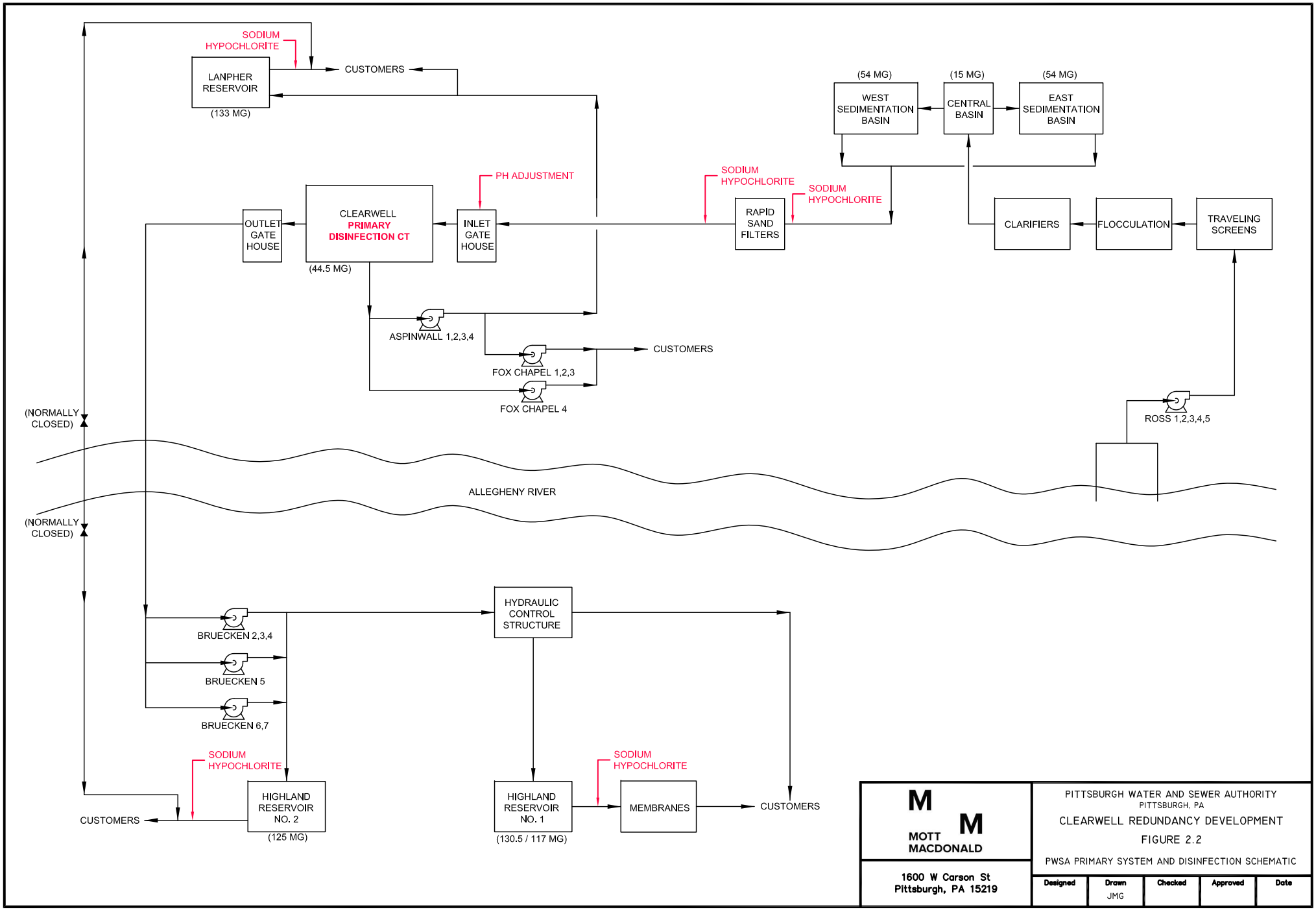
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PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
CLEARWELL REDUNDANCY DEVELOPMENT
FIGURE 2.1 - PRIMARY SYSTEM AERIAL

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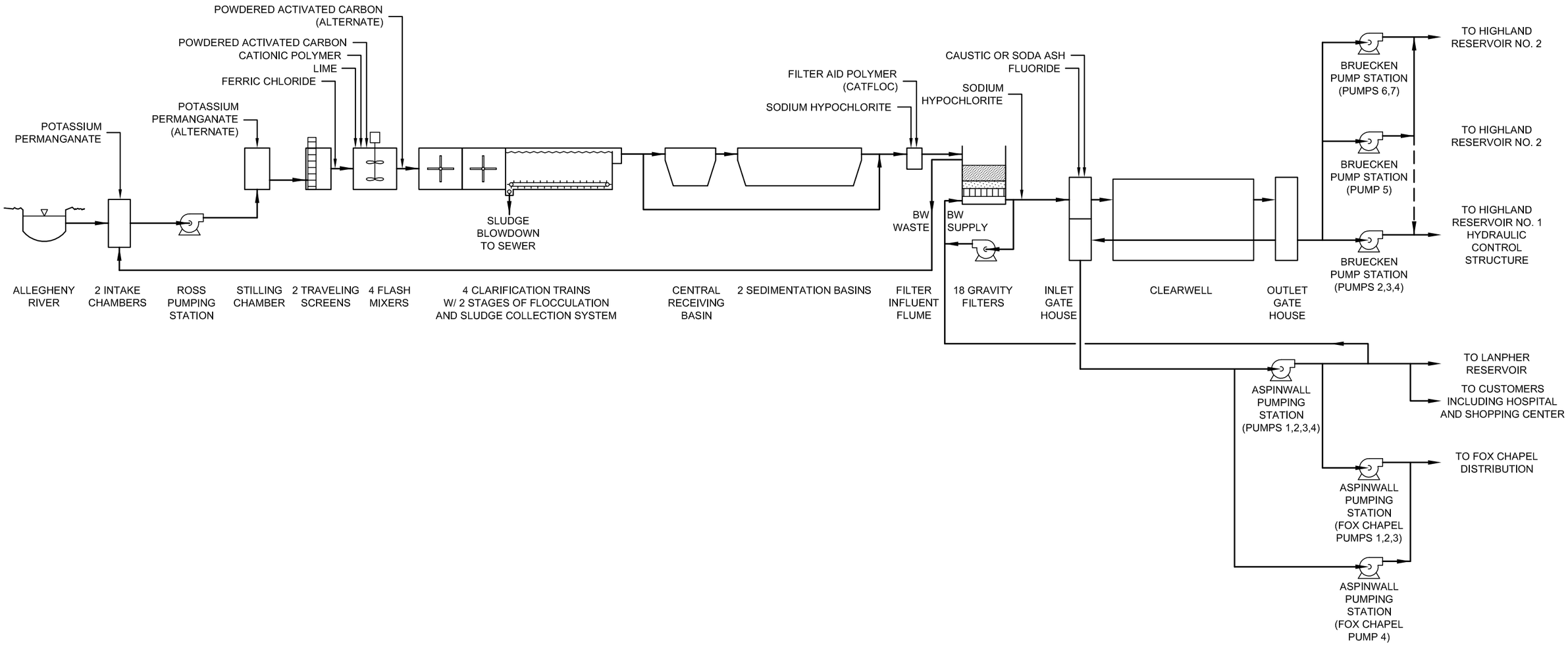
CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 2.2

PWSA PRIMARY SYSTEM AND DISINFECTION SCHEMATIC

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CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 2.3

PWSA WTP EXISTING PROCESS SCHEMATIC

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The alternatives described in this report will modify the disinfection practices, and the modifications could potentially impact disinfection by-product formation. In addition, the PADEP is considering increasing the minimum required disinfectant concentration in the distribution system. The impact of this proposed regulation may affect the selection of the optimum solution. The changes to disinfection practice may also impact distribution system corrosion. In 2007, the USEPA published modifications to the Lead and Copper rule which indicated that Long-Term Treatment changes should address the impact on lead and copper.

2.2.1 Allegheny River

The Allegheny River is the raw water source for the WTP. Table 1 is a summary of raw water quality data that was collected by plant personnel over the 12-month period from November 1, 2014 to October 31, 2015.

Table 1: Raw water quality summary

Parameter	Average	Minimum	Maximum
Temperature (degrees C)	18.3	4	28
pH	7.50	7.19	2.88
Turbidity (NTU)	17.5	4.4	92
Alkalinity (mg/L as $CaCO_3$)	40	25	51
Total hardness (mg/L as $CaCO_3$)	97	52	142
TOC (mg/L)	2.66	1.79	4.95
UV254 (cm^1)	0.102	0.039	0.317
Iron (mg/L):			
Total	0.36	0.02	1.58
Dissolved	0.07	0.00	0.20
Manganese (mg/L):			
Total	0.10	0.02	0.30
Dissolved	0.06	0.00	0.21

* Summary of Data November 1, 2014 through October 31, 2015. The summary is based on one data set per week, as reported on Mondays.

The raw water temperature data that is collected by plant personnel indicates that the low water temperatures are a minimum of 4 degrees C, which is higher than expected given the raw water source. Since the water temperature is an important factor when determining disinfection requirements, additional Allegheny River temperature data for a nearby USGS sampling station was reviewed. Based on data from the USGS Sampling Station on the Allegheny River at the C.W. Bill Young Lock and Dam at Acmetonia, Pennsylvania (ID 03049640), the river water minimum temperature over the period of 1999 through 2015 was as low as 0.5 degrees C. The USGS data also showed that the water temperature from the beginning of May to the end of October is typically a minimum of 10 degrees C. For the alternative evaluated in Section 3, a minimum raw water temperature of 0.5 degrees C will be used.

2.2.2 Raw water intakes and Ross Pump Station

The WTP has two (2) raw water intakes, known as the East Intake and the West Intake, through which water is drawn from the Allegheny River to supply raw water pumps in the Ross Pump Station. Potassium permanganate is added to the raw water at the intakes. Raw water is pumped from the intake to Clarifier Building by five (5) low lift raw water pumps. The water then flows through the remainder of the WTP by gravity. Table 2 shows that the Ross Pump Station raw water pumps have rated capacities

in excess of the daily demands (average 61 MGD, peak demand 103 MGD as recorded during the 2012-2015 period).

Table 2: Ross Pump Station raw water pump summary

Pump No.	Capacity	Comments
1	87 MGD	Constant speed
2	50 MGD	Equipped with VFD
3	50 MGD (split – 25/25)	Split pump – 25 MGD/25 MGD
4	120 MGD	Equipped with VFD
5	110 MGD	Constant speed

2.2.3 Clarification Building

The Clarification Building houses travelling screens, rapid mix facilities, clarifiers, and powdered activated carbon (PAC) facilities. The powdered activated carbon facility is reportedly not currently in use. The raw water pumps in the Ross Pump Station pump water to the stilling chamber in the clarification building. Raw water then flows by gravity through two (2) traveling screens, after which the primary coagulant, ferric chloride is added. The water then flows through the rapid mix basins where lime and flocculant aid cationic polymer are added. Powdered activated carbon may also be added at this location.

After the rapid mix chambers, the chemically conditioned raw water then enters the plant's primary clarification process via the clarifier influent flume. The clarifier influent flume distributes the water to eight (8) flocculation chambers. The flocculation chambers, each equipped with paddlewheel flocculators, feed four (4) clarification basins. The clarification basins were originally designed as solids contact units but are currently operated as conventional settling basins. Each clarification basin has surface area of approximately 12,000 ft^2 and a volume of 1.8 million gallons. With all four (4) trains in service at the maximum flow rate of 117 MGD, the detention time in the clarification basins is approximately 1.5 hours and the surface loading rate is approximately 1.7 gpm/ft^2. The detention time and loading rate are above the PADEP requirements for clarifiers, and secondary sedimentation is necessary. Clarified water is collected through a series of overflow weirs in each of the basins at a maximum overflow rate of approximately 12,800 gpd per linear foot of weir length when all four (4) trains are in service. The overflow weirs discharge to the clarifier effluent flume. Clarified water then exits the effluent flume and is conveyed by gravity in a 96-inch pipeline to the secondary clarification process, the Sedimentation Basins.

The sludge that settles in the clarification basins is removed by chain and flight sludge collectors that direct the settled solids to a central sludge sump that has screw conveyors that direct the sludge to basin drains. The sludge is drained to the sewer.

Table 3 is a summary of clarified water quality data that was collected by plant personnel over the 12-month period from November 1, 2014 to October 31, 2015. The absence of total organic carbon (TOC) data does not permit an assessment of the clarifications facility's performance with respect to organics removal.

Table 3: Clarified water quality summary

Parameter	Average	Minimum	Maximum
pH	6.89	6.60	7.40
Turbidity (NTU)	1.90	0.60	4.69
Alkalinity (mg/L as $CaCO_3$)	31	17	44
Iron (mg/L):			
Total	0.94	0.21	2.70
Dissolved	0.03	0.00	0.20
Manganese (mg/L):			
Total	0.06	0.00	0.013
Dissolved	0.02	0.00	0.09

* Summary of Data November 1, 2014 through October 31, 2015. The summary is based on one data set per week, as reported on Mondays.

PADEP recommends the clarified water turbidity be less than 1 NTU when the raw water turbidity is below 10 NTU and that the clarified water turbidity be less than 2 NTU when the raw water turbidity is above 10 NTU. The average clarified water turbidity of 1.90 NTU indicates that the secondary sedimentation basins are valuable for meeting the PADEP turbidity goal.

2.2.4 Sedimentation facilities

The sedimentation facilities provide secondary clarification and significant detention time in the treatment process. The additional settling time minimizes the solids loading on the downstream filters and gives additional flexibility in the plant operation process.

There are three (3) open/uncovered concrete lined basins that comprise the sedimentation facilities. The first basin is the Central Receiving Basin. This basin has a volume of approximately 15 million gallons and receives the clarified water from the primary clarification process. The clarified water enters the Central Basin through a central distribution conduit with circular ports on top. Under normal operation, water then flows through the Central Receiving Basin to outlet ports on both sides of the basin. Four (4) outlet ports on one side of the basin feed the East Sedimentation Basin, and four (4) outlet ports on the other side feed the West Sedimentation Basin. The East and West Sedimentation Basins each have a volume of approximately 54 million gallons. Settled water is collected at the opposite end of each of the East and West Sedimentation Basins into each basins 84-inch settled water effluent line. The settled water effluent lines from each basin combine into a common 96-inch settled water line that conveys settled water by gravity to the influent flume of the filters.

The total volume of the three sedimentation basins is approximately 123 million gallons. When clear of sediment build-up, these basins have a detention time of 25 hours at 117 MGD. The basins reportedly have not been cleaned since the early 1990's and currently may have reduced capacity available for clarified water flow. Therefore, the detention time is currently reduced. The sedimentation basins are concrete lined and are not covered.

Table 4 is a summary of settled water quality data that was collected by plant personnel over the 12-month period from November 1, 2014 to October 31, 2015.

Table 4: Settled water quality summary

Parameter	Average	Minimum	Maximum
Temperature (degrees C)	19	9	29
pH	6.93	6.53	7.48
Turbidity (NTU)	0.39	0.11	0.89
Alkalinity (mg/L as $CaCO_3$)	32	21	45
Total hardness (mg/L as $CaCO_3$)	115	82	150
TOC (mg/L)	1.28	0.91	1.85
UV254 (cm^1)	0.026	0.013	0.044
Iron (mg/L):			
Total	0.21	0.05	0.42
Dissolved	0.02	0.00	0.16
Manganese (mg/L):			
Total	0.03	0.01	0.09
Dissolved	0.01	0.00	0.06

* Summary of Data November 1, 2014 through October 31, 2015. The summary is based on one data set per week, as reported on Mondays.

2.2.5 Filtration facilities

The filtration facilities have 18 double cell dual media anthracite and sand gravity filters. The filters operate at a peak loading rate of 2.1 gpm/ft^2 at 117 MGD with one (1) filter offline for backwashing. The filtration facility is grouped into nine (9) north and nine (9) south filters. Clarified water enters the filtration facility and sodium hypochlorite is fed at a dose of 0.2 to 0.4 mg/L chlorine. The chlorinated clarified water then feeds both the north and south filter influent flumes. The water is then filtered and collected into a north effluent flume and a south effluent flume. Two (2) 72-inch reinforced concrete pipes convey filtered water from each of the effluent flumes into the yard. Once in the yard, the two (2) filtered water pipelines combine into a singled 96-inch filtered water header that conveys filtered water by gravity to the clearwell inlet gate house. Sodium hypochlorite is dosed at approximately 1 mg/L at each of the filter effluent flumes. This is the final application point for sodium hypochlorite before the clearwell.

2.2.6 Finished water clearwell

The existing clearwell is a single compartment ground level reservoir constructed around 1908. It currently operates at a volume in the range of approximately 36 to 44 million gallons. The clearwell serves two (2) main purposes. First, it provides the necessary primary disinfection free chlorine contact volume for achieving one-log Giardia inactivation and two-log virus inactivation. Second, it provides equalization for the finished water pumps in the Aspinwall Pump Station and the Bruecken Pump Station that pump the finished water to primary finished water reservoirs and one of its customers, Fox Chapel. The existing clearwell typically operates between the water elevation ranges of 744.5 feet and 748.5 feet. Filtered water that has been chlorinated enters the clearwell via the inlet gate house where fluoride is added and soda ash is added for final pH adjustment. The target final pH is reportedly 8.2 to 8.5 for distribution system corrosion control. Since the clearwell has only one (1) compartment and there is currently no other means to achieve finished water disinfection requirements and provide pump suction equalization, the clearwell cannot be taken out of service for repairs. According to the 2008 Malcolm Pirnie *Clearwell Improvements Phase I – Study* report, an underwater inspection of the clearwell facilities was performed in 1998. At the time of the inspection, it was determined that the clearwell concrete was “structurally sound,” but that the gates were corroded and approximately 182,000 cubic yards of sediment built up in the clearwell.

Table 5 is a summary of finished water quality data that was recorded by plant personnel at the clearwell outlet gate house over the 12-month period from November 1, 2014 to October 31, 2015. This represents the typical finished water quality that enters the water distribution system. The existing finished water free chlorine residual and pH were considered when evaluating the alternatives in Section 3 of this report.

Table 5: Finished water quality summary*

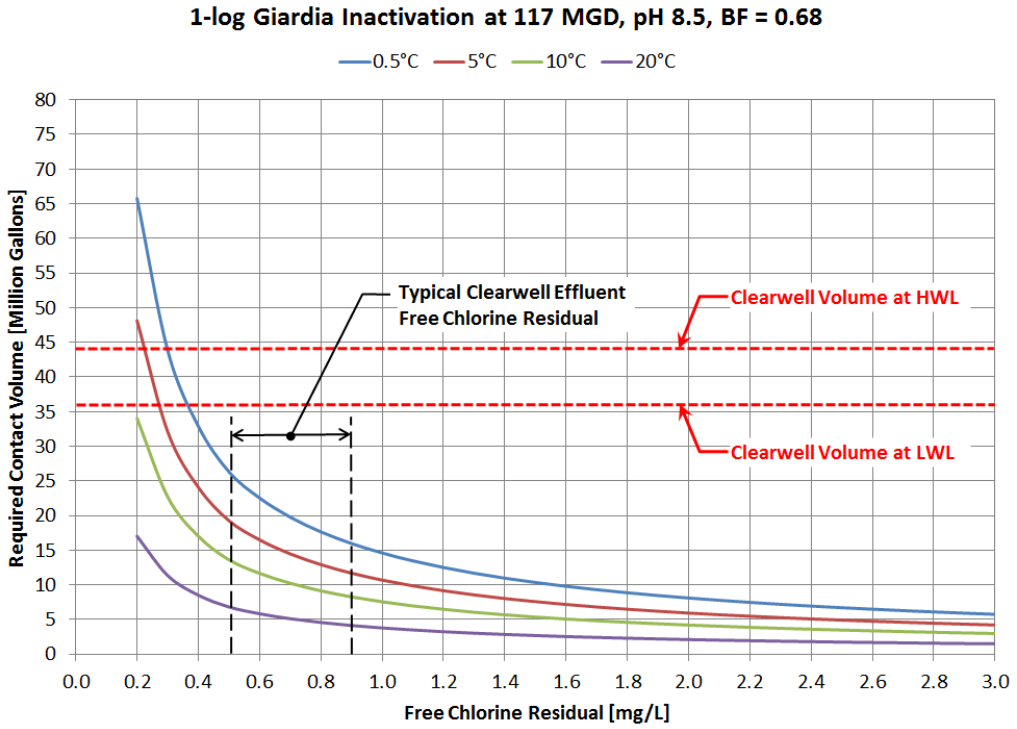
Parameter	Average	Minimum	Maximum
Temperature (degrees C)	18	5	28
pH	8.41	7.87	8.90
Chlorine residual (mg/L):			
Free	0.71	0.55	0.92
Total	0.79	0.62	0.99
Alkalinity (mg/L as $CaCO_3$)	45	26	62
Total hardness (mg/L as $CaCO_3$)	116	76	162
TOC (mg/L)	1.25	0.82	1.74
UV254 (cm^1)	0.015	0.007	0.029

* Summary of Data November 1, 2014 through October 31, 2015. The summary is based on one data set per week, as reported on Mondays.

Figure 2.4 is a graph of the required disinfection contact volume for a range of finished water temperature conditions when the treatment plant is operating at the maximum capacity of 117 MGD. The existing clearwell reportedly has an approved baffling factor of 0.68[2]. The required contact volume versus chlorine residual curves for each temperature were developed based on the required CT to achieve one-log Giardia inactivation at the associated temperature with free chlorine at a pH of 8.5 and a basin baffling factor of 0.68. The graph demonstrates that for the range of clearwell effluent chlorine residuals experienced at the plant, the clearwell provides sufficient free chlorine contact volume to achieve the required one-log Giardia inactivation. More free chlorine CT is required to achieve one-log Giardia inactivation than to achieve two-log virus inactivation. For this reason, the free chlorine disinfection requirement analysis in this section and Section 3 focus on what is required for one-log Giardia inactivation. When the free chlorine one-log Giardia inactivation has been achieved, the two-log virus inactivation requirements will already have been achieved in excess.

[2] 2008 HDR Engineering: Pittsburgh Water Treatment Plant Clearwell Improvements Phase 1 - Study

Figure 2.4
Disinfection in Existing Clearwell



2.3 Finished water pump stations

The finished water clearwell feeds two (2) main pumping stations; the Bruecken Pump Station that supplies water to the Highland No. 1 and Highland No. 2 Reservoirs and the Aspinwall Pump Station that feeds Lanpher Reservoir. The Aspinwall Pump Station also houses pumps that supply finished water to the municipality of Fox Chapel. The pumps, electrical equipment, and other ancillary equipment are very close to the end of their useful life, and the operation and maintenance presents a serious challenge.

Each pump station has more than adequate capacity to respond to sudden changes in demand. Under the current operating procedure, the operators use pumps to maintain a preset, desired level in the primary reservoirs (i.e. Lanpher, Highland No. 1 and Highland No. 2). For example, the Lanpher Reservoir target operating level is 965.85 feet. Average daily demand in the Lanpher Reservoir supply area during the period 2012 to 2015 was estimated to be approximately 14.3 MGD, while the maximum daily demand recorded during this period was 27 MGD. This allows operators to select which pump or combination of pumps (the design capacity of pumps is shown in Table 6 will be operated at any time to maintain the preset, desired level in the reservoir. If the operators see an accelerated level drop in the reservoir or a significant drop of pressure in the system, they will start another pump to add more flow to the reservoir until the levels reach the preset values again.

2.3.1 Aspinwall Pump Station

Aspinwall Pump Station in its present state, houses four (4) two-stage, centrifugal, end-suction type pumps with synchronous motors, installed in 1958, that supply Lanpher Reservoir and four (4) pumps that supply water to the Fox Chapel Water District. The basic characteristics of these pumps are presented in Table 6. The pumps that pump water to Lanpher Reservoir are located on the ground floor at elevation 750.25. The Aspinwall Pump Station draws water from the existing clearwell. As discussed earlier, current operation maintains water level in the clearwell at elevations between 744 and 749. The operation at the Aspinwall Pump Station (Aspinwall Pumps) is equipped with a vacuum priming system needed for pump start-up. The Fox Chapel pumps are in the basement of the building.

Table 6: Aspinwall Pump Station existing pump summary

Pump No.	Aspinwall pumps				Fox Chapel pumps			
	1	2	3	4	1	2	3	4
Capacity (MGD)	12	15	22	28	3	3	3	2.2
TDH (feet)	265	265	265	265	375	375	375	375
Motor (HP)	1,000	1,000	1,500	1,500	400	400	400	500

A review of pumping data from January 2014 through September 2015 indicates that the operators, in order to meet the demands of the Lanpher Reservoir supply district, use Pumps No. 1 and No. 2 most of the time. Except for three (3) months during this period, Pump No. 2 was the lead pump, supplemented by Pump No. 1. The monthly usage of each pump during this period is presented in Table 7. It must be noted that all flow data (and demands) presented in the report are approximate values based on the original design capacity of each pump running. **Any future improvements to the system should include accurate flow monitoring equipment and instrumentation.**

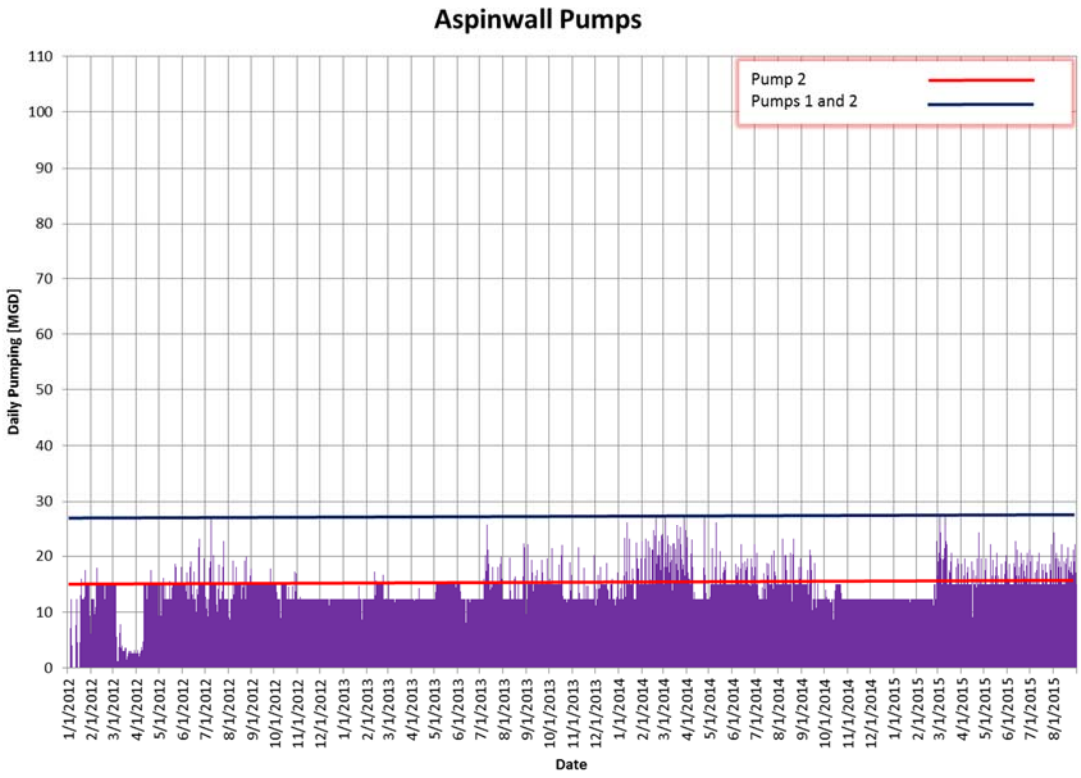
Table 7: Aspinwall Pump Station - Aspinwall pumps run time (hours)

Month	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4
January 2014	355	321	109	0
February 2014	251	659	10	0
March 2014	323	516	154	0
April 2014	579	220	24	0
May 2014	121	700	0	0
June 2014	103	720	3	0
July 2014	412	419.5	4.5	0
August 2014	42	360	0	0
September 2014	377.5	337	18	5.5
October 2014	535.5	192	6.5	0
November 2014	720	0	0	0
December 2014	744	0	0	0
January 2015	743	0	0	0
February 2015	592	96	0	0
March 2015	203	743	0	0
April 2015	90	703	0	0
May 2015	99	741.5	0	0
June 2015	168.5	691	0	0
July 2015	105	742	0	0

Month	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4
August 2015	197	693	0	0
September 2015	83	382	0	0
October 2015	535.5	192	6.5	0
Total	**7,379**	**9,428**	**335.5**	**5.5**
Average month hours	**335**	**429**	**15**	**0.25**

The average daily flow recorded in the three-year period (2012 to 2015) was 14.3 MGD, with a maximum daily flow of 27.25 MGD recorded on July 9, 2012. It is apparent that the design characteristics of Pumps No. 1 and No. 2 lead to their prevalent usage. Pump No. 4 is not functional. The stuffing boxes are deteriorated and a prime cannot be achieved. Figure 2.5 is the chart that summarizes average daily flows at the Aspinwall Pump Station during this period.

Figure 2.5
Aspinwall Pump Station Daily Flow Summary

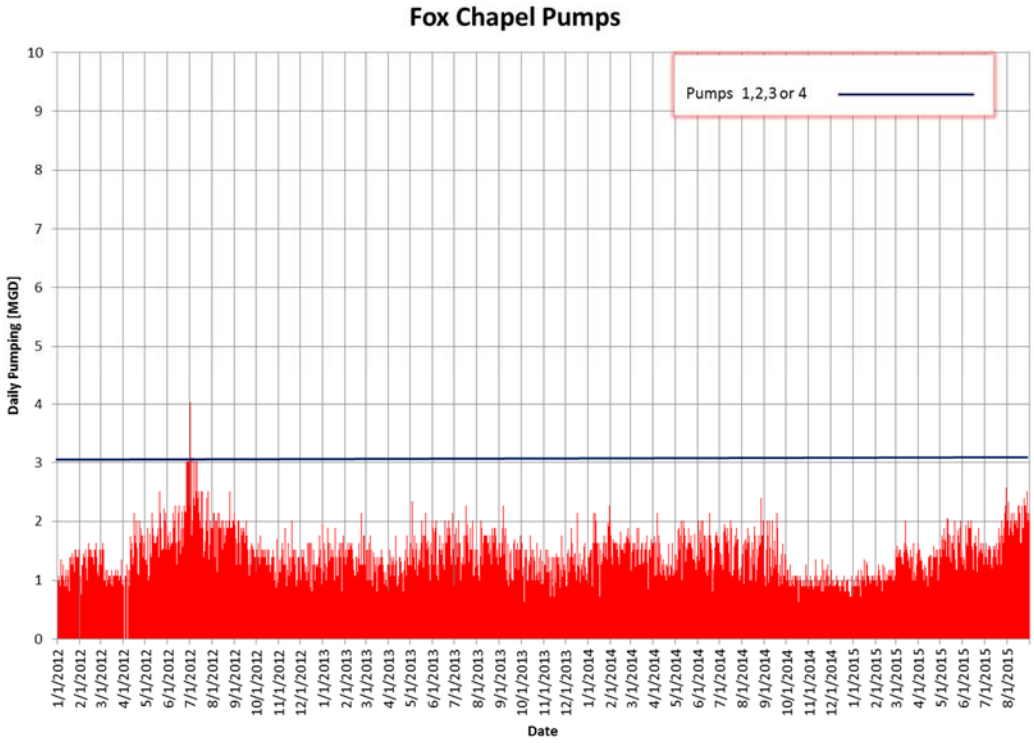


The Fox Chapel pumps are similar, if not identical, in design characteristics allowing the operators to use each of them more frequently than the pumps dedicated to the Lanpher reservoir. Table 8 shows the average and total hours for each of the four (4) pumps. The 2012 through 2015 flow data review indicates that the average daily flow to the Fox Chapel District is 1.44 MGD with a maximum recorded flow of 4 MGD occurring on July 2, 2012. The data indicates that the pump station is operating approximately half a day or on average, 384 hours per month. Figure 2.6 shows the daily flow at the Fox Chapel pump station during the monitoring period.

Table 8: Aspinwall Pump Station - Fox Chapel pumps run time (hours)

Month	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4
January 2014	103.5	133.5	96	79.5
February 2014	108	119.5	98.5	41
March 2014	101.5	114.5	99	71.5
April 2014	51	44	9	297.75
May 2014	70	95	101.5	166.5
June 2014	94	108	104.5	105
July 2014	48.5	89.5	87.5	197.5
August 2014	73	137.5	85	119
September 2014	15	144.5	0	240
October 2014	0	0	0	344
November 2014	0	0	0	336.5
December 2014	0	0	0	319.5
January 2015	0	0	0	354.5
February 2015	12	0	0	320.5
March 2015	292.5	0	0	70.5
April 2015	142	55.5	0	155
May 2015	119	110.5	98	102
June 2015	99	119.5	111	63
July 2015	175.5	167.5	58	0
August 2015	0	504.5	0	0
September 2015	11	222.5	66	0
Total	**1,515.5**	**2,166**	**1014**	**3383.25**
Average month hours	**72**	**103**	**48**	**161**

Figure 2.6
Fox Chapel Pump Station Daily Flow Summary



2.3.2 Bruecken Pump Station

Bruecken Pump Station supplies water to the Highland No. 1 and Highland No. 2 Reservoirs. The pump station at the current location was constructed in 1932, replacing the old pump station built at the beginning of 20th century. It currently houses six (6), two-stage, centrifugal, end-suction type pumps with synchronous motors. Four (4) pumps (designated as Pumps No. 2, 3, 4, and 5) are designed to supply water to Highland No. 1 Reservoir, two (2) pumps (Pump Nos. 6 and 7) are designed to supply water to Highland No. 2 Reservoir. The current valve arrangement at the discharge vault allows the operators to use Pump No. 5 to supply water in both directions. The basic characteristics of these pumps are presented in Table 9. The pumps are located at elevation 738.25 feet. The Bruecken Pump Station draws water from the existing clearwell via a pair of 72-inch suction lines that cross the Allegheny River and merge into a single 96-inch line. Due to the flooded suction, the pumps do not require continuous priming. However, it appears that the pumps experience cavitation when the levels in the clearwell are drawn below the standard operating levels (744 to 748 feet). Previous reports[3] indicate that the pumps in their current design are not capable of pumping the entire volume of the clearwell due to an insufficient net positive suction head available (NPSHA).

[3] Malcolm Pirnie: PWSA Clearwell Improvements: Phase I – Study, December 2008

Table 9: Bruecken Pump Station existing pump summary

Pump No.	2	3	4	5	6	7
Capacity (MGD)	28	28	28	24	24	24
TDH (Feet)	365	365	365	272	272	272
Motor (HP)	2,250	2,250	2.250	1,500	1,500	1,500

Table 10 shows the distribution of the hours in use for each pump at the Bruecken Pump Station. A review of the pumping data from January 2014 through September 2015 indicates that the operators, in order to meet the demands of the Highland No. 1 Reservoir Supply District in 2014, used Pump Nos. 2, 3, and 4 individually or in different combinations. This table also shows that Pump Nos. 6 and 7 were used to supply water to the Highland No. 2 Reservoir. Most of the time the demands are met with only one (1) of the two (2) pumps running. However, when needed, the operators run both pumps to respond to increased system demands.

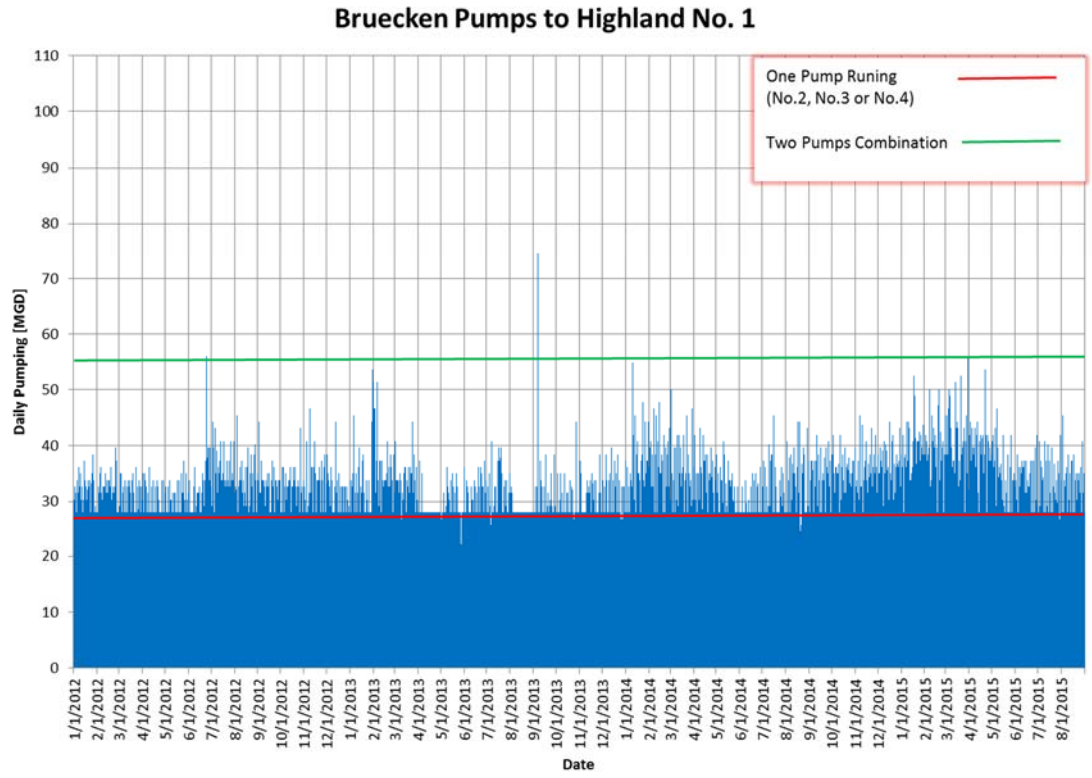
The average daily flow recorded for the three-year period (2012 to 2015) for the Highland No. 1 Reservoir supply system was 33.5 MGD, with a maximum daily flow of 74.7 MGD recorded on September 6, 2013. This is the only day that the three (3) available pumps were used due to extremely high demand. The flow data reported is approximate and is based on the original design capacity of each pump running. Figure 2.7 is the chart that summarizes the average daily flows pumped to the Highland No. 1 Reservoir during this period.

Table 10: Bruecken Pump Station pumps run time (hours)

Month	Pump No. 2	Pump No. 3	Pump No. 4	Pump No. 5	Pump No. 6	Pump No. 7
January 2014	94	730	98	10	262	68
February 2014	219	672	0	0	351	5
March 2014	197	743	0	0	396	0
April 2014	172	720	0	0	441	36
May 2014	308	537	8	0	179	186
June 2014	720	5	46	0	28	393
July 2014	501	291.5	66.5	0	121.5	229
August 2014	17	360	52	0	125.5	19.5
September 2014	169	719	0	0	259.5	68
October 2014	195	744	0	0	267.5	60.5
November 2014	200.5	720	0	3	342.5	261.5
December 2014	221	744	0	0	438.5	172.5
January 2015	312	744	0	0	466.5	214.5
February 2015	283	672	0	0	180	475
March 2015	346.5	742	0	0	6	302.5
April 2015	285.5	730	0	0	0	242.5
May 2015	614	219	98	0	42	251.5
June 2015	719	3	149	0	168	134
July 2015	743	9.5	134	0	15.5	298.5
August 2015	696	2	131	0	1	301.5

Month	Pump No. 2	Pump No. 3	Pump No. 4	Pump No. 5	Pump No. 6	Pump No. 7
September 2015	384	0	75.5	0	0	167
October 2015	195	744	0	0	267.5	60.5
Total	**7,591.5**	**10,851**	**858**	**13**	**4,358.5**	**3,946.5**
Average month hours	**345**	**493**	**39**	**1**	**198**	**179**

Figure 2.7
Bruecken Pump Station Daily Flow Summary to Highland No. 1



The average daily flow to Highland No. 2 Reservoir during the same period was 12 MGD with a maximum recorded daily flow of 32 MGD. It is apparent that most of the time the demands in Highland No. 2 reservoir supply district were met by utilizing only one (1) pump as a lead (Pump Nos. 6 or 7) while supplemented with the other pump when the demand exceeds the capacity of one pump. Figure 2.8 summarizes daily flows to Highland No. 2 Reservoir.

It should be noted that during this period Pump No. 5 was used only twice. This pump is designed to pump water to the Highland No. 1 Reservoir, yet it appears that it is only used to supplement water supply to the Highland No. 2 Reservoir. Due to a lack of continuous flow and pressure data recording, it is not clear how Pump No. 5 operates under the changed hydraulic conditions (approximately 100 feet of difference in elevation between Highland No. 1 and Highland No. 2 Reservoirs).

Figure 2.8
Bruecken Pump Station Daily Flow Summary to Highland No. 2

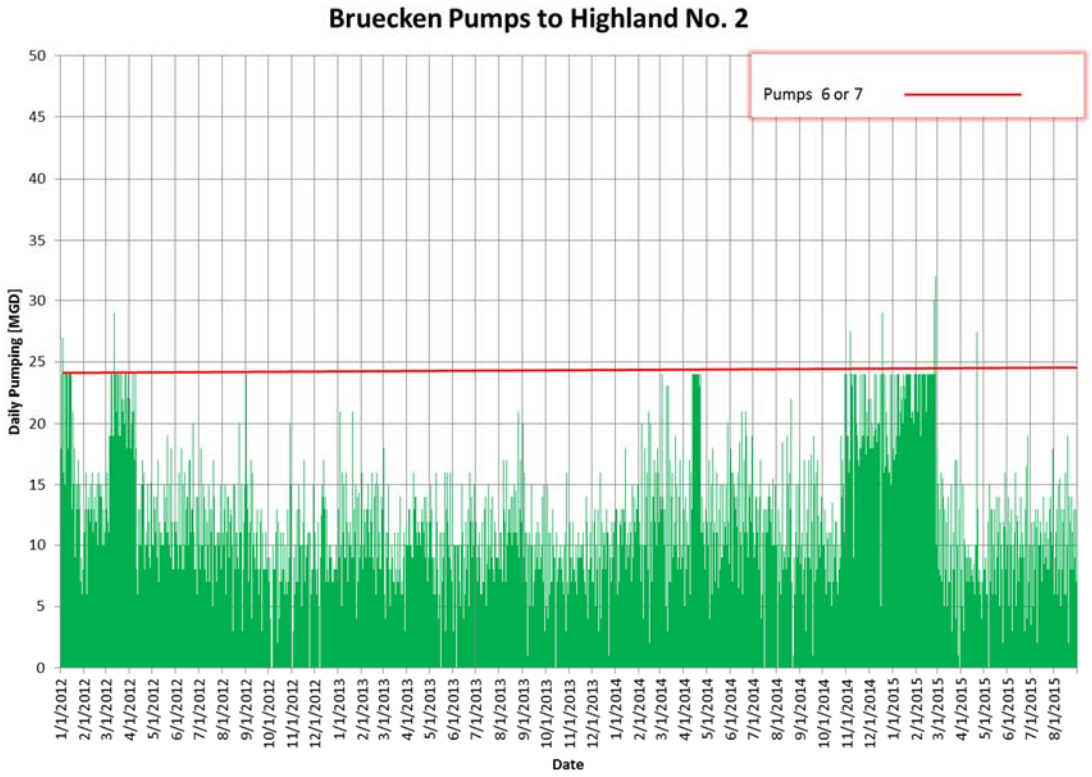


Figure 2.9 summarizes flow pumped from the Bruecken Pump Station to both the Highland No. 1 and Highland No. 2 Reservoirs. The average daily flow from the Bruecken Pump Station was 45.6 MGD with a maximum day of 85.6 MGD recorded on September 6, 2013.

Figure 2.10 shows the total flow pumped from both the Bruecken Pump station and Aspinwall Pump Station on a daily basis during the indicated monitoring period. The average total daily flow delivered from the Aspinwall WTP was 61.4 MGD with a maximum day of 102.9 MGD recorded on September 6, 2013.

Figure 2.9
Bruecken Pump Station Combined Daily Flow

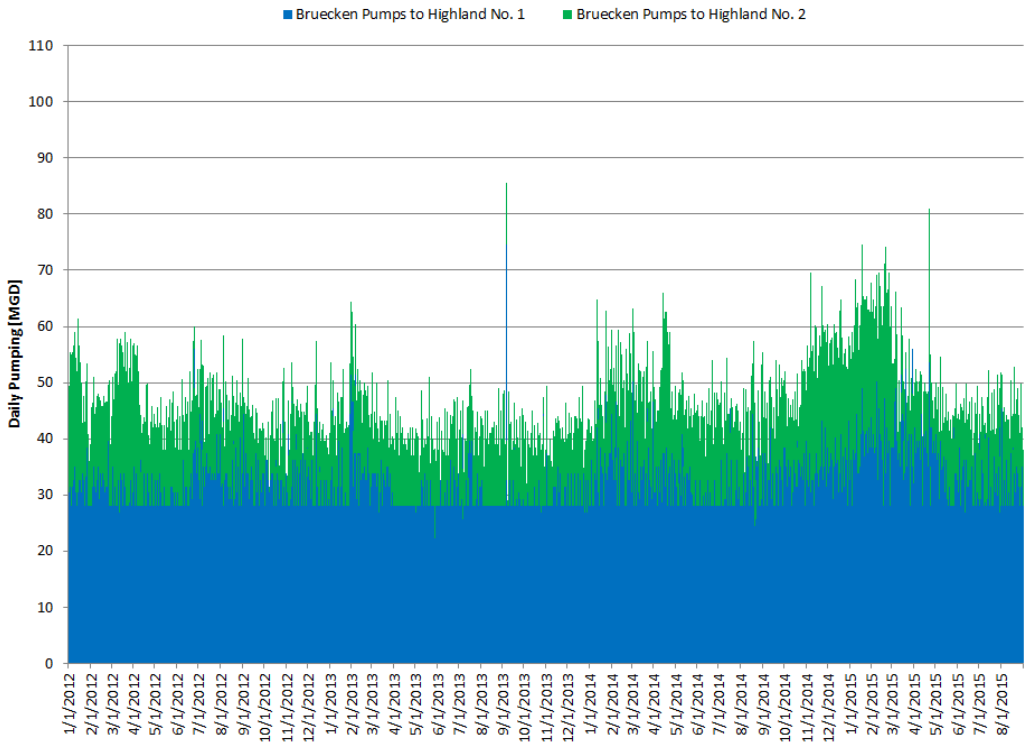
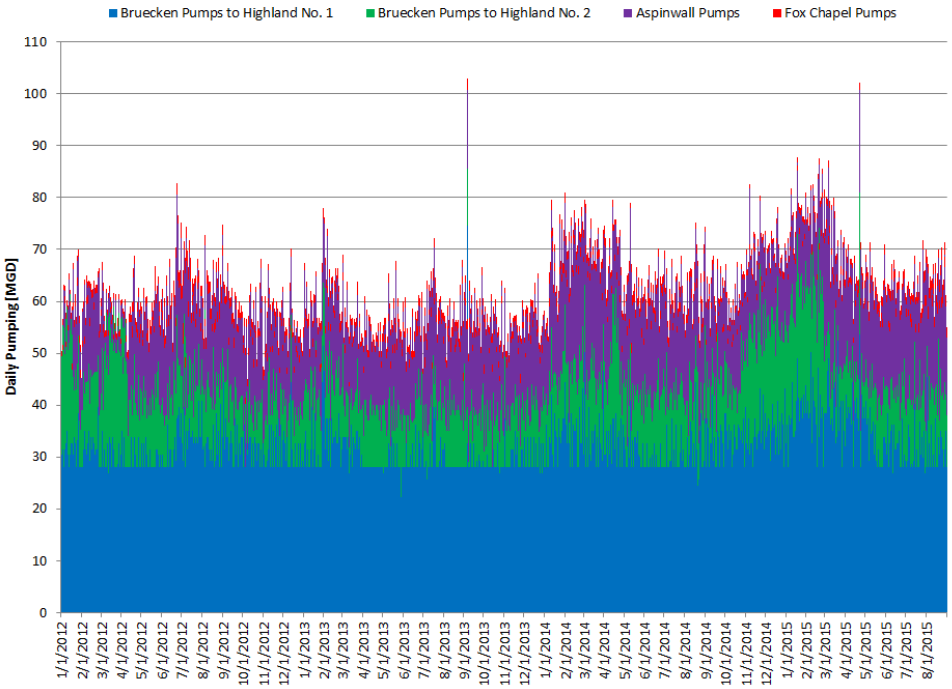


Figure 2.10
Aspinwall WTP Total Daily Flow



2.4 Primary reservoirs

There are three (3) primary reservoirs that receive finished water from the Aspinwall WTP – Lanpher Reservoir, Highland No. 1 Reservoir, and Highland No. 2 Reservoir.

2.4.1 Lanpher Reservoir

The Lanpher Reservoir is a covered 133-million-gallon dual compartment reservoir that receives finished water pumped via the Aspinwall Pump Station. Figure 2.11 is an aerial photo of the Lanpher Reservoir. The reservoir is supplied by a single 60-inch rising main that serves several customers prior to delivering water to the Lanpher Reservoir. Water enters the reservoir at the Main Gate House, and an inlet distribution box supplies two (2) 48-inch ductile iron pipelines that convey the water through the central berm between the reservoir compartments to inlet conduits at the opposite end of the reservoir. Water then flows back through each side of the reservoir toward the main gate house where it exits via a 60-inch outlet pipe in each compartment.

There are booster chlorination facilities in the Main Gate House that feed chlorine to the effluent of the Lanpher Reservoir. The booster chlorination equipment includes five (5) 160-gallon sodium hypochlorite tanks connected to a common discharge manifold that supplies two (2) metering pumps. Chemical feed rate adjustment is manual and based on maintaining a desired distribution system chlorine residual at select locations remote to the reservoir. There is reportedly no chlorine residual monitoring that occurs at the reservoir itself. The daily sodium hypochlorite usage at the reservoir is reported to be typically in the range of 50 to 200 gallons per day.

Figure 2.11
Lanpher Reservoir Aerial Photo



2.4.2 Highland No. 1 Reservoir and membrane filtration plant

The Highland No. 1 Reservoir is an open 130.5-million-gallon reservoir that receives finished water pumped via the Bruecken Pump Station. Since the Highland No. 1 Reservoir is open and therefore, at greater risk of contamination. A Membrane Filtration Plant with 26 MGD design capacity re-filters the water and boosts the chlorine residual as it leaves the reservoir prior to entering the distribution system. Figure 2.12 is an aerial photo of the Highland No. 1 reservoir and membrane filtration plant. The reservoir has two (2) 50-inch rising mains that convey water from the Bruecken Pump Station to the hydraulic control structure at the membrane filtration plant. The hydraulic control structure has a series of weirs. A portion of the water that enters the hydraulic control structure discharges directly to the distribution system in accordance with distribution system demand that is more than what the membrane filtration plant is producing. The remainder overflows to the reservoir. The membrane filtration plant reportedly can treat up to 20 MGD.

Figure 2.12
Highland No. 1 Reservoir and Membrane Filtration Plant Aerial Photo

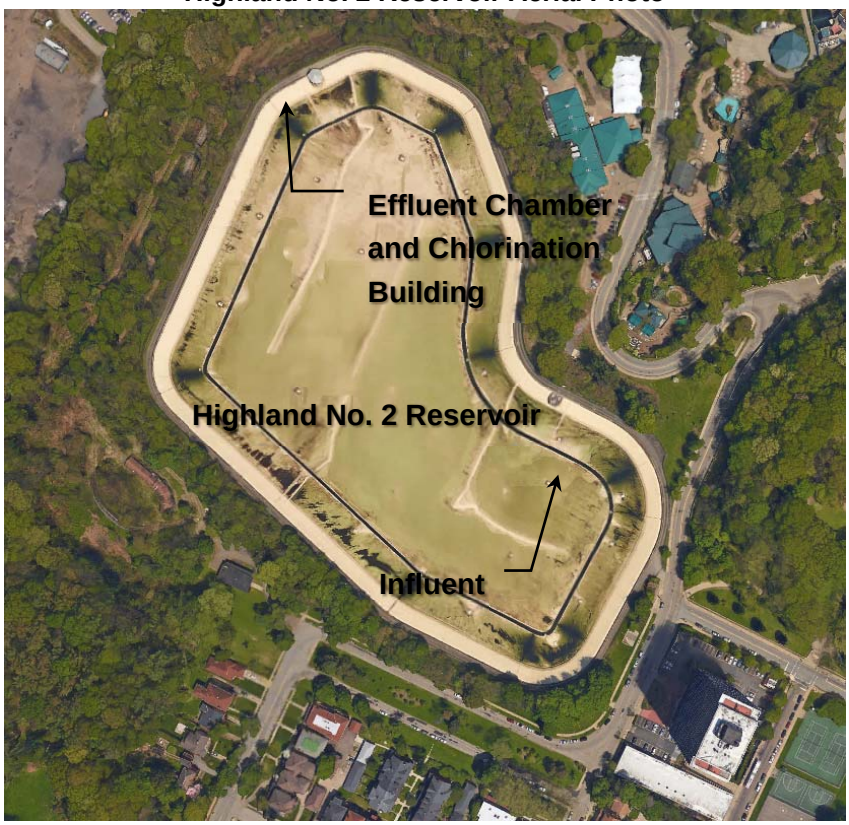


2.4.3 Highland No. 2 Reservoir

The Highland No. 2 reservoir is a covered and baffled 125-million-gallon single compartment reservoir that receives finished water pumped via the Bruecken Pump Station. Figure 2.13 is an aerial photo of the Highland No. 2 Reservoir. The reservoir is supplied by a pair of 48-inch rising mains that convey water from the Bruecken Pump Station to the Highland No. 2 Reservoir. Water enters the reservoir at an influent chamber. Water then flows via serpentine route around the reservoir's floating baffle walls to the effluent chamber.

There are booster chlorination facilities in the chlorination building above the effluent chamber that feed chlorine to the effluent of the Highland No. 2 Reservoir. The booster chlorination equipment includes five (5) 160-gallon sodium hypochlorite tanks connected to a common discharge manifold that supplies two (2) metering pumps. Similar to the Lanpher Reservoir booster chlorination system, chemical feed rate adjustment is manual and based on maintaining a desired distribution system chlorine residual at select locations remote to the reservoir. There is reportedly no chlorine residual monitoring that occurs at the reservoir itself. The daily sodium hypochlorite usage at the reservoir is reported to be typically in the range of 50 to 200 gallons per day.

Figure 2.13
Highland No. 2 Reservoir Aerial Photo



3 ALTERNATIVES

3.1 Overview

This section presents six (6) alternatives for maintaining water supply to the PWSA's customers if the existing clearwell is taken out of service for an extended period for repairs or replacement. The alternatives are described by their method of achieving the disinfection requirements, and are as follows:

- Alternative 1 – Obtain Disinfection CT in Secondary Sedimentation Basins
- Alternative 2 – Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine
- Alternative 3 – Obtain Disinfection CT in New Filtered Water Clearwell at Sedimentation Basin
- Alternative 4 – Obtain Disinfection CT in Lanpher Reservoir and Highland No. 2 Reservoir
- Alternative 5 – Obtain Full System Disinfection CT in Lanpher Reservoir
- Alternative 6 – Obtain Full System Disinfection CT in Highland No. 2 Reservoir

As each of the above alternatives is presented in this section, the following will be presented and discussed to assist in the final evaluation of each alternative:

- Disinfection Method
- Storage and Distribution
- Project Implementation
- Cost Estimate

3.1.1 Evaluation methodology

The evaluation and selection process will be based on a cost benefit analysis. Capital cost will be used as a primary economic factor due to the temporary nature of most the proposed alternatives. The non-economic benefits for each alternative will also be determined using the ranking procedure described below. The economic and non-economic score will be combined into a cost benefit score. The maximum total score for the combined criteria is 100. A workshop was conducted with Mott MacDonald and the PWSA staff to determine the total amount of points for economic and each non-economic criterion. The cost benefit score for each option will be compared and be used to select the most acceptable alternative. This subsection describes the evaluation approach that was used to develop the cost estimates and the cost benefit analysis. A summary table that shows the different factors that may influence the final decision will be presented at the end of this report.

3.1.1.1 Capital cost

For each alternative, capital costs were prepared. The capital costs were based on the development of a conceptual design for each alternative. The conceptual design is based on providing a maximum treated water capacity of 117 MGD and delivering the following peak flows:

- Lanpher Reservoir Supply System: 28 MGD
- Highland No. 1 Reservoir Supply System: 56 MGD
- Highland No. 2 Reservoir Supply System: 32 MGD

The Capital Costs were developed in accordance with the American Association of Cost Engineers International (AACEI) Recommended Practice No. 18R-97 "*COST ESTIMATE CLASSIFICATION SYSTEM. AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES.*" These estimates are considered to be "Class 4, Feasibility Level." In accordance, the AACEI 18R-97 a 40 percent contingency was applied to each estimate. The estimates were based on the following criteria:

- Division 0 costs were based on 5 percent of the total estimated construction cost without the contingency.
- Division 2 Site Work costs were based on takeoffs for site piping and earthwork.
- Division 3 Concrete costs were based on takeoffs using a unit concrete price of $1,000 per cubic yard.
- Divisions 4 through 10 Superstructure were based on the building area and a unit price of $100 per sf.
- Division 11 Equipment was based on:
  - Vendor equipment quotes
  - Labor for installation based on 70 percent of the equipment quote.
  - Overhead and profit based on 15 percent of the equipment.
  - Interior piping was estimated based on piping take offs and unit pricing from similar projects.
- Division 13 Instrumentation and Control was based on 15 percent of the total of Division 11.
- Division 15 HVAC and Plumbing was based on 5 percent of the total of Divisions 3 through 11.
- Division 16 Electrical was based on:
  - Vendor equipment quotes
  - Cost data from similar projects. The electrical cost does not include any upgrades to the existing emergency generators.
- The contingency was estimated based on 40 percent of the total of Division 0 through 16.
- Design Engineering, Construction Management, Legal, Project Management Costs were estimated at 25 percent of Division 0 through 16 plus the contingency.

3.1.1.2 Operation and maintenance costs and life cycle cost

Standard practice in evaluation of economic factors for a multiple-alternative type of project includes evaluation of operation and maintenance costs and summarizing final values in life cycle cost values for each alternative. Typically, a present worth cost is used for the lifecycle cost. The present worth cost converts the annual O&M cost to a current cost and that adds this to the capital cost. The annual O&M cost for the alternatives ranges between $50,000 and $450,000 and as all the alternatives will be in service for approximately two (2) years, the present worth of the O&M costs will be less than $1 million whereas the capital cost of all the six (6) alternatives will be much higher (see remainder of this section).

Since the capital cost for each alternative is by far the greatest portion of the total life cycle cost that even for alternatives with proposed long-term new facilities, the impact of annual operation and maintenance cost and its life cycle value would not impact overall economic ranking.

3.1.1.3 Non-economic criteria

Non-economic criteria will include factors that have a significant impact on efficiency, productivity, ease of operation, etc. All alternatives must completely meet the rudimentary requirements such as flow and water quality standards.

The non-economic criteria that will be evaluated are as follows:

a. Permitting and implementation schedule

Permitting requirements may significantly impact the implementation schedule and increase the cost of the project.

b. Water quality impact

This criterion will evaluate each alternative for the ability to provide a greater inactivation of pathogens or result in lower disinfection-by-products (DBPs). Also, this criterion will consider the potential impact of future regulations and trends in enhancing water quality. This criterion will evaluate the ability of the system under each alternative to respond to changes in water quality. For example, moving the chlorine application to downstream of the first set of clarifiers will be impacted by upsets to the clarifier, as compared to options where chlorine is applied after the second set of clarifiers.

c. Operation and maintenance

All the processes are automated, but some place a much higher emphasis on automation. UV requires 95 percent of the water treated each month to be in compliance requiring a need for the installation and operation of UV sensors and automated valves as compared to chlorination which is much simpler. Also, the pumping operation utilizing limited volumes of temporary suction wells will require careful coordination of operations of the WTP intake pump station, treatment process, and continuous observation of changes in demand within the system.

d. Sustainability

This criterion can contain any of the standard environmental and energy factors related to the sustainability assessment, including carbon footprint of the proposed alternatives, reuse, and other factors.

> Quality of Life Category:
- Enhance Public Health and Safety
- Minimize Noise and Vibration
- Minimize Light Pollution
- Improve Community Mobility and Access
- Improve Site Accessibility, Safety, and Wayfinding
- Preserve Historic and Cultural Resources

- Leadership
  - Establish Sustainability Management System
  - Foster Collaboration and Teamwork
  - Stakeholder Involvement
  - Pursue By-Product Synergy Opportunities
  - Improve Infrastructure Integration
  - Address Conflicting Regulations and Polices
  - Extend Useful Life
- Resource Allocation
  - Reduce Net Embodied Energy
  - Support Sustainable Procurement Practices
  - Use Recycled Materials
  - Use Regional Materials
  - Reduce Excavated Materials Taken Off Site
  - Reduce Energy Consumption
  - Protect Fresh Water Availability
  - Reduce Water Consumption
  - Monitor Water Systems
- Climate and Risk
  - Reduce Greenhouse Gas Emission
  - Reduce Air Pollution Emission
  - Prepare for Long-Term Adaptability
  - Prepare for Short-Term Hazards

e. Long-term benefits and infrastructure renewal

The main objective of the clearwell redundancy development project is to mitigate the risks associated with the age and condition of the existing clearwell. To develop and implement viable alternatives, many of the existing facilities must be modified and updated, along with the construction and installation of new transmission mains, pump stations, and treatment facilities. Many of the upgrades and new facilities will not only accommodate temporary operation during the clearwell rehabilitation, but significantly improve reliability and efficiency of the PWSA's water supply system now and in the near future.

f. Constructability

The risk factor will capture all risk associate with the construction and of the proposed alternatives. Construction risks include risks associated with installation of the proposed facilities and its impact on the existing facilities whether owned by the PWSA or other entities.

g. Operations risk

The operations' risks criteria should capture risks associated with the remote possibility that the main objectives of this project (safe and reliable distribution of water at daily demands under worst case scenario) will not be able to be met due to potential failures of the equipment, weather related conditions, or other factors.

Table 11 presents a ranking matrix that will be used in the alternatives' evaluation process.

Table 11: Alternative ranking matrix

Criteria	Alternatives					
	1	2	3	4	5	6
Economic						
Project cost						
Economic score						
Non-economic						
Permitting and implementation schedule						
Water quality impact						
Operation and Maintenance						
Sustainability						
Long-term benefits and infrastructure renewal						
Constructability						
Operations risk						
Total non-economic score						
Total score						

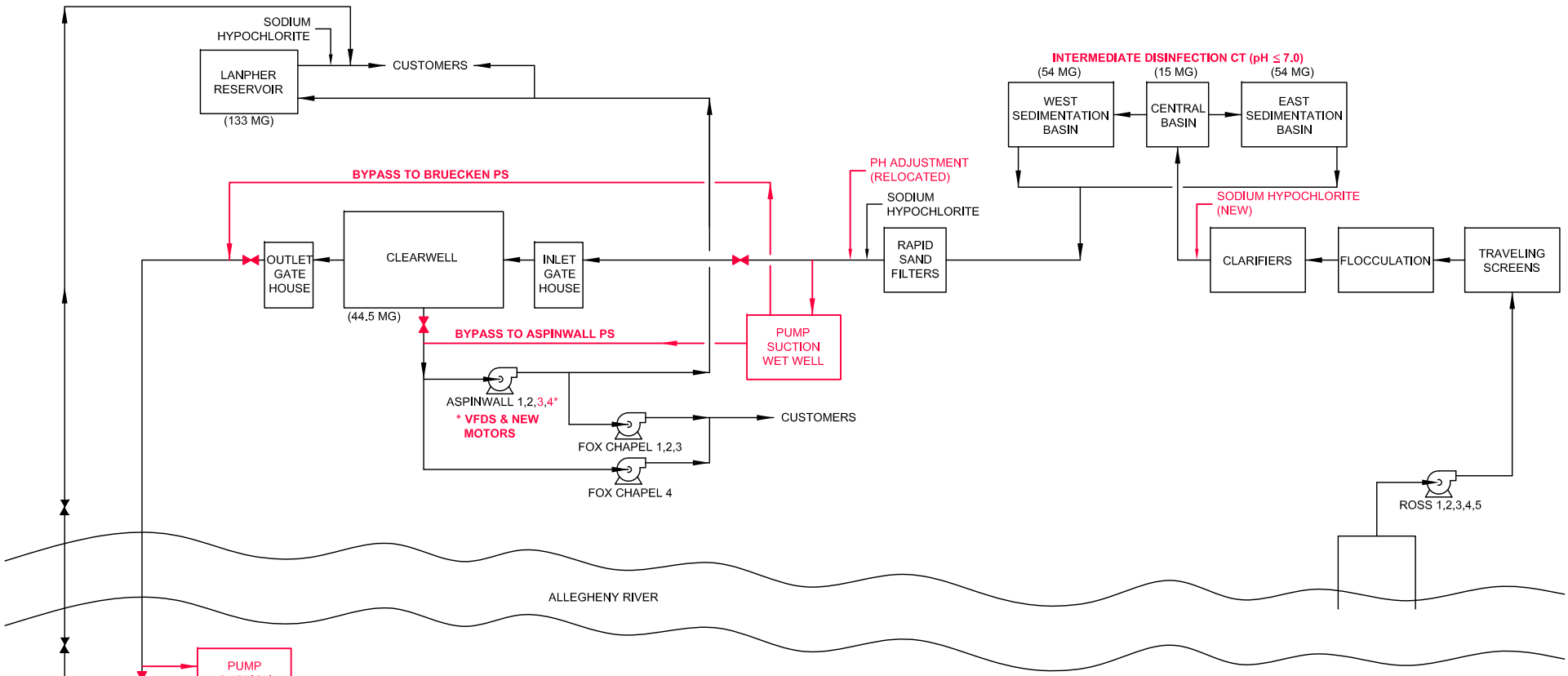
3.2 Alternative 1

For this alternative, the detention volume in the water treatment plant's existing secondary sedimentation process would be used to achieve the plant's required disinfection using free chlorine for one-log Giardia and two-log virus inactivation. This method of achieving disinfection would be used on a temporary basis during clearwell rehabilitation or replacement. A new pump suction equalization well and modifications to the Aspinwall and Bruecken Pump Stations would be required. Figure 3.1 presents a schematic, and Figure 3.2 presents a concept plan for this alternative.

3.2.1 Description of disinfection method

As shown in Figure 3.1, sodium hypochlorite would be added at the discharge of the clarification facility's effluent flume at the entrance of the clarified water pipeline that conveys clarified water by gravity to the sedimentation facility's central receiving basin. Unlike the finished water, which has a target pH of up to 8.5, the clarified water has a pH that is typically maintained at less than 7 for the purpose of optimizing coagulation chemistry. At this lower pH, less disinfection CT with free chlorine is required to achieve the required Giardia inactivation than for the higher pH finished water.

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MOTT MACDONALD

1600 W Carson St
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA

CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 3.1

ALTERNATIVE I SCHEMATIC

Designed	Drawn	Checked	Approved	Date
	JMG			

Exhibit RAW/C-30

SEDIMENTATION BASINS TO BE COVERED

WATER QUALITY ANALYZERS

Existing Lanpher Rising Main

Existing Clearwell

84" CLEARWELL BYPASS TO BRUECKEN

2 - 72" Bruecken Pump Suction Lines

Aspinwall Pump Station

RELOCATED FOX CHAPEL RISING MAIN

1.1 MG WET WELL

Fox Chapel Rising Main

Filter Building

Clarifier Building

96" Settled Water Line

96" Clarified Water Line

Bruecken Pump Station

Old Foundation

1.5 MG WET WELL

Legend

- Proposed Facilities
- RisingMain
- GravityMain

0 300 600 Feet

N W E S

Map Document: (C:\Users\wen74945\Documents\ArcGIS\PWSA\Alternative 1.mxd)
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MOTT MACDONALD

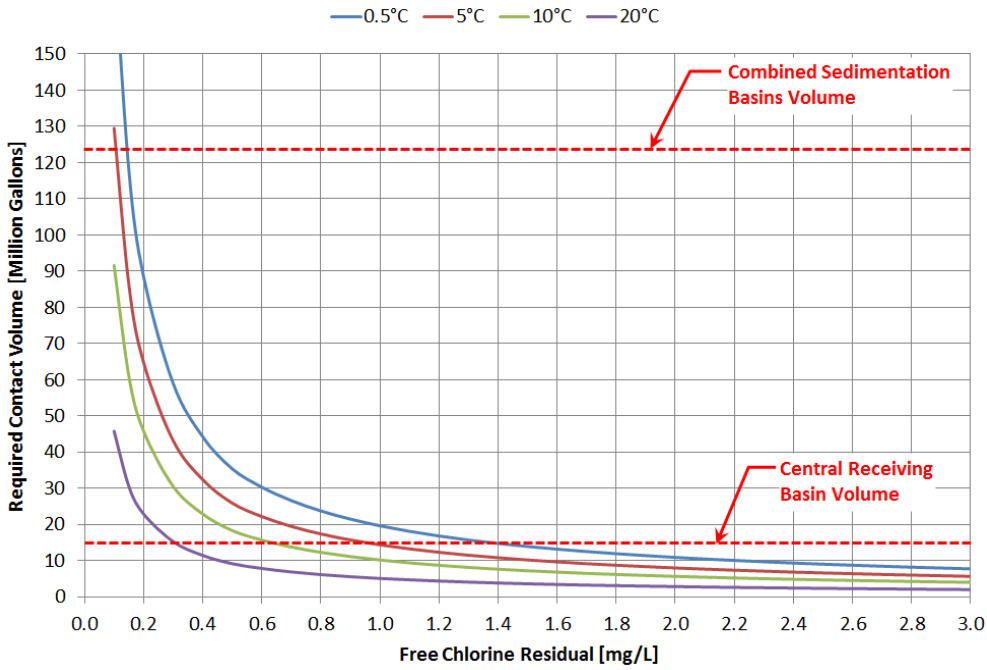
1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
CLEARWELL REDUNDANCY DEVELOPMENT
FIGURE 3.2
ALTERNATIVE 1 CONCEPTUAL PLAN

	Designed	Drawn	Checked	Approved	Date
		DWW			3/15/2016

Figure 3.3 is a graph of the required disinfection contact volume for a range of water temperature conditions when the treatment plant is operating at the maximum capacity of 117 MGD. The baffling classification for the sedimentation basins is assumed to be "poor." In accordance with the Surface Water Treatment Rule Guidance Manual, a poor baffling condition for a basin is described as "single or multiple unbaffled inlets and outlets, no intra-basin baffles." A baffling factor of 0.3 is applied when determining required disinfection contact volumes for poorly baffled basins. The required contact volume versus free chlorine residual curves for each temperature were developed based on the required CT to achieve one-log Giardia inactivation at the associated temperature at a pH of 7.0 and a basin baffling factor of 0.3. It is more difficult to achieve the required one-log Giardia inactivation than the required two-log virus inactivation using free chlorine. Therefore, the volume necessary for one-log Giardia inactivation is used to determine the minimum disinfection volume requirement in the analysis.

Figure 3.3
Clarified Water Disinfection Contact Volume Requirements
1-log Giardia Inactivation at 117 MGD, pH 7.0, BF = 0.3



The graph illustrates the two (2) options considered for achieving the required disinfection CT in the sedimentation basins. The first option involves using the entire volume of the three (3) sedimentation basins. If the full volume of the three (3) sedimentation basins is used, a measured effluent free chlorine residual of as little as 0.2 mg/L would be adequate to meet the disinfection requirements over the range of temperatures that may be experienced. The second option involves using the central receiving basin only. The graph shows that the volume of the central receiving basin may be adequate for achieving the disinfection requirements over the range of temperatures, albeit at a higher required residual of up to 1.4 mg/L at the maximum flow and coldest water conditions. This second option would require verification that the baffling factor of 0.3 is appropriate when applied to the central receiving basin volume alone. An implementation challenge for either of these options is determining the applied chlorine dose needed to achieve the required effluent residual, particularly if the basins are left open.

The main water quality concern associated with this disinfection alternative is that it would likely increase the formation of disinfection byproducts (DBPs) as the sedimentation basins may be providing some additional organics removal. The increase in DBP concentration largely depends on the clarified water quality characteristics and the effectiveness of the upstream clarifiers at removing total organic carbon (TOC) and specifically the portion of the TOC contributing to DBP formation prior to the sedimentation basins. The increase in DBPs may be such that the total trihalomethanes and halo acetic acids (TTHMs and HAA5s) are still below the regulatory requirements. As noted earlier, the location of the sedimentation basins in the treatment process is prior to final pH adjustment. The disinfection requirements may therefore be achieved at the clarified process water's lower pH of 7.0, rather than at the finished water pH, which would be as high as 8.5. The lower pH reduces the required CT for free chlorine and may help mitigate the impact on overall DBP formation, particularly with respect to TTHMs.

This alternative was reviewed with the PADEP and the Allegheny County Health Department (ACHD). At the December 15, 2015 alternatives presentation meeting and subsequent communication, PADEP suggested that covering the sedimentation basins would be prudent and may be required. PADEP indicated that they have plants that achieve part of their disinfection CT in open basins, but they do not have any plants that achieve all of their disinfection CT in open basins. PADEP indicated that bench testing would be an acceptable method to assess the impact of pre-chlorination and that pilot testing would not be needed. The bench testing would need to capture at least three (3) seasons and the third quarter, which is typically the highest DBP season. PADEP stated that the bench testing would need to address the impact of the open basins on chlorine demand if maintaining open basins is proposed. PADEP indicated that they were open to the idea of a full-scale demonstration test using sodium hypochlorite. It was also discussed that there may be some benefit to performing some bench testing/full scale trials to improve DBP precursor removal, which would reduce DBP formation and provide additional data to determine if Alternative 1 will not cause DBP exceedances in the distribution system. The protocol for the bench testing and demonstration testing would need to be approved by PADEP.

For the purposes of this evaluation, it is proposed that this alternative will require the following improvements for implementation of the alternate disinfection method:

- Bench testing/demonstration testing to determine chlorine demand and DBP formation impacts.
- Tracer testing to confirm appropriate baffling factors for sedimentation basins.
- New sodium hypochlorite feed pumps, located in the Sodium Hypochlorite Building, for new clarifier effluent feed point.
- New sodium hypochlorite injection point at clarifier effluent flume outlet including chemical piping and diffusers.
- Sample pump and piping system and chlorine residual and pH analyzers for the Central Receiving Basin inlet and effluent and the East and West Sedimentation Basin effluents. Equipment could be in the Old Administration Building.
- Cleaning of the sedimentation basins
- Sedimentation basin covers; floating covers were used for the cost estimate

3.2.2 Description of storage and distribution

In order to provide an uninterrupted, safe, and reliable water supply throughout the system during the clearwell rehabilitation/replacement work, changes to the current pumping operation and distribution would have to be made.

In the current operation, the service area demands are met by distributing water from one (1) of the three (3) primary reservoirs: Lanpher, Highland No. 1 and Highland No. 2. As described in Section 2, Lanpher Reservoir is continuously filled via a set of four (4) constant speed, centrifugal pumps at the Aspinwall Pump Station, adjacent to the clearwell. Highland No. 1 and Highland No. 2 Reservoirs are continuously supplied from the Bruecken Pump Station located across the river from the WTP. There is a total of six (6) double stage constant speed centrifugal pumps, three (3) of which are dedicated to Highland No. 1 Reservoir and two (2) dedicated to Highland No. 2 Reservoir, while one (1) pump can send the finished water to either Highland No. 1 or Highland No. 2.

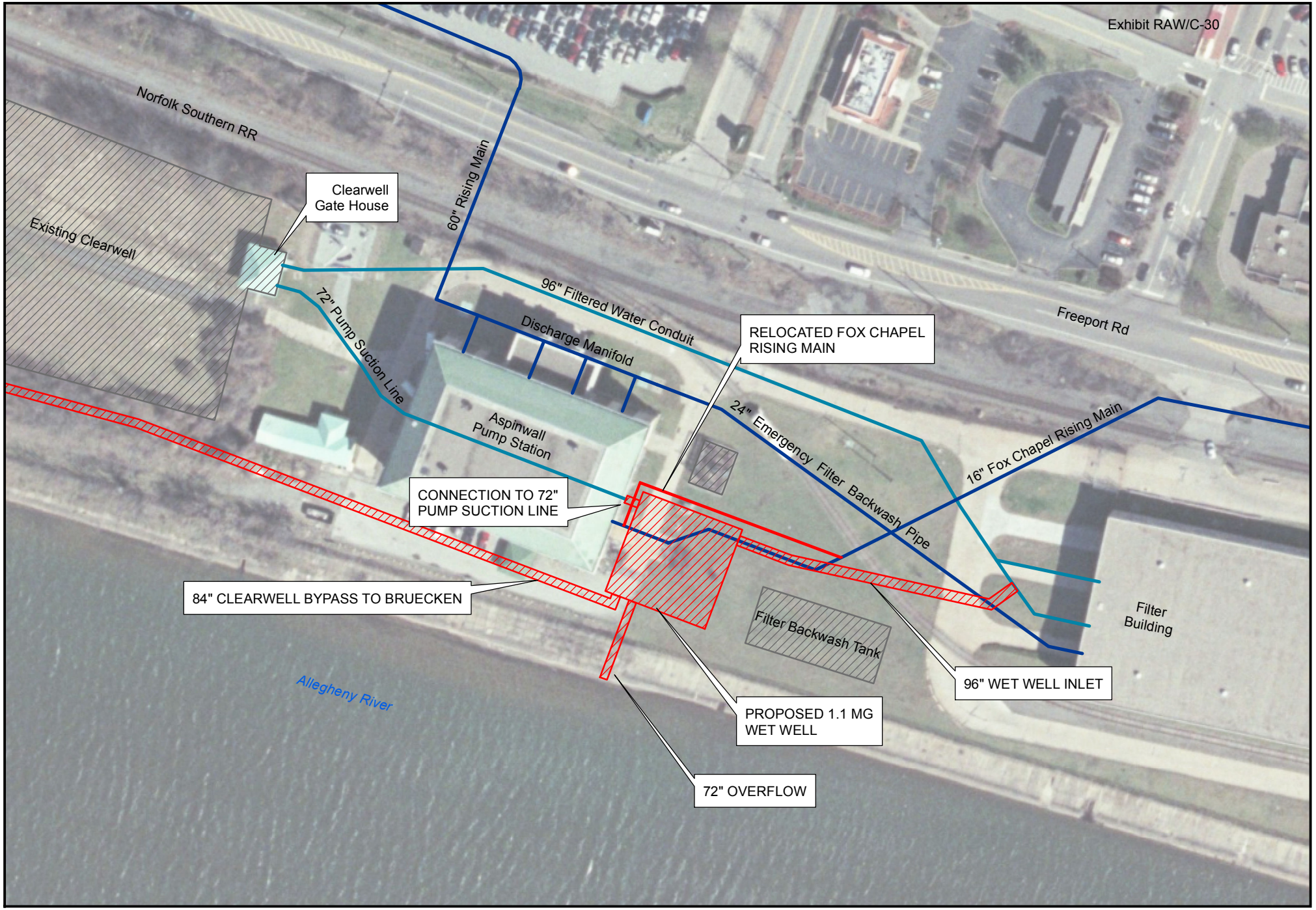
According to the PWSA staff, the current pumping operation is generally conducted in a way to maintain a preset elevation at the Lanpher, Highland No. 1, and Highland No. 2 Reservoirs. If the operators identify or anticipate a change in demand, they can increase or decrease the number of pumps in operation while maintaining a preset level and pressure within the system. This simple operating procedure is enabled by the existence of the 44 million gallon clearwell which provides a significant buffer volume that can easily equalize the system's demand and production of water.

One of the challenges in implementation of this and other alternatives would be to ensure the safe and reliable operation of the Aspinwall and Bruecken Pump Stations without jeopardizing the reliability of the water supply system. As shown in Figure 3.2, under Alternative 1, the new suction well structures would be built in the vicinity of each pump station which would allow for uninterrupted and reliable operation.

a. Facilities description

The Aspinwall Pump Station must maintain its capacity at the established maximum demand, estimated at 19,440 gpm (28 MGD). Under this scenario, Pump Nos. 3 and No. 4 would be equipped with new motors and variable frequency drives (VFD) to allow for the safe and timely operation of the pumps. The pump synchronous type motors will be replaced with induction type rated for inverter duty. The existing breakers should be used to feed the variable frequency drives, thereby using the existing 2400-volt switchgear merely as a means of disconnect and feeder protection. If the size of the motors is changed, the disconnects and the electrical feeders must be evaluated to determine if they are compatible with the new motors' rating. The pumps' speed would be automatically adjusted to maintain a narrow level band in the suction well. The average demand in the Lanpher Reservoir supply district is estimated at 17.6 MGD. For the majority of time, this demand will be met by only one (1) pump in service; however, the peak or the extreme demand conditions (even in case of a failure of Pump No. 4), can be met by utilizing any combination of the four (4) pumps. Information about the pumps, motors, and other equipment used to evaluate this alternative is presented in Appendix A.

The pumps can be sped up and slowed down to respond to any changes in water production and demand. The level in the suction well would be maintained at the elevation span of 744.5 to 748.5 feet as used in current operation. The elevation of the centerline of the pumps' impeller is reported at 750.25. It is apparent that the pump will continue to use the existing priming system. The suction well should be sized to allow for the change in the elevation span to occur in no sooner than 5 to 10 minutes. This would require a minimum pumping volume of 95,000 gallons for a 4-foot operating band. An approximately 25-foot deep suction well, with an emergency overflow line, would be constructed at the best available location, either west or east of the pump station. The preferred location identified during the limited investigation for this report is to the east of the pump station; however, the final decision should be made during the detailed design phase. For this arrangement, a common suction well supply line for both Bruecken and Aspinwall Pump Stations sites would be constructed with minimum interruption of the ongoing operations. The proposed facilities arrangement is shown in Figure 3.4.



Legend

- Proposed Facilities
- Existing Facilities

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FIGURE 3.4
ASPINWALL PS PROPOSED FACILITIES

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	DWW			3/15/2016

As shown in Figure 3.2, a new 84-inch by-pass line would be constructed between the existing clearwells influent and effluent gate house, which would connect to the existing pair of 72-inch Bruecken Pump Station supply pipes under the Allegheny River. The maximum demand at the Bruecken Pump Station is estimated to be around 61,000 gpm (88 MGD), with 39,000 gpm (56 MGD) pumped to Highland No. 1 Reservoir and 22,000 gpm (32 MGD) delivered to Highland No. 2 Reservoir. In order to provide an uninterrupted and reliable operation of pumps at the Bruecken Pump Station, a suction well would be constructed in the yard next to the pump station. A pumping volume of 300,000 gallons would be needed to allow for a smooth pumping operation, maintaining the level in the suction well between approximate elevations of 743 and 747 feet. This would require the construction of, at minimum, 10,000 ft^2 structure along with an emergency overflow and associated equipment and instrumentation, as shown in Figure 3.5.

Pump Nos. 2, 3, 5, and 6 would be equipped with variable frequency drives. This would allow for tight control of continuous pumping operations while delivering the required system demands. The pump synchronous type motors will be replaced with an induction type rated for inverter duty. The existing starters should be replaced with variable frequency drives using the existing 2400-volt switchgear merely as a means of disconnect and feeder protection. In the event that the size of the motors is changed, the disconnects and the electrical feeders must be evaluated to determine if they compatible with the new motors' rating. If not, they must be replaced. In order to meet the objective of this project, it is not recommended to change the main bus voltage to 4160 volts. This would entail the power company having to replace its main transformers to provide the 4.16 KV secondary voltage. It would also require replacing the main switchgear and all secondary transformers providing low voltage for the station that at this point may be cost prohibitive.

However, due to the age and condition of the equipment, an in-depth analysis should be conducted to determine whether an entire upgrade of the electrical service and equipment could be undertaken and whether it could be conducted simultaneously with other improvements needed to accomplish the objectives of this project.

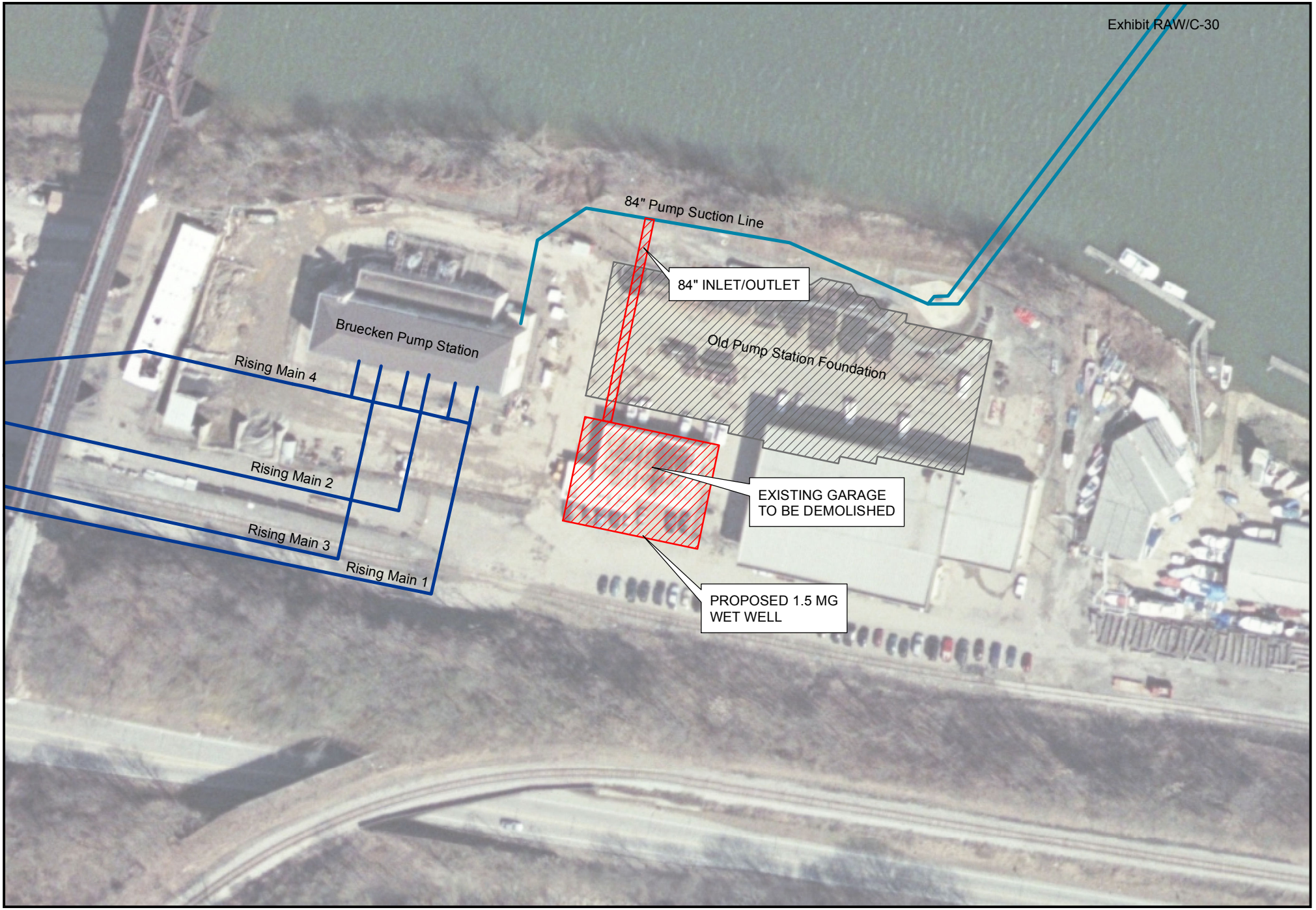
The peak flow to the Highland No. 2 Reservoir would be delivered by Pump Nos. 5 and 6 while Pump Nos. 2 and 3 would be used to pump the peak demand to Highland No. 1 Reservoir. A limited hydraulic analysis shows that this pumping arrangement would be sufficient to maintain the maximum demand in the system. More information on equipment used for this evaluation is presented in Appendix A.

This report acknowledges that the existing pumps, motors, and ancillary equipment are rapidly approaching the end of its useful life. Although this report is focusing on clearwell rehabilitation, it is important to acknowledge that an upgrade or replacement of other equipment would improve efficiency, reliability, and cost of future operations.

3.2.3 Project implementation

3.2.3.1 Constructability

Construction of any facilities, temporary or permanent, must be carefully planned and meticulously staged to allow for a minimum amount of production interruption and interference with existing facilities. The following presents a brief description of construction challenges and a preliminary sequence.



Legend

- Proposed Facilities
- Existing Facilities

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FIGURE 3.5
BRUECKEN PS PROPOSED FACILITIES

	Designed	Drawn	Checked	Approved	Date
		DWW			3/15/2016

The first step in the implementation of the project will be the construction of suction well facilities at the Aspinwall and Bruecken Pump Station sites. A detailed utilities and geotechnical investigation must be conducted during the project's design phase. At the same time, the upgrades to the mechanical and electrical equipment at each pump station will take place one (1) pump at a time to ensure uninterrupted operation during construction.

In order to construct the suction well facility east of the Aspinwall pump station (see Figure 3.4), the 16-inch Fox Chapel force main alignment will be relocated, and the existing railroad spur temporarily abandoned. The suction well will be connected to the existing 72-inch pump station's suction manifold through the existing connection on the pump station's east side. During the geotechnical and utility investigation phase of design, this connection should be uncovered to determine its existence and the appropriate ways to make the connection. Similarly, a final decision regarding the clearwell by-pass piping and suction well feed lines will be made after the thorough geotechnical and utilities investigation phase.

The construction of the new suction well facility at the Bruecken Pump Station site will also require a very detailed preparation and meticulous planning. The site for the proposed 10,000 ft^2 suction well is in the yard to the east of the pump station. The location of this facility shown in Figure 3.5 takes the place of the former pump station site demolished in 1930s. The site utilities and geotechnical investigation should provide clear guidance as to whether the site can be modified within a reasonable effort to house the suction well facility. Alternatively, the suction well could be built to the south on the location of the existing maintenance facility. This facility could potentially be relocated either to the newly acquired property west of the pump station or another location as determined by the PWSA.

a. Sequence of construction

The following is a simplified overview of the expected construction sequence:

- Clean sedimentation basins (this can be done in advance of the construction during the project design phase by a specialized cleaning contractor).
- Construct facilities at Aspinwall Pump Station site.
  - Relocate all utilities that interfere with the new construction.
  - Construct Suction Well Facility at Aspinwall and Bruecken, 96-inch and 72-inch by-pass piping, with an overflow pipes and outfall facilities.
  - Implement structural improvements to accommodate the installation of new drives.
  - Replace and install a new motor and VFD for Pump No. 3. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate pump station brief shutdown to connect the new motor, drive, and associated PLC.
  - Start Pump No. 3.
  - Replace and install new motor and VFD for Pump No. 4. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate the pump station's brief shutdown to connect the new motor, drive, and associated PLC.
  - Start Pump No. 4.
  - Construct emergency power facilities (if included in this project).

- Construct facilities at the Bruecken Pump Station site.
  - Relocate all utilities that interfere with the new construction.
  - Construct suction well facility at Bruecken, with an overflow pipe and outfall facilities.
  - Replace and install new motor and VFD for Pump Nos. 2 and 6. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate pump station brief shutdown to connect the new motor, drive, and associated PLC.
  - Start Pumps Nos. 2 and 6 (one at a time).
  - Repeat construction sequence for Pump Nos. 3 and 5.
  - Construct emergency power facilities (if included in this project).
- Coordinate the shutdown of Aspinwall Pump Station to connect the new suction well facility.
- Start-up the Aspinwall temporary pumping facilities.
- Coordinate shutdown of Bruecken Pump Station to connect the new suction well facility.
- Start-up the Bruecken temporary pumping facilities.

3.2.3.2 Permitting and project implementation schedule

The sensitive nature of the construction of drinking water facilities often result in the long duration of planning, permitting, and construction activities. The implementation of this alternative cannot even begin its design phase until the water quality aspects are tested and the results accepted by permitting agencies as described in this section. The following is a list of permits that would have to be obtained prior to construction:

- Public Water Supply Management Permit
- Construction Permits:
  - NPDES permit (discharge from the construction activities over 1 acre if applicable)
  - Erosion and Sediment Control (with or without NPDES)
  - 404 Joint permit USACOE and PADEP Pennsylvania Water Encroachment

Table 3.1 presents estimated timeline for the implementation of Alternative 1.

Table 12: Alternative 1 implementation timeline

Activity No.	Activity Description	Activity Duration
1	Water quality test and report approval	Month 1-12
2	Design	Month 13-30
3	Permitting	Month 31-33
4	Bidding and project award	Month 34-36
5	Construction of facilities	Month 37-60

3.2.3.3 Water quality impacts

This alternative is expected to increase disinfection byproduct formation due to the dosing of sodium hypochlorite to the clarified water process stream, which is prior to achieving maximum organics removal in the treatment process. Upsets in the primary clarifier treatment process leading to higher organics and solids loads in the sedimentation basins during disinfection would be expected to have a more significant impact on disinfection byproduct formation at the plant than the current disinfection method. Cleaning

and covering the sedimentation basins may provide some water quality benefits by reducing the risk of re-dissolving accumulated settled solids in the short term and limiting algae growth long term.

3.2.3.4 Operations

a. Operations control and risks

The operation of the water supply system during the clearwell rehabilitation will require detailed preparation and strict implementation. The limited available pumping volume at the pump stations will require that the pumping rate at each pump station matches the rate of the filters' effluent rate. A new programming logic controller (PLC) will be installed at each pump station to ensure that the pumps output match the water treatment plant's production. The signal shall be transferred to the main operations desk where the operators will ensure that the system is operating as designed. An emergency overflow will be installed at each station in case of system failure. During this period, the entire City Water System Supply must be closely monitored for daily and seasonal changes. This may require a temporary change in the overall operations approach. For example, in the case of emergency demand requirements in the system, the operations will use available volume from the system's reservoirs until either the emergency ceases or the plant's production increases to catch up with the system's demand. Hydraulic modeling of this temporary operations simulated an emergency water demand in each of the three reservoirs' sectors must be conducted prior to the alternatives system design takes place.

The operators will have at their disposal a combination of variable and constant speed-driven pumps and will be able to match any required output. A detailed operations sequence should be developed during the design phase.

In order to provide a full reliability of the temporary arrangements, each of the pumping stations should be equipped with the emergency power supply facilities.

b. Maintenance

Maintenance of the temporary system will follow the same standard operating procedures established for the current operations. The addition of new chlorination equipment, by-pass lines and appurtenances, suction wells, and new electrical equipment will require extra time and effort to ensure that the new equipment and facilities operate as designed. However, it is not expected to see any significant time or funds dedicated towards the maintenance of the new facilities.

3.2.3.5 Sustainability

As described above, some of the main sustainability criteria have been reviewed and where appropriate will be applied throughout the planning, design, and construction of the selected project. The main objective of this project is to minimize the risks of failure of the City of Pittsburgh water supply system's failure and to extend useful life of the existing facilities. Implementation of this alternative will, at minimum, improve the quality of life not only by enhancing public health and safety but by limiting the construction to the PWSA's property, thereby eliminating any impact to the community or public property. It will also promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration, and extending the useful life of the existing clearwell by allowing for its rehabilitation. The sustainable impact of this alternative can be identified in the category of resource allocation. Reduction in net energy consumption by utilizing variable speed motors, the use of regional materials (this should be developed during the project design phase), and protection of our fresh water availability.

3.2.3.6 Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefit of the temporary facilities; including reservoirs, pipes, process equipment, electrical equipment, and all other facilities. The additions to the treatment process (additional chemical feed locations and equipment) will remain in place and could potentially be reused in the future if needed. The upgrade of Aspinwall and Bruecken Pump Stations consisting of the replacement of the motors and addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied structure should be considered. For example, at the Bruecken Pump Station Site, the suction well could potentially be built to allow for the future addition of some type of super structure that could be used in day to day operations.

3.2.4 Cost estimate

The estimated capital cost for the implementation of Alternative 1 is $50,360,000. Summary of capital cost breakdown by construction divisions is presented in Table 13.

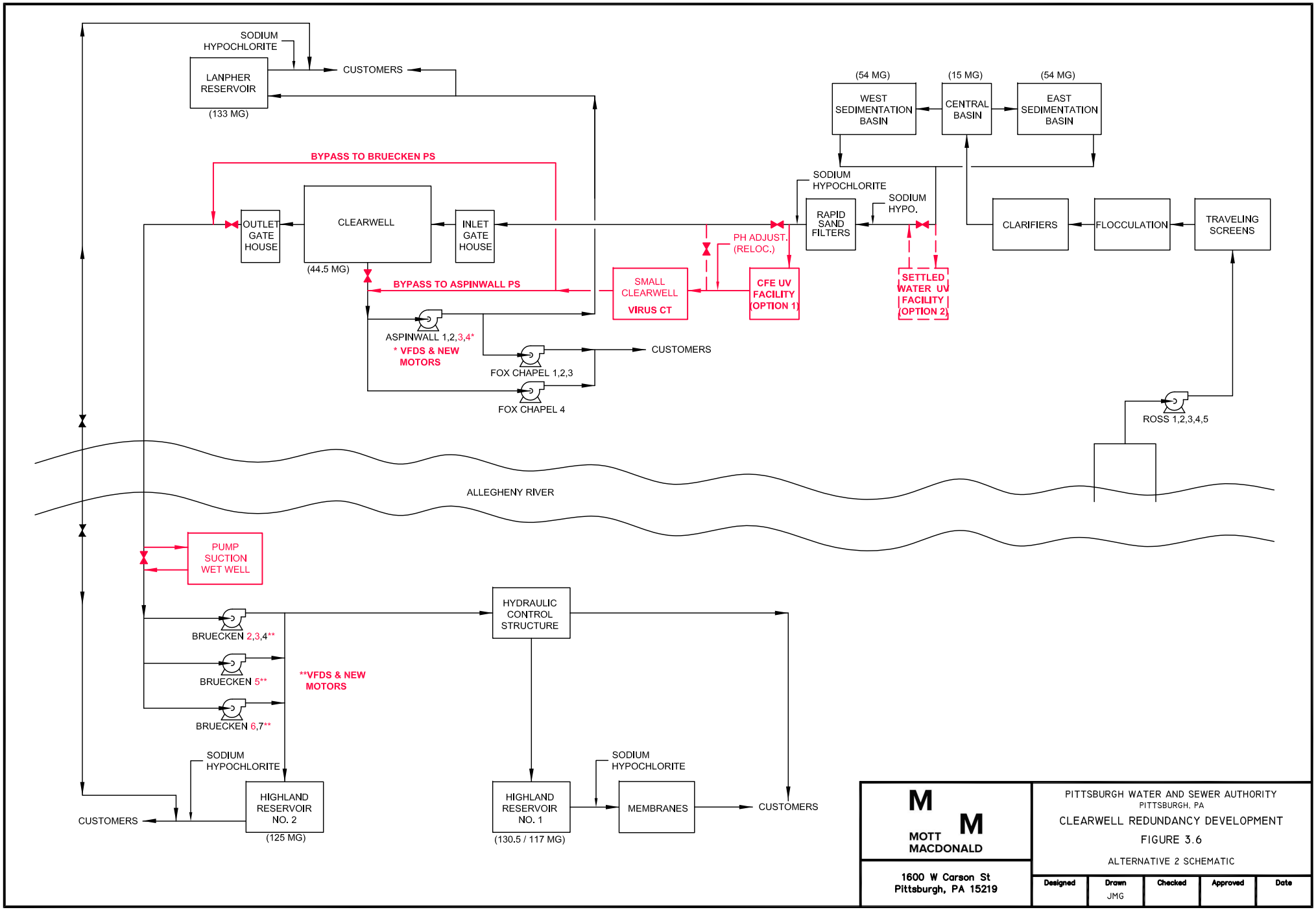
Table 13: Alternative 1 capital cost estimate

Division	Cost
Division 0 – General Conditions	$1,370,000
Division 2 - Sitework	$16,320,000
Division 3 – Structural	$3,690,000
Divisions 4 through 10 – Architectural	$3,330,000
Division 11 – Equipment	$210,000
Division 13 – I&C	$30,000
Division 15 – HVAC, Plumbing, and Fire	$360,000
Division 16 – Electrical	$3,470,000
Subtotal Division 0 through 16	**$28,780,000**
Contingencies @ 40 Percent	$11,510,000
Engineering, CM, Legal, PM @ 25 Percent	$10,070,000
Total estimated capital cost	**$50,360,000**

3.3 Alternative 2

For this alternative, ultraviolet (UV) disinfection would be used to achieve credit for one-log Giardia inactivation and free chlorine would be used in a new, smaller clearwell to achieve two-log virus inactivation. This method of achieving disinfection would be required on a temporary basis during clearwell rehabilitation or replacement but would involve the installation of a permanent UV facility that may provide added long-term treatment benefits. New pump suction equalization well and pump modifications for the Aspinwall and Bruecken Pump Stations' pumps would be required. Figure 3.6 presents a schematic and Figure 3.7 presents a conceptual plan for this alternative.

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FIGURE 3.6

ALTERNATIVE 2 SCHEMATIC

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Exhibit RAW/C-30

Existing Lanpher Rising Main

ALTERNATE LOCATION:
SETTLED WATER UV
FACILITY

96" Settled Water Line

96" Clarified Water Line

Existing Clearwell

84" CLEARWELL BYPASS
TO BRUECKEN

Aspinwall
Pump Station

RELOCATED FOX
CHAPEL RISING MAIN

Fox Chapel Rising Main

1.1 MG
WET WELL

Filter Building

Clarifier Building

COMBINED FILTER
EFFLUENT UVFACILITY

2 - 72" Bruecken Pump Suction Lines

Bruecken
Pump
Station

Old Foundation

1.5 MG
WET WELL

Legend

- Proposed Facilities
- RisingMain
- GravityMain

0 300 600 Feet

N W E S

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FIGURE 3.7
ALTERNATIVE 2 CONCEPTUAL PLAN

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		DWW			3/15/2016

3.3.1 Description of disinfection method

Under this alternative, ultraviolet (UV) disinfection would be used to achieve credit for one-log Giardia inactivation and free chlorine would be used to achieve two-log virus inactivation. The use of UV for disinfection credit is permitted by the EPA and PADEP provided that the requirements of the EPA's Ultraviolet Disinfection Guidance Manual (UVDGM) are followed. Table 14 presents the UV dose requirements developed by the EPA for Public Water Systems to receive credit for inactivation of Cryptosporidium, Giardia, and viruses. The UV dose values in the table are applicable to post-filter applications of UV disinfection in filtered systems and to unfiltered systems.

Table 14: UV dose requirements in millijoules per centimeter square (mJ/cm2)*

Target Pathogens	Log inactivation							
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12	15	22
Giardia	1.5	2.1	3.0	5.2	7.7	11	15	22
Virus	39	58	79	100	121	143	163	186
* 40 CFR 141.720(d)(1)								

Table 14 shows that UV dosages for two-log virus inactivation are much higher than for one-log Giardia inactivation; therefore, it is typically more cost effective to achieve virus inactivation with free chlorine than with UV. As such, for this disinfection alternative a limited volume clearwell sized to meet the two-log virus inactivation CT requirements is proposed in conjunction with UV disinfection for one-log Giardia inactivation.

Locations for UV disinfection facility installation that were initially considered as part of this evaluation were on the combined filter effluent in a below grade chamber between the filter building and Aspinwall Pump Station and on the effluent of each individual filter in the filter pipe gallery. The PWSA subsequently requested that a third location also be considered upstream of the filters on the sedimentation basin effluent near the old Administration Building. Due to the complexity of an individual filter effluent installation, it was determined during the December 10, 2015 project workshop that this location was less feasible and was eliminated from further consideration.

Either medium pressure (MP) or low pressure high output (LPHO) UV reactors may be used. MP systems require more energy as well as cooling water for operation but have a smaller footprint. LPHO systems use less energy and have a longer lamp life but have a larger footprint. Preliminary UV reactor sizing was obtained from Trojan UV for both MP and LPHO systems for the combined filter effluent using an assumed filtered water quality UV transmittance of 90 percent. According to data provided by the PWSA, the UV transmittance tests indicated that the UV transmittance was on the order of 92 percent. Based on Trojan UV's preliminary reactor sizing, a four (4) train LPHO system was selected for the conceptual design due to its lower head loss characteristics, lower energy usage, and lack of cooling water requirement in comparison to the equivalent MP system. The system would require a 48-inch diameter, eight-lamp reactor for each train able to treat up to 40 MGD. The system would have sufficient capacity to treat 117 MGD of flow with three (3) of the four (4) trains on line. Should this alternative be selected as the optimum solution for clearwell redundancy, the UV reactor type and configuration can be confirmed and further optimized. More information on equipment reviewed in preparation of the report is presented in Appendix B.

Figure 3.8 is a conceptual layout for the UV facility at the combined filter effluent location. The equipment and facility sizing for a UV facility at the sedimentation basin effluent location option is expected to be similar. Additional water quality information and further discussions with PADEP will be required before the sedimentation basin effluent location option is accepted by PADEP. The PADEP has indicated that they have some questions regarding the applicability of the UV disinfection doses provided in the UVDGM for this process location.

Figure 3.8
UV Facility Conceptual Layout

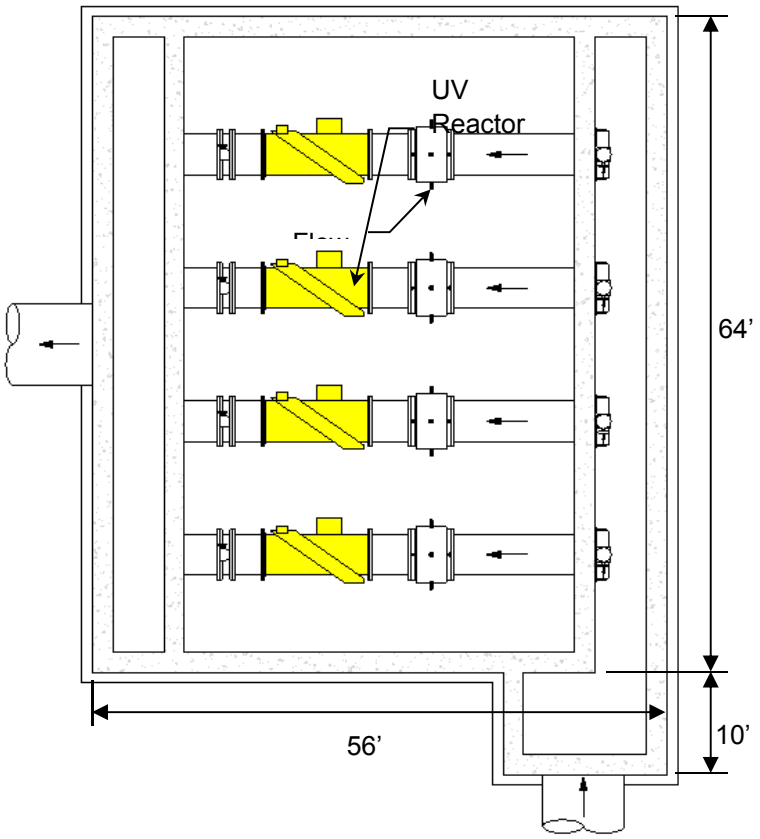
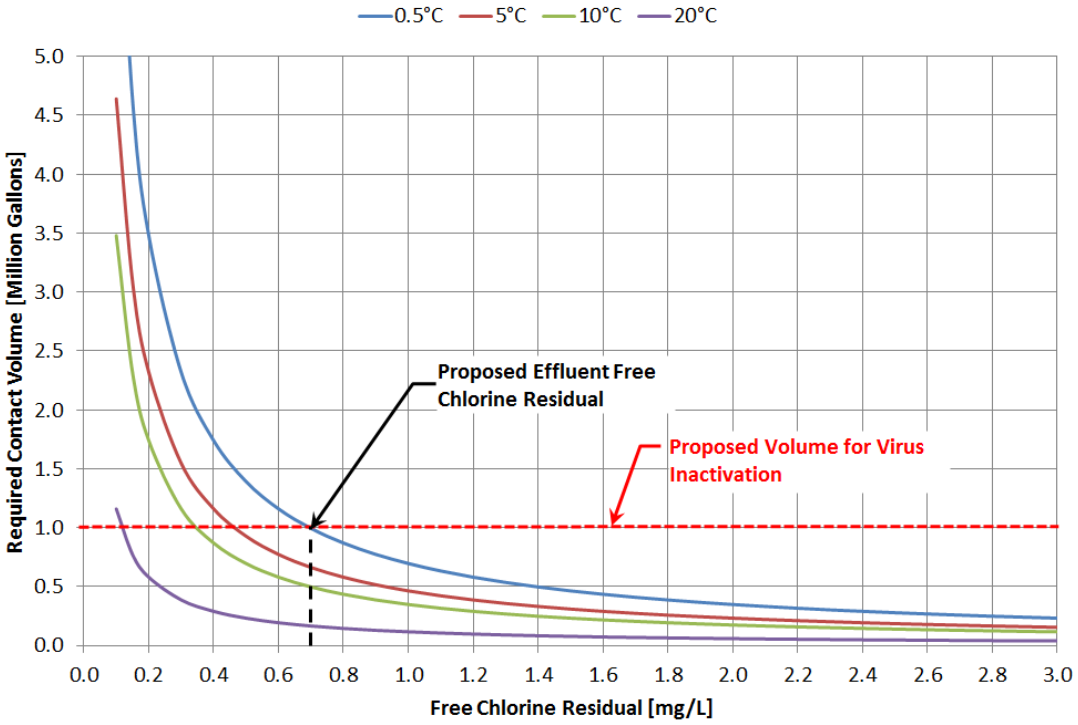


Figure 3.9 is a graph of the required two-log virus inactivation disinfection contact volume for a range of water temperature conditions when the treatment plant is operating at the maximum capacity of 117 MGD. The new clearwell for achieving the two-log virus inactivation CT requirements would be designed to have a minimum baffling classification of “Superior” which permits the use of a baffling factor of 0.7 in the CT volume requirement calculations. The required contact volume versus chlorine residual curves for each temperature were developed based on the required CT to achieve two-log virus inactivation at the associated temperature and a pH of up to 9.0.

Figure 3.9
Filtered Water Disinfection Contact Volume Requirements
2-log Virus Inactivation at 117 MGD, pH 6 - 9, BF = 0.7



Based on the calculation results presented in Figure 3.9, it is proposed that a small clearwell with a volume for the virus disinfection CT of approximately 1,000,000 gallons be provided to achieve two-log virus inactivation. With a disinfection volume of this size, the plant can maintain an effluent chlorine residual of 0.7 mg/L, which is consistent with the current clearwell effluent free chlorine residual. The clearwell will also have additional capacity above that which is required for disinfection so that it can also provide pump suction equalization. The requirements for pump equalization are discussed above.

This alternative will require the following improvements for implementation.

<u>Option 1 – Combined Filter Effluent Location:</u>

- Approximately 56-foot by 64-foot chamber with four (4) low pressure high output UV reactor trains (three duty, one standby), with dedicated flow meters and manual sluice gates and automated valves for train isolation.
- Superstructure/building to house ballasts and electrical components.
- Approximately 1,100,000 gallon filtered water clearwell with a minimum baffling factor of 0.7 for 2-log virus CT at a free chlorine residual of 0.7 mg/L
- Bench testing would be needed to confirm UV transmittance over the range of filtered water quality

Option 2 – Sedimentation Basin Effluent Location:

- Approximately 56-foot by 64-foot chamber with four (4) low pressure high output UV reactor trains (three duty, one standby), with dedicated flow meters and manual sluice gates and automated valves for train isolation.
- Settled water diversion chamber with sluice gates to divert settled water flow through UV facility.
- Superstructure/building to house ballasts and electrical components.
- Approximately 1,100,000 gallon filtered water clearwell with a minimum baffling factor of 0.7 for two-log virus CT at a free chlorine residual of 0.7 mg/L.
- Bench testing would be needed to determine UV transmittance over the range of settled water quality.
- Purchase of property/easement for new facilities adjacent to sedimentation basins behind shopping center.

3.3.2 Description of storage and distribution

The proposed clearwell for virus disinfection CT will also provide adequate pumping volume for the operation of Aspinwall Pump Station. Upgrades to the pump stations at Aspinwall and Bruecken will be identical to the upgrades proposed for Alternative 1 as explained above.

3.3.2.1 Facilities description

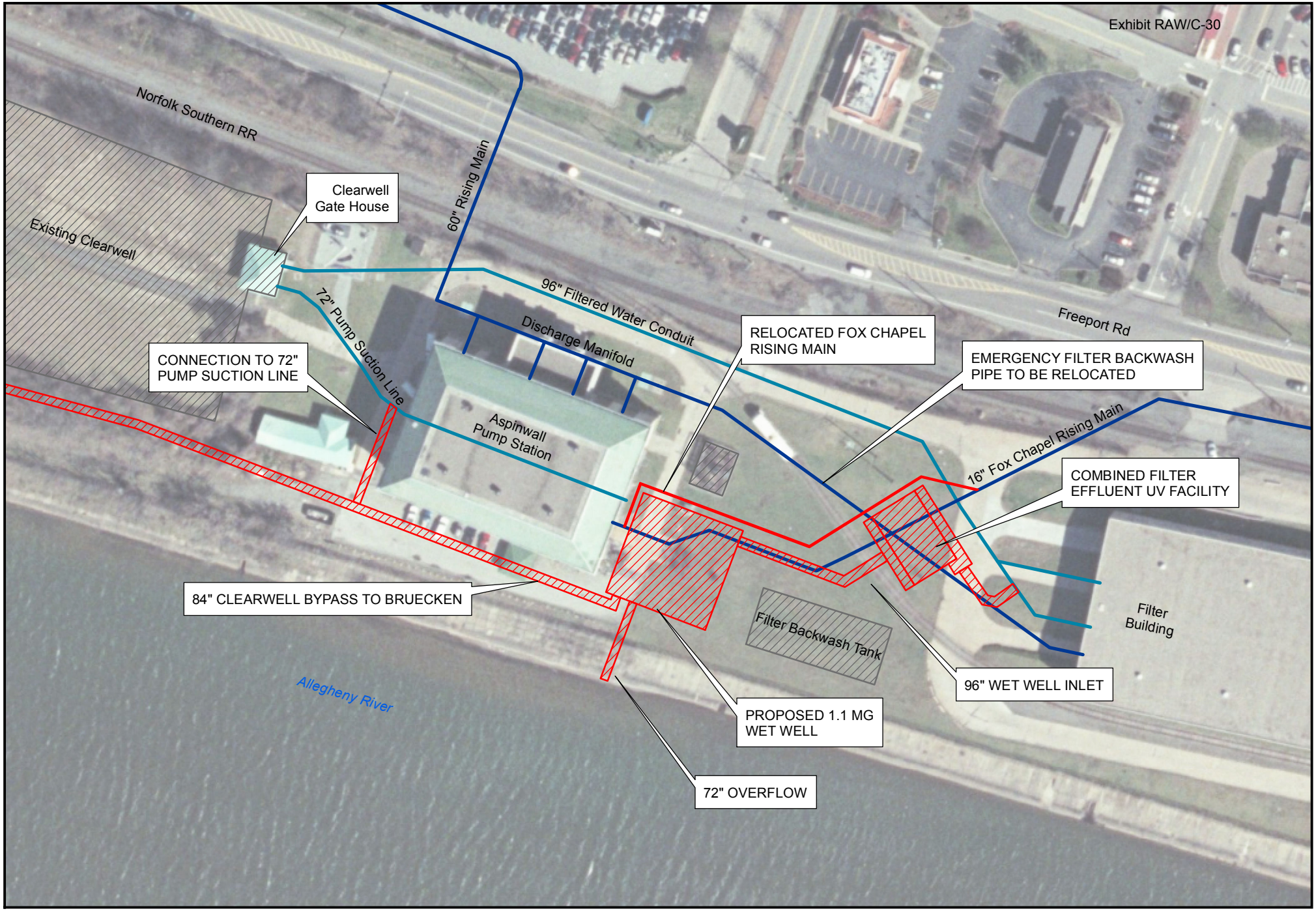
In addition to the disinfection requirements, the new 1.1 million gallon clearwell will have the extra volume necessary to provide for continuous pumping utilizing pumps driven by VFDs. A 25-foot deep suction well/clearwell with an emergency overflow line would be constructed east of the pump station, as shown in Figure 3.10. The new clearwell would receive the filtered water after passing through the new UV facility. The suction well would be configured with a system of baffle walls to provide short circuiting and ensure required CT.

New feeders to power the UV Reactors would be provided. The UV equipment would be supplied power from the 480-volt secondary system motor control center. New circuit breakers would need to be installed in the motor control center (MCC) to protect the new feeders. In the event that no space is available, an additional cubicle would need to be added or an available power panel could be used or added to the system for this purpose.

3.3.3 Project implementation

3.3.3.1 Constructability

As explained in Alternative 1 the first step in the implementation of the project will be the construction of clearwell/suction well facilities at the Aspinwall and Bruecken pump station sites, along with the construction of the UV facility. A detailed utilities and geotechnical investigation must be conducted during the project's design phase. At the same time, the upgrades to the mechanical and electrical equipment at each pump station would take place, one pump at a time, to ensure uninterrupted operation during construction.



Legend

- Proposed Facilities
- Existing Facilities

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Map Document: (C:\Users\wen74945\Documents\ArcGIS\PWSA\AspinwallSiteClearwellUV.mxd)
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FIGURE 3.10
PROPOSED DISINFECTION FACILITIES

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The construction of the UV facility and the temporary clearwell at the Aspinwall Pump Station site will be a challenging task considering the variety of underground and aboveground utilities, the railroad spur, driveways, and other existing facilities. It appears that at least one (1) utility pole would have to be relocated, which may require a prolonged outage. A detailed relocation plan must be developed during the early design phase of the project.

The critical component of the construction will be the connection of new facilities to the existing system. This will be done in close collaboration with the PWSA staff in order to minimize the production shutdown time.

c. Sequence of construction

The following is a simplified overview of the expected construction sequence:

- Construct facilities at the Aspinwall Pump Station Site
  - Relocate all utilities that interfere with the new construction.
  - Construct the suction well facility, 96-inch and 84-inch by-pass piping, with an overflow pipes and outfall facilities.
  - Construct the UV facility.
  - Implement structural improvements for the VFD's installation.
  - Replace and install a new motor and VFD for Pump No. 3. Install all ancillary electrical equipment and wiring necessary for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
  - Start Pump No. 3.
  - Replace and install a new motor and VFD for Pump No. 4. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
  - Start Pump No. 4.
  - Construct the emergency power facilities (if included in this project).
- Construct facilities at the Bruecken Pump Station Site.
  - Relocate all the utilities that interfere with the new construction.
  - Construct the suction well facility at Bruecken, with an overflow pipes and outfall facilities.
  - Replace and install a new motor and VFD for Pump Nos. 2 and 6. Install all ancillary electrical equipment and wiring necessary for the installation. Install PLC- related instrumentation and supporting wiring for pump operation.
  - Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
  - Start Pump Nos. 2 and 6 (one at a time).
  - Repeat construction sequence for Pump Nos. 3 and 5.
  - Construct emergency power facilities (if included in this project).

- Start Up
  - Coordinate the shutdown of the Aspinwall Pump Station and the WTP to connect the new clearwell/suction well facility
  - Start-up the Aspinwall temporary pumping facilities.
  - Start-up the UV facility.
  - Coordinate the shutdown of Bruecken PS to connect the new suction well facility.
  - Start-up the Bruecken temporary pumping facilities.

3.3.3.2 Permitting and project implementation schedule

Due to the many considerations, necessary during the planning and permitting phase of the construction of drinking water facilities, they can often be long in duration. The following is a list of permits that would have to be obtained prior to construction:

- Public Water Supply Management Permit
- Construction Permits:
  - NPDES permit (discharge from the construction activities over one acre if applicable)
  - Erosion and Sediment Control (with or without NPDES)
  - 404 Joint permit USACOE and PADEP Pennsylvania Water Encroachment

Table 15 presents estimated timeline for the implementation of Alternative 2.

Table 15: Alternative 2 implementation timeline

Activity No.	Activity Description	Activity Duration
1	Design	Month 0-20
2	Permitting	Month 21-26
3	Bidding and project award	Month 27-29
4	Construction of facilities	Month 30-54

3.3.3.3 Water quality impacts

This alternative may impact disinfection byproduct formation if the organics that are not removed through clarification and filtration are degraded by the UV light into organic components that are more reactive with free chlorine. The potential long-term water quality benefit of UV is that it could be used for Cryptosporidium inactivation credit or converted for UV advanced oxidation treatment should the future need arise.

3.3.3.4 Operations

a. Operations control and risks

The operation of the water supply system during the clearwell rehabilitation will require detailed preparation and strict implementation. The limited available pumping volume at the pump station will require that the pumping rate at each pump station matches the rate of the filters effluent rate. A new programming logic controller (PLC) will be installed at each pump station to ensure that the pumps' output matches the water treatment plant's production. The signal would be transferred to the main operations desk where the operators will ensure that the system is operating as designed. An emergency overflow would be installed at each station in the case of system failure. During this period the entire city water system supply would have to be closely monitored for any daily and seasonal changes. This may require

a temporary change in the overall operations approach. For example, in case of emergency demand requirements within the system, the operations would use available volume from the system reservoirs until either the emergency stops or the plant's production increases to catch up with the system's demand. The operators would have at their disposal a combination of variable and constant speed driven pumps and would be able to match any required output. A detailed operations sequence should be developed during the design phase.

In order to provide for the full reliability of the temporary arrangements, each of the pumping stations should be equipped with the emergency power supply facilities.

The operation of the UV facilities introduced as a new treatment process would present an operational challenge. As with any new treatment process, the operators would conduct a comprehensive training program including visits to the sites utilizing UV facilities as their primary disinfection process. An extended warranty that includes site visits, training, and expert support by the UV equipment manufacturer would be made a priority requirement during the equipment selection process.

b. Maintenance

The maintenance of the proposed system will follow the same standard operating procedures established for the current operations. The addition of new UV facilities, by-pass lines and appurtenances, new clearwell and suction wells, and new electrical equipment would require extra time and effort to ensure that the new equipment and facilities operate as designed. Special attention would be paid to the operation of the UV facility and the need for maintaining its designed capacity.

c. Sustainability

As described above, some of the main sustainability criteria have been reviewed, and where appropriate, would be applied throughout the planning, design, and construction of selected project. The main objective of this project is to minimize the risks of failure of the City of Pittsburgh water supply system's and extend useful life of the existing facilities. Implementation of this alternative would, at minimum, improve the quality of life by enhancing public health and safety. It will also promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration, and extend the useful life of the existing clearwell by allowing for its rehabilitation. The sustainable impact of this alternative can be identified in the category of resource allocation, the use of regional materials (this should be developed during the project design phase), and the protection of our fresh water availability.

d. Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefit of the temporary and permanent facilities, including reservoirs, pipes, process equipment, electrical equipment, and all other facilities. The addition of the UV facility to the treatment process would be a permanent upgrade that would result in enhanced water quality. The 44 million gallon existing clearwell could be rehabilitated, reconfigured, or used in the future as an additional storage for the system. An upgrade of the Aspinwall and Bruecken Pump Stations consisting of the replacement of the motors and addition of variable speed drives on selected pumps is timely, considering the age and condition of the existing equipment, and should be carefully considered to account for inevitable future upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied structure should be considered. For example, at the Bruecken Pump Station, the suction well could potentially be built to allow for the future addition of some type of super structure that could be used in day to day operations.

3.3.4 Cost estimate

Estimated capital cost for the implementation of Alternative 2 is $38,500,000. A summary of capital cost breakdown by construction divisions is presented in Table 16.

Table 16: Alternative 2 capital cost estimate

Division	Cost
Division 0 – General Conditions	$1,050,000
Division 2 - Sitework	$8,250,000
Division 3 – Structural	$4,430,000
Divisions 4 through 10 – Architectural	$880,000
Division 11 – Equipment	$2,980,000
Division 13 – I&C	$450,000
Division 15 – HVAC, Plumbing, and Fire	$410,000
Division 16 – Electrical	$3,550,000
Subtotal Division 0 through 16	**$22,000,000**
Contingencies @ 40 Percent	$8,800,000
Engineering, CM, Legal, PM @ 25 Percent	$7,700,000
Total estimated capital cost	**$38,500,000**

3.4 Alternative 3

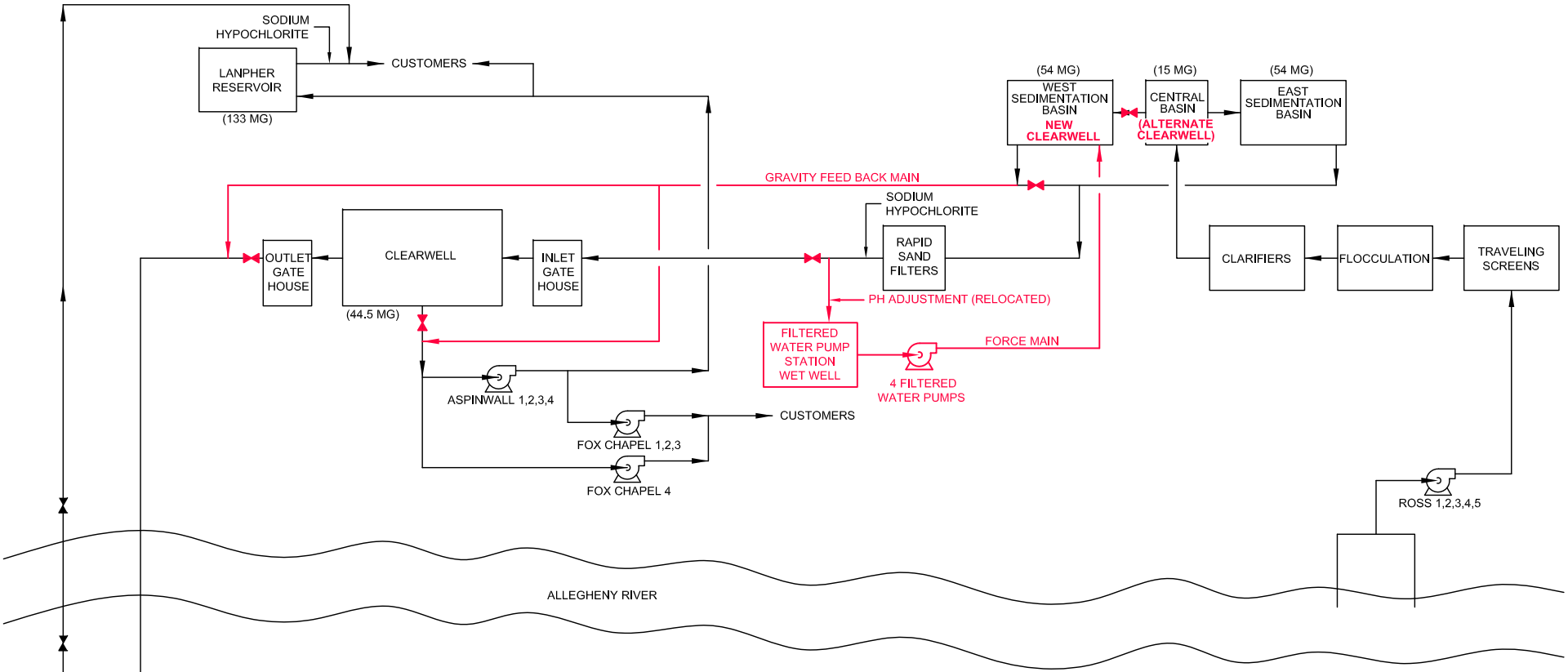
For this alternative, either the west sedimentation basin or the central receiving basin structures would be modified and converted to a finished water clearwell to achieve the plant's required disinfection for one-log Giardia and two-log virus inactivation using free chlorine. This method of achieving disinfection would be used on a temporary basis during clearwell rehabilitation or replacement. A new, permanent, or temporary filtered water pump station sized for the full plant capacity (117 MGD) along with conveyance lines to and from the sedimentation basin area would be required. Figure 3.11 presents a schematic and Figure 3.12 presents a concept plan for this alternative.

3.4.1 Description of disinfection method

This disinfection alternative would use a modified sedimentation basin structure as a finished water clearwell to achieve the plant's disinfection requirements while maintaining the plant's existing target effluent free chlorine concentration of approximately 0.7 mg/L. Either the west sedimentation basin or the central receiving basin could be modified and converted into a clearwell. Both options would require that the converted sedimentation basin be lined and covered. It is anticipated that with a properly new designed inlet configuration, the west sedimentation basin would be able to achieve the minimum baffling factor of 0.3 that would be required to make the west sedimentation basin's volume suitable for achieving the regulatory disinfection requirements. Use of the central receiving basin would require the installation of baffles in addition to inlet and outlet modifications to obtain a minimum baffling factor of 0.7 that would be required to make the central receiving basin's volume suitable for achieving the regulatory disinfection requirements. The central receiving basin option would also require relocation of the final pH adjustment to downstream of the clearwell so that the reduced CT requirement at a lower pH of approximately 7.0 may be applied.

Figures 3.13 and 3.14 present the converted west sedimentation and converted central receiving basin finished water clearwell options, respectively, for the full plant 117 MGD flow.

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PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA

CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 3.II

ALTERNATIVE 3 SCHEMATIC

Designed	Drawn	Checked	Approved	Date
	JMG			

Exhibit RAW/C-30

96" CLEARWELL EFFLUENT LINE

WEST SEDIMENTATION BASIN TO BE LINED AND COVERED AS NEW CLEARWELL

ALTERNATIVE CLEARWELL LOCATION

Existing Lanpher Rising Main

60" FILTERED WATER RISING MAIN

84" CLEARWELL BYPASS TO BRUECKEN

84" CLEARWELL BYPASS TO ASPINWALL

60" FILTERED WATER RISING MAIN

Existing Clearwell

96" Settled Water Line

96" Clarified Water Line

Aspinwall Pump Station

Fox Chapel Rising Main

Filter Building

Clarifier Building

0.43 MG FILTERED WATER WET WELL AND LOW LIFT PUMP STATION

2 - 72" Bruecken Pump Suction Lines

Bruecken Pump Station

Old Foundation

Legend

- Proposed Facilities
- RisingMain
- GravityMain

0 300 600 Feet

Map Document: (C:\Users\wen74945\Documents\ArcGIS\PWSA\Alternative 3.mxd)
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FIGURE 3.12
ALTERNATIVE 3 CONCEPTUAL PLAN

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Figure 3.13
Converted West Sedimentation Basin Disinfection Contact Volume Requirements

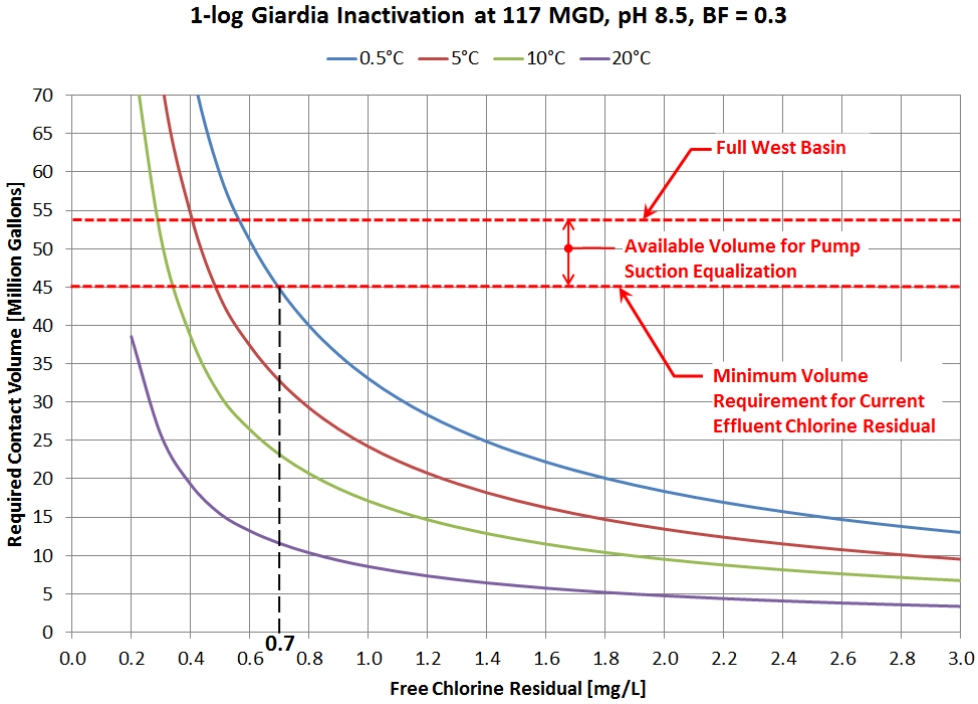
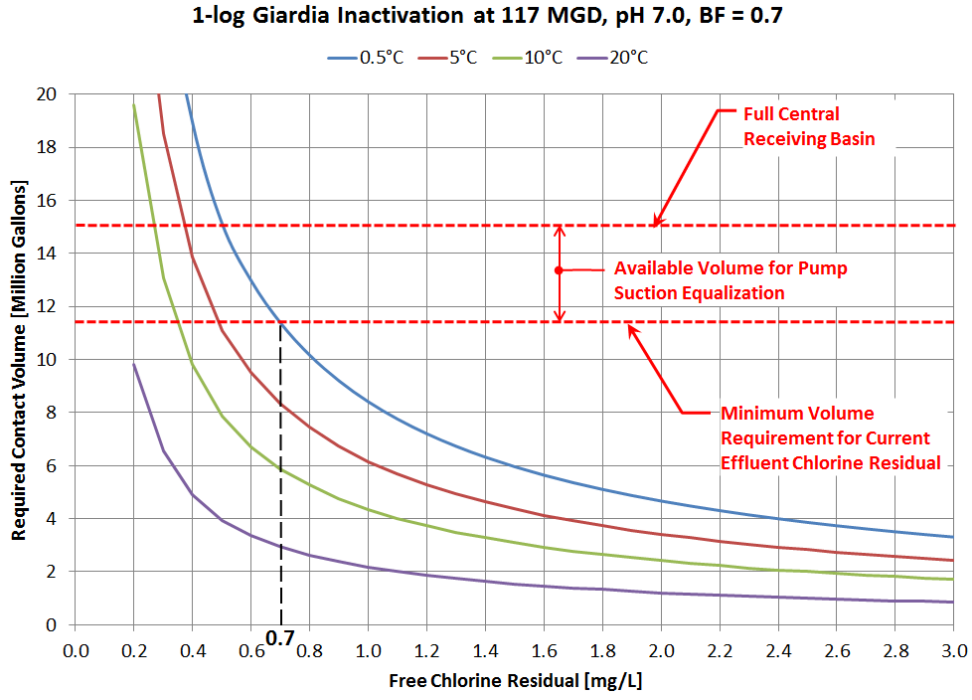


Figure 3.14
Converted Central Receiving Basin Disinfection Contact Volume Requirements



With one of the sedimentation basins converted to a clearwell, the available secondary sedimentation volume would be reduced. Table 17 summarizes the sedimentation detention time for each option.

Table 17: Secondary sedimentation detention time summary

Plant Operation Condition	Plant Flow Rate (MGD)	Secondary Sedimentation Detention Time (Hours)		
		Existing (123 MG)	West Basin Clearwell Option (69 MG)	Central Receiving Basin Clearwell Option (108 MG)
Average	62	48	27	42
Peak	117	25	14	22

Even with the reduced sedimentation volume, there is still significant detention time available, greater than 24 hours of detention during average conditions. This detention time will still provide significant mitigation of water quality impacts due to clarifier upsets or poor raw water quality events. Should the PWSA have concerns related to the reduced sedimentation volume, options such as installing tube settlers in the clarifiers or sludge removal systems in the sedimentation basins may be considered to enhance the performance of those systems. These enhancements, however, are not a requirement of this alternative and therefore are not included as part of the proposed improvements for this alternative.

It is proposed that this alternative will require the following improvements for its implementation:

- New 117 MGD low lift filtered water pump station with force main to the new clearwell in Sedimentation Basin area. This pump station is discussed in further detail below.
- New finished water gravity mains from Sedimentation Basin area to Aspinwall and Bruecken Pump Station suction lines. The gravity mains are discussed in further detail below.
- Clearwell options:
  - Cleaning, covering/lining, and converting West Sedimentation Basin to finished water clearwell. This would require modifications to the basin inlet and outlet piping configurations.
  - Cleaning, covering/lining, baffling, and converting Central Receiving Basin to finished water clearwell. This would require modifications to the basin inlet and outlet piping configurations.

3.4.2 Description of storage and distribution

The report reviewed three (3) options based on the similar concept as laid out in this alternative; the use of the west sedimentation basin as the temporary clearwell; the use of the west sedimentation basin as the permanent clearwell; and the use of the central sedimentation basin as the permanent clearwell. Each of the three (3) options would require construction of a permanent or temporary pumping station designed to lift the maximum capacity flow (117 MGD) from the filter effluent to the high-water elevation of the existing sedimentation basins (future temporary or permanent clearwell). As shown in Figure 3.12, the low service pump station would be in the general location between the filters and the Aspinwall Pump Station and would house four (4) vertical either turbine, or axial flow, low head high flow pumps, three (3) duty and one (1) stand-by, each with the design capacity of 27,000 gpm at 42 feet TDH. As shown in Figure 3.12, the flow would be conveyed through a new 60-inch force main. Flow from the clearwell would be conveyed via a 96-inch gravity line back to the Aspinwall Pump Station general area where it would be split and connected to suction lines feeding the Aspinwall and Bruecken Pump Stations. Both the force main and the feedback gravity line will be constructed in the same corridor within the right of way of Delafield Avenue.

This alternative would require a completely new electrical design; from the interface with the power utility's transformer's secondary to new main and secondary voltage systems. This would entail a design of the main medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/volts. The secondary voltage system would supply power for the low lift pumping station's auxiliary equipment including lighting, ventilation, and low voltage process equipment.

For a temporary solution, the pump station would be established as a temporary facility with the series of rental pumps capable of delivering the required flow.

The existing sedimentation basins are 19 feet deep, with the bottom elevation at 751 feet. The assumed maximum water elevation in the new clearwell would be 768 feet. This elevation would have an impact on pumping capacity and characteristics of the Aspinwall and Bruecken Pump Stations. In both cases, the average suction head would increase by approximately 15 feet. This may result in an increased pumping capacity; however, due to the uncertainty of the available data and the age and condition of the existing pumps, this could also result in unfavorable hydraulic conditions, with pumps operating outside of the preferred operating range. As a solution, the pumps could be equipped with the new induction motors and variable frequency drives which would allow operators to mitigate these unfavorable hydraulic conditions.

The conversion of the sedimentation basins into a finished water clearwell would also impact the future utilization of the existing clearwell. The existing clearwell (after the rehabilitation) would be hydraulically disconnected from the system since the hydraulic grade is approximately 20 feet below the grade of the new clearwell (converted sedimentation basin), making it unusable for storage except in case of the emergency.

3.4.3 Project implementation

3.4.3.1 Constructability

There are three (3) main construction projects associated with the implementation of this alternative; the conversion of a sedimentation basin (west or central); the construction of a high-flow, low-head filter effluent pump station; and the construction of a conveyance infrastructure, a 60-inch force main and 96-inch gravity feed line with connections to the suction feed of the Aspinwall and Bruecken Pump Stations. Each of these projects would require thorough planning and preparations and close coordination with the operations staff, the local utilities, and entities. The construction of the pump station would most likely require the relocation of underground utilities, a railway spur, and adjacent electrical facilities. Connection to the existing filter effluent would require careful shutdown planning in coordination with the WTP operations.

Construction of the force main and the gravity feedback will face many challenges, requiring a thorough investigation of the existing utilities within the construction corridor of Delafield Avenue (or an alternate route), trenchless construction under the railroad and probably Freeport Road, and making precise connections to the existing suction feed lines to the Aspinwall and Bruecken Pump Stations.

Construction of the sedimentation basins' conversion would be challenged by the somewhat limited access and location of the basins. A thorough sequence of construction would have to be developed and implemented.

e. Sequence of construction

The following is a simplified overview of the expected construction sequence:

> Sedimentation basins' conversion
  – Remove the sedimentation basin from service and convert to a finished water clearwell. The work will include, cleaning, lining, covering and construction of ancillary facilities and features including site modifications that may need to include stormwater mitigation from Route 28.
> Construct new low lift filtered water pump station
  – Temporary and/or permanently relocate the railroad spur, underground and aboveground facilities near the Aspinwall Pump Station.
  – Construct the pump station and supporting electrical facilities.
  – Connect the pump station suction line to the filter effluent line at the opportune time.
> Construct conveyance utilities
  – Construct both the transmission main and gravity feed lines within the selected corridor. The work would have to be coordinated between trenchless and open-cut excavation construction.
  – Connect the pipes to the new clearwell and the existing suction supply lines to Bruecken and Aspinwall Pump Stations.
> New clearwell system start-up.
> Dry-run test all the new facilities.
> Start-up the facilities and provide continuous water quality monitoring.

3.4.3.2 Permitting and project implementation schedule

Permitting process would require close coordination with the permitting agency to assure that the clarified and settled water quality remains at the highest standards. This may require bench testing and data collection and analysis to confirm the water quality standards. This data will be complied, analyzed, and presented to PADEP during the permitting process. In addition to standard construction permits, this alternative would require permits from the railroad company and Pennsylvania Department of Transportation (PennDOT) for crossings of the railroad track and Freeport Road.

The following is a list of permits that would have to be obtained prior to construction:

> Public water supply management permit
> Construction permits:
  – NPDES permit (discharge from the construction activities over one acre)
  – Erosion and Sediment Control (with or without NPDES)
  – Penn DOT Highway Occupancy Permit for crossing Freeport Road
  – Local Occupancy Permit for work in Delafield Avenue
  – Railroad Crossing Permit
  – Low Lift Pump Station City Building Permit

Table 18 presents estimated timeline for the implementation of Alternative 3.

Table 18: Alternative 3 implementation timeline

Activity description	Activity duration
Design	Month 0-20
Permitting	Month 21-26
Bidding and project award	Month 27-29
Construction of facilities	Month 30-60

3.4.3.3 Water quality impacts

This alternative would decrease the existing available secondary sedimentation volume due to the removal of a sedimentation basin from the secondary sedimentation process. Even with the reduced volume, significant detention time would still be available in the sedimentation basins and therefore, it is not anticipated that this alternative would have an impact on the overall plant performance. Cleaning and regular maintenance of the sedimentation basins would help maintain the performance of the reduced secondary sedimentation volume by preventing excessive settled solids' buildup over time.

3.4.3.4 Operations

a. Operations control and risks

The operation of the water supply system during the clearwell rehabilitation will require detailed preparation and strict implementation. The initial operation would have to be closely monitored due to introduction of three (3) new facilities. A detailed, standard operating procedures would have to be followed to ensure of proper mechanical and process operation. The available volume in the new clearwell would allow for a more flexible operation (comparing to the other alternatives) resembling current operational practices. A new programming logic controller (PLC) will be installed to ensure that the pumps' output at the low lift effluent pump station matches WTP production. The signal shall be transferred to the main operations desk where the operators will ensure that the system is operating as designed. During this period, the entire City Water System Supply will continue to be closely monitored for its daily and seasonal changes. A detailed operations sequence should be developed during the design phase.

In order to provide a full reliability of the temporary arrangements, each of the pumping stations should be equipped with the emergency power supply facilities.

b. Maintenance

The maintenance of the proposed system would follow the same standard operating procedures established for the current operations. Addition of a new pump station, new finished water clearwell, and two (2) large diameter pipes would increase the need for the regularly scheduled asset maintenance.

3.4.3.5 Sustainability

Implementation of this alternative will at minimum improve the quality of life by enhancing public health and safety. However, this alternative will negatively, albeit temporarily, impact the Aspinwall community's mobility and access to homes and businesses along the Delafield Avenue including an entrance to St. Margaret Hospital. It will promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration. The sustainable impact of this alternative can be identified in the category of resource allocation; the use of regional materials (this should be developed during the project design phase) and the protection of our fresh water availability.

3.4.3.6 Long-term benefits

The conversion of the sedimentation basin to the new finished water clearwell will have an impact on future operations. The permanent conversion would reduce the secondary sedimentation volume, but is not anticipated to have an impact on future water quality. The construction of a new clearwell would allow the PWSA to have multiple options related to the utilization of the existing clearwell, from the emergency (or primary) finished water clearwell to an altogether different use of the available location.

3.4.4 Cost estimate

The estimated capital cost for the implementation of Alternative 3 (permanent conversion of West sedimentation basin) is $72,010,000. A summary of capital cost breakdown by construction divisions is presented in Table 19.

Table 19: Alternative 3 capital cost estimate

Division	Cost
Division 0 – General Conditions	$1,960,000
Division 2 – Sitework	$21,060,000
Division 3 – Structural	$1,030,000
Divisions 4 through 10 – Architectural	$4,480,000
Division 11 – Equipment	$3,560,000
Division 13 – I&C	$530,000
Division 15 – HVAC, Plumbing, and Fire	$450,000
Division 16 – Electrical	$8,080,000
Subtotal Division 0 through 16	**$41,150,000**
Contingencies @ 40 Percent	$16,460,000
Engineering, CM, Legal, PM @ 25 Percent	$14,440,000
Total estimated capital cost	**$72,010,000**

3.5 Alternative 4

For this alternative, the required disinfection CT would be obtained at Lanpher Reservoir and at Highland No. 2 Reservoir. This use of the reservoirs to achieve required disinfection would be a temporary solution while the rehabilitation or replacement of the existing clearwell takes place. The infrastructure improvements that are required to make this alternative viable hydraulically will have permanent benefits with respect to the reliability and redundancy of the PWSA's distribution system infrastructure. Figure 3.15 presents a schematic and Figure 3.16 presents a conceptual plan for this alternative.

Exhibit RAW/C-30

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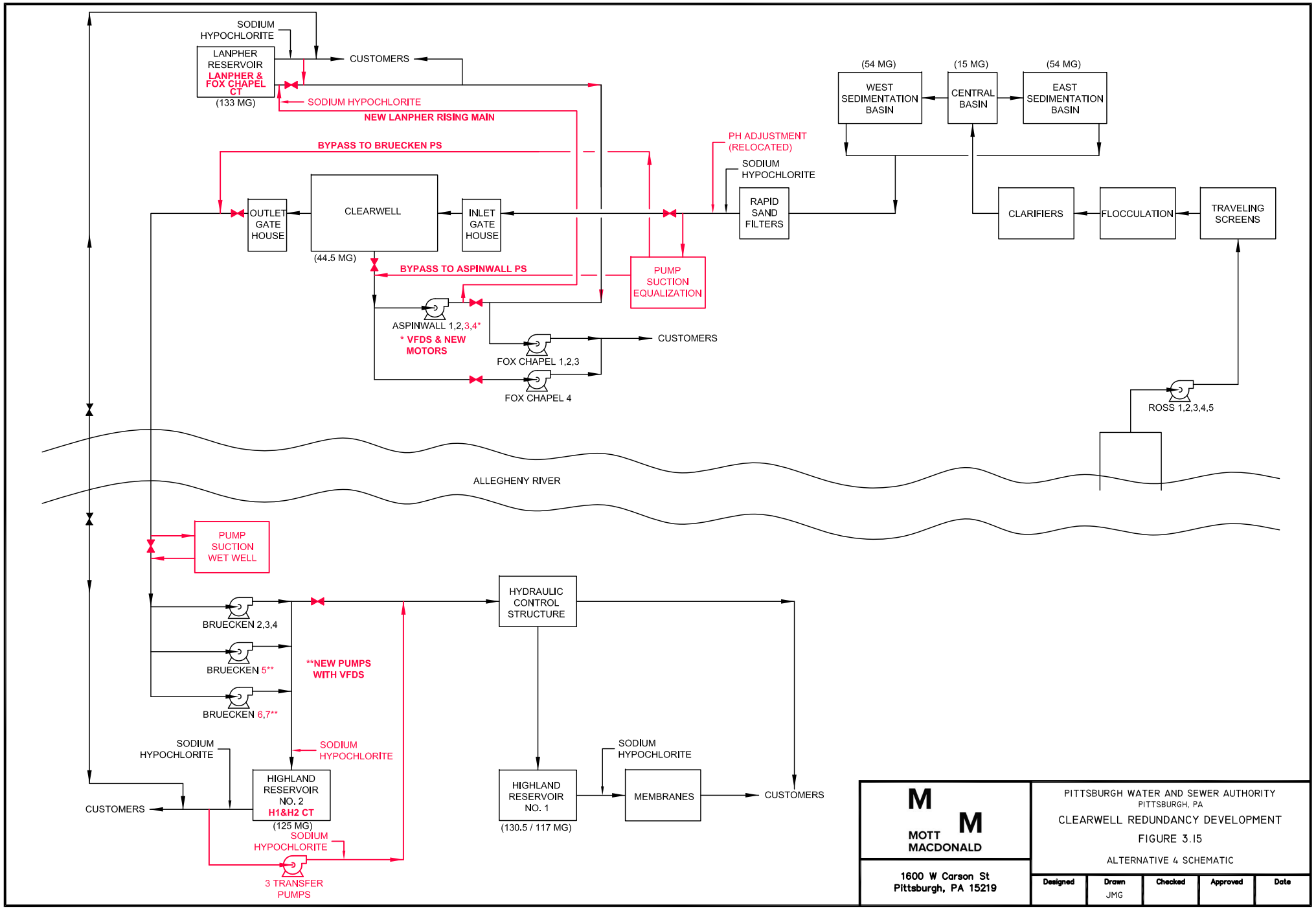


Exhibit RAW/C-30

EXISTING RISING MAIN CONVERTED TO SUPPLY MAIN RETURNING FLOW TO ASPINWALL PS

BOOSTER CHLORINATION FACILITY

NEW RISING MAIN

Lanpher Reservoir

EXISTING RISING MAIN RETURNS FLOW FROM LANPHER RESERVOIR

Existing Lanpher Rising Main

NEW LANPER RISING MAIN

Existing Clearwell

84" CLEARWELL BYPASS TO BRUECKEN

1.1 MG WET WELL

Existing Highland 2 Rising Main

Existing Highland 2 Rising Main

ALTERNATIVE HIGHLAND TRANSFER RISING MAIN

Existing Highland 1 Rising Mains

EXISTING HIGHLAND 1 RISING MAINS TAKEN OUT OF SERVICE

1.5 MG WET WELL

Highland 2 Reservoir

Highland 1 Reservoir

HIGHLAND TRANSFER RISING MAIN

HIGHLAND TRANSFER PUMP STATION

Legend

- Proposed Facilities
- RisingMain
- GravityMain

N W E S

0 600 1,200 Feet

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1600 W Carson St.
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PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
CLEARWELL REDUNDANCY DEVELOPMENT
FIGURE 3.16
ALTERNATIVE 4 CONCEPTUAL PLAN

Designed	Drawn	Checked	Approved	Date
	DWW			3/16/2016

3.5.1 Description of disinfection method

This disinfection alternative would use both the Lanpher Reservoir and rising main and the Highland No. 2 Reservoir to achieve the full system disinfection CT requirements. The Lanpher Rising Main and two (2) compartment Lanpher Reservoir would be used to achieve the required CT for the Lanpher and Fox Chapel service areas. Highland No. 2 Reservoir would be used to achieve the required CT for the Highland No. 1 Reservoir and Highland No. 2 Reservoir service areas. For the Lanpher Reservoir and Fox Chapel service areas, the water would not be potable until after it has travelled through the rising main and reservoir for disinfection. Since the Lanpher Reservoir's existing single rising main serves customers prior to the reservoir, a second redundant rising main is proposed. With a second redundant rising main, one (1) of the two (2) rising mains would operate in rising mode with the sole function of filling the reservoir.

The second rising main would operate in return mode to serve potable water to the customers that are currently served by the existing single rising main.

For the purposes of reviewing the disinfection requirements of this scenario, it was assumed that the maximum flow to the Lanpher Reservoir would be 28 MGD and that the maximum combined Highland No. 1 and No. 2 demand flow to Highland No. 2 would be 88 MGD.

Figures 3.17 and 3.18 are graphs that show the disinfection contact volume requirements to achieve 1-log Giardia inactivation in the Lanpher Rising Main and Lanpher Reservoir, respectively, when the Aspinwall Pump Station is delivering a maximum flow of 28 MGD to the Lanpher Reservoir.

The existing and proposed new Lanpher Rising Mains are each approximately 22,000 feet long. The existing rising main is 60-inch diameter. The size of the proposed new rising main is yet to be determined but would be a minimum of 48-inch diameter, as detailed in the Aspinwall – Lanpher Rising Main Report. The executive summary of the report is presented in Appendix C of this report. The Lanpher rising main contact volume requirements graph, presented in Figure 3.17, was developed using a baffling factor of 1.0 and finished water pH of 8.5, which represents the perfect baffling conditions of plug flow conditions that pipelines provide. This graph shows that if the a 60-inch rising main is used (either existing or new), an effluent-free chlorine residual of approximately 0.7 mg/L entering the Lanpher Reservoir during the coldest water conditions would be sufficient to achieve the disinfect CT requirements in the rising main alone. The residual requirements would be reduced under warmer water conditions. The use of a smaller 48-inch rising main would require an effluent free chlorine residual of approximately 1.2 mg/L during colder months, but in the warmer months from May through October when DBPs are a greater concern and the temperature is typically at least 10 degrees C, an effluent free chlorine residual of 0.6 mg/L would be sufficient, which is a residual consistent with existing clearwell operations. Figure 3.18 demonstrates that since the Lanpher Reservoir provides significant detention volume, it is not necessary to rely on the rising main alone to achieve disinfection CT requirements.

Figure 3.17
Lanpher Rising Main Disinfection Contact Volume Requirements

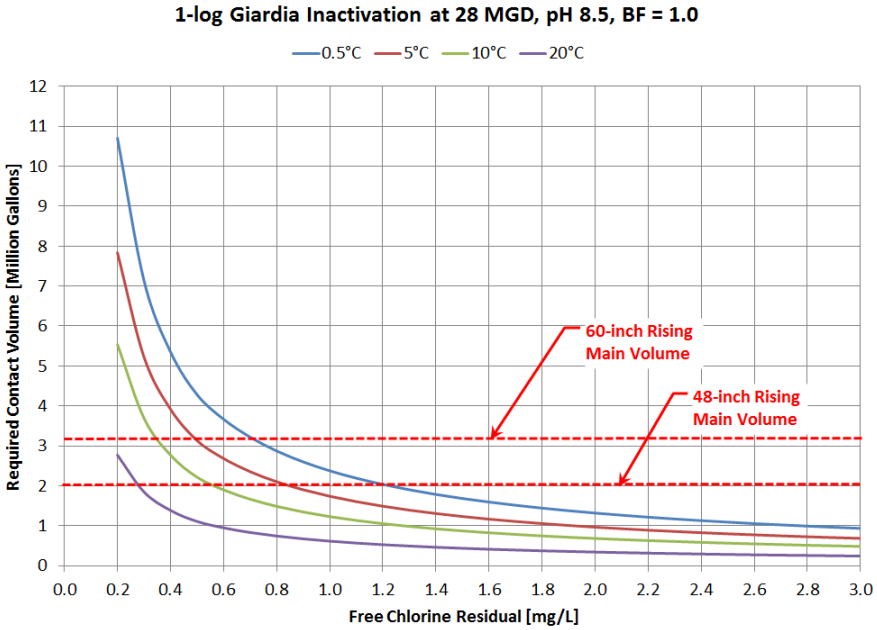
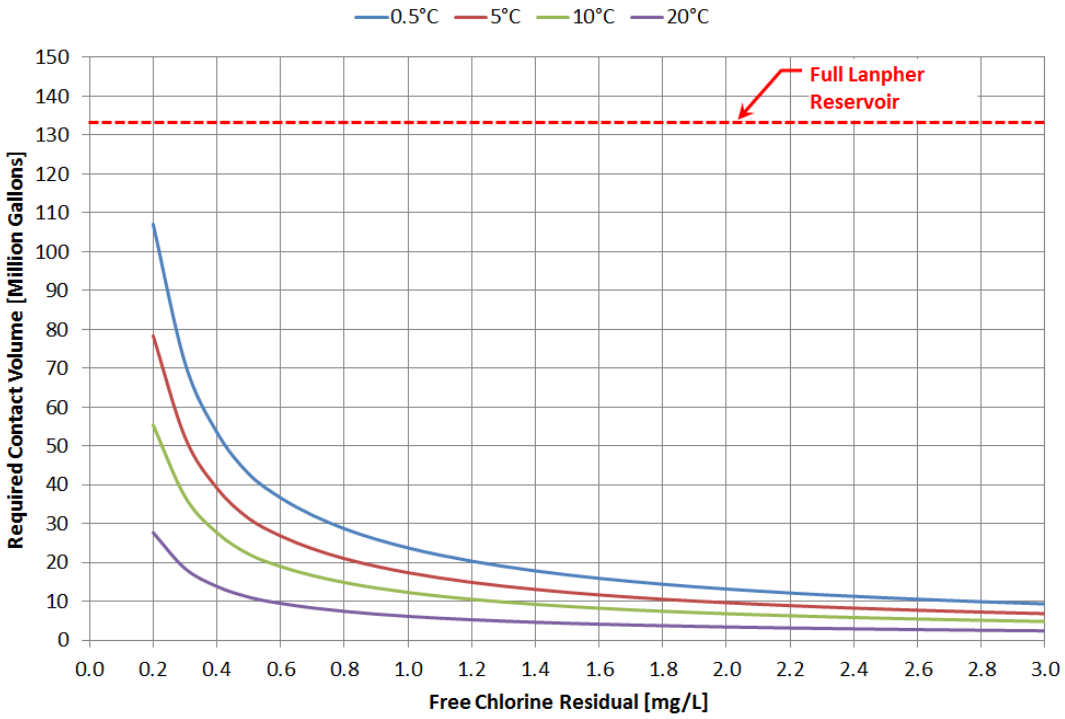


Figure 3.18 is a graph of the required disinfection contact volume for achieving one-log Giardia inactivation at a pH of 8.5 in the Lanpher reservoir alone. The baffling classification for the Lanpher Reservoir is estimated conservatively to be “unbaffled” which would mean a baffling factor of 0.1 is applied. It is anticipated that a tracer study may be required in order to claim a higher baffling factor than 0.1. The graph shows that even with the low baffling factor, the full Lanpher Reservoir alone has adequate volume to achieve the required disinfection CT at the anticipated maximum flow rate, even at an effluent free chlorine residual as low as 0.2 mg/L. With a slightly higher effluent free chlorine residual of 0.4 mg/L, the reservoir can be operated over a level range as low as half of the volume capacity. The combined disinfection CT that can be achieved in the rising main and Lanpher Reservoir is more than sufficient to meet the 1-log Giardia disinfection requirements for a maximum service area demand of 28 MGD.

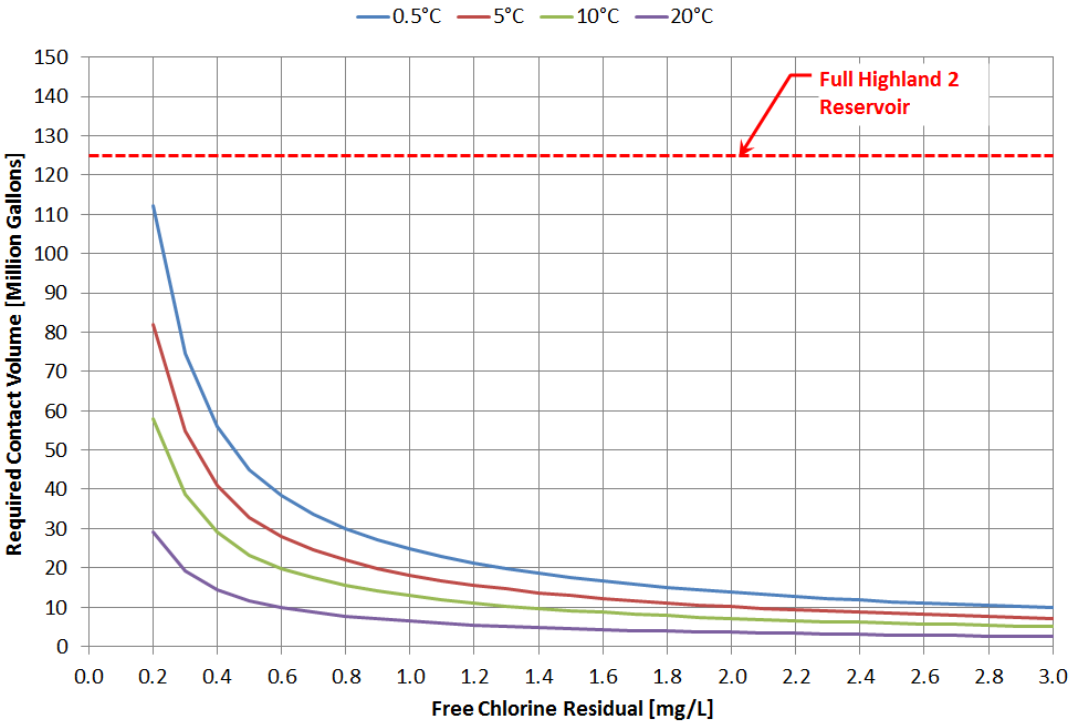
Figure 3.18
Lanpher Reservoir Disinfection Contact Volume Requirements
1-log Giardia Inactivation at 28 MGD, pH 8.5, BF = 0.1



The Highland No. 1 and Highland No. 2 service areas disinfection CT requirements would be achieved primarily in the Highland No. 2 Reservoir. A limited amount of CT would be achieved in the Bruecken suction mains and the reservoir rising mains in comparison to the Lanpher configuration due to the lower volume and detention time in these mains at the 88 MGD maximum flow rate. For the purposes of this analysis, the contribution of the suction and rising mains to achieving the disinfect requirements is not included. The ability to achieve the disinfection requirements in the Highland No. 2 Reservoir alone was reviewed.

Figure 3.19 is a graph of the required disinfection contact volume for a range of water temperature conditions when the Bruecken Pump Station is delivering a maximum flow of 88 MGD to the Highland No. 2 Reservoir. The baffling classification for the Highland No. 2 Reservoir is estimated conservatively to be "poor," which would mean a baffling factor of 0.3 is applied. The Highland No. 2 Reservoir's intra-basin baffles provide a better baffling condition than the Lanpher Reservoir so a higher factor may be employed. It is anticipated that a tracer study would be required in order to claim a baffling factor higher than 0.3. The required contact volume versus chlorine residual curves for each temperature were developed based on the required CT to achieve one-log Giardia inactivation at the associated temperature at a pH of 8.5. The graph shows that even with the conservative baffling factor, the Highland No. 2 Reservoir alone has adequate volume to achieve the required disinfection CT at the anticipated maximum flow rate even at an effluent free chlorine residual as low as 0.2 mg/L. With a slightly higher effluent free chlorine residual of 0.4 mg/L, the reservoir can be operated over a level range as low as half of the volume capacity.

Figure 3.19
Highland No. 2 Reservoir Disinfection Contact Volume Requirements
1-log Giardia Inactivation at 88 MGD, pH 8.5, BF = 0.3



Implementation of primary disinfection at the two (2) reservoirs would require several infrastructure improvements. The first step in the implementation of this alternative at Lanpher Reservoir would be the construction of a new Lanpher Reservoir Rising Main. As previously discussed, the Lanpher Reservoir currently has a single rising main, and there are several customers that receive their potable water from this water main. A second redundant rising main is required so that under this temporary method of achieving disinfection, one (1) of the two (2) rising mains would operate in pure “rising mode” and the second in “return mode” to serve potable water to the customers that are currently served off the single rising main. Additional required infrastructure for implementing primary disinfection at the Lanpher Reservoir include a water quality sampling system at the inlet and outlet of the Lanpher Reservoir that includes chlorine residual and pH analyzers. Also required are new automated booster chlorination facilities with new sodium hypochlorite storage facilities and metering pumps that can supplement the residual entering or leaving the reservoir, as needed, to maintain disinfection CT and desired distribution system chlorine residual.

Implementation of primary disinfection at Highland No. 2 Reservoir would also require several infrastructure improvements. As at Lanpher Reservoir, a new water quality sampling system at the inlet and outlet of the Highland No. 2 Reservoir that includes chlorine residual and pH analyzers would be required. Also required are new automated booster chlorination facilities with new sodium hypochlorite storage tanks and metering pumps that can supplement the residual entering or leaving the reservoir as needed to maintain disinfection CT and desired distribution system chlorine residual. The most substantial infrastructure improvement required at this reservoir is a new pump station to transfer finished water from Highland No. 2 to the Highland No. 1 service area to meet the demands of the Highland No. 1

system. The new pump station would house the new booster chlorination facilities. The new Highland No. 2 Pump Station is discussed in further depth below. Due to the increased pressure/head needed to pump the water to Highland 2 Reservoir, a detailed condition assessment and subsequent rehabilitation of the existing rising mains to Highland 2 must be conducted.

In summary, it is proposed that this alternative will require the following improvements:

- Lanpher Reservoir
  - New rising main.
  - New booster chlorination facilities, housed in a new structure, with a 6,000-gallon bulk storage tank, a day tank, feed pumps for 12.5 percent sodium hypochlorite.
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines
- Highland 2 Reservoir
  - New transfer pump station between Highland No. 1 and Highland No. 2 service areas.
  - Condition assessment and rehabilitation of the Highland 2 Reservoirs two (2) rising mains.
  - New booster chlorination facilities, housed in the new pump station, with two (2) 6,000-gallon bulk storage tanks, a day tank, feed pumps for 12.5 percent sodium hypochlorite
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines

3.5.2 Description of storage and distribution

A new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would be constructed. Three (3) main alternatives regarding the alignment, size, and material of the proposed rising main are currently being evaluated under the separate feasibility study. The evaluation of alternatives will be made based on the criteria and factors such as:

- Provide a redundant level of drinking water service.
- Construction cost.
- Trenchless crossings.
- Impacts to residents and business during construction.
- Methods and materials of construction.

Similar to Alternatives 1 and 2, a suction well would be constructed at one of the proposed locations to provide for an adequate pumping volume. Depending on the selected size of the new rising main, there may be a need to install new pumps that would pump at a higher total dynamic head due to the selected smaller diameter of the new rising main. At this stage of planning, it will be assumed that new pumps, motors, and drives will be installed. Preliminary evaluations indicate that limited structural improvements would be made to accommodate the installation of the new drives.

The pumping operation for the Fox Chapel service areas would remain the same, utilizing the existing pumps with new variable speed drives as booster pumps. Slight adjustments (using multiple pumps) in operations may be required on a temporary basis if available pressure in the Lanpher service areas falls below certain set points due to high demands.

An 84-inch bypass line around the clearwell would be connected to the pair of 72-inch Bruecken Pump Station suction feed lines. The maximum demand at the Bruecken Pump Station is estimated to be around 61,000 gpm. The entire volume under this alternative would be pumped to the Highland No. 2 Reservoir through a pair of 48-inch rising mains. The increase in flow would result in higher head loss. A

preliminary hydraulic analysis indicates that the total dynamic head (TDH) at the maximum flow to Highland No. 2 Reservoir is 252 feet. The design capacity of each of the three (3) existing pumps (5, 6, and 7) according to the manufacturer's data is 19,450 gpm at 365 feet for Pump No. 5 and 16,670 gpm at 272 feet of TDH for Pump Nos. 6 and 7. The lack of exact operating data (flow and corresponding system head) prevents a confirmation of the preliminary hydraulic analysis. For the cost estimating purpose, this report will assume that three (3) new pumps would replace the existing Pump Nos. 5, 6, and 7; however, it may be prudent to conduct a flow/pressure monitoring test during the early design phase to confirm that the pumps operate at the design conditions. If the test shows that the existing pumps put out flow more than the design capacity, the existing pumps could be utilized.

The new pumps would be driven by VFDs to allow for future operation at decreased capacity (after the rehabilitation of the existing clearwell). The new motors are slightly larger than the existing motors. In all cases, the existing synchronous motors would be replaced with inverter duty-rated induction motors with variable frequency drives and new switchgear and feeders. The proposed size of the motors will require a new electrical service for this facility. It is recommended that this service be provided at 4160 volts. The new switchgear could then be permanently connected to the standby generator/generators.

In order to provide a smooth and reliable operation of pumps at the pump station, a suction well of sufficient pumping volume would be constructed in the yard next to the pump station. The pumping volume would be determined to allow for a smooth pumping operation, maintaining the level in the suction well between 743 and 747 feet. This would require the construction of, at a minimum, a 10,000 ft^2 structure as shown in Figure 3.16.

As discussed earlier, the Highland No. 2 Reservoir would be used to obtain the required disinfection contact time. In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer required volume from Highland No. 2 to Highland No. 1 Reservoir via a newly constructed pump station as shown in Figure 3.20. Two (2) alternative locations and supply transmission main alignments are selected. Both locations' properties are owned by the City of Pittsburgh, easily accessible, and close to all needed utilities. The final location and the alignment should be selected during the early phase of the project design. The pump station would match the maximum capacity of the existing Highland No. 1 distribution system. It will house three (3) 1,000 HP pumps capable of delivering a total of 38,000 gpm at approximately 120 TDH via a new 48-inch supply main. The pumps would be equipped with VFDs and controlled via a pressure indicating control system. The new force main will connect with the two (2) 48-inch rising mains that currently supply the Highland No. 1 Reservoir.

The Highland No. 2 Pump Station would require a completely new electrical service for the facility. This would include new main and secondary voltage systems switchgear. This would entail the installation of a new medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/208 volts. The secondary voltage system would supply power for all pumping station's auxiliary equipment including lighting, ventilation, and low voltage process equipment. The design would incorporate induction motors rated for inverter duty, controlled by VFDs to provide optimized pump performance not available with soft starters. The system would incorporate means to provide a second source of power to ensure redundancy.

Exhibit RAW/C-30



Legend

- Proposed Alignment 1
- Proposed Alignment 2
- Existing Rising Main

0 400 800 Feet

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CLEARWELL REDUNDANCY DEVELOPMENT
FIGURE 3.20
HIGHLAND 2 FORCE MAIN CONCEPTUAL PLAN

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3.5.3 Project implementation

3.5.3.1 Constructability

This alternative is predicated on construction of a new Aspinwall-Lanpher Rising Main. Details related to constructability of the rising main are presented in Appendix C. This will be a high risk, most challenging construction due to the nature of the urban environment and multiple highway crossings. The upgrades to the mechanical and electrical equipment at the Aspinwall and Bruecken Pump Stations will take place one (1) pump at time to ensure uninterrupted operation during construction.

As explained elsewhere in this report, the temporary suction well at the Aspinwall Pump Station site will be a challenging task considering a variety of underground and aboveground utilities, railroad spur, driveways, and other existing facilities. A detailed relocation plan must be developed during the early design phase of the project.

Construction of the new Highland No. 2 Pump Station and the supply transmission main is anticipated to be within acceptable industry standard risks. Due to the sensitive nature of the area proposed for the force main alignment (recreational area of Highland Park), the construction should be scheduled and implemented to produce minimal disturbance.

A critical component of the construction will be the connection of the new facilities to the existing system. This will be done through a close collaboration with the PWSA staff in order to minimize the production shutdown time.

c. Sequence of construction

The following is a simplified overview of the expected construction sequence:

- Aspinwall-Lanpher New Rising Main
  - Construct the new rising main to the point of connection at Lanpher Reservoir and Aspinwall Pump Station.
  - Construct the connection facility and provide system isolation.
  - Construct chemical addition facilities at Lanpher reservoir.
- Aspinwall Pump Station Site
  - Relocate all utilities that interfere with new construction.
  - Conduct investigation and rehabilitation of existing two (2) 48-inch rising mains Bruecken – Highland No. 2.
  - Construct suction well, 96-inch and 84-inch by-pass piping, the overflow pipe and outfall facility.
  - Replace and install a new pump, motor, and VFD for Pump No. 1. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
  - Start Pump No. 1.
  - Repeat the same sequence for Pump Nos. 2, 3, and 4.
  - Construct emergency power facilities (not included in this project).

- Construct facilities at the Bruecken pump station site.
  - Relocate all the utilities that interfere with the new construction.
  - Construct the new electrical service (new walk-in enclosure west side of the building)
  - Construct the suction well at Bruecken, with an overflow pipes and outfall facilities.
  - Replace and install the new pumps and motors and VFDs. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
  - Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
  - Start Pump No. 5.
  - Repeat the construction sequence for Pumps Nos. 6 and 7.
  - Construct the emergency power facilities (not included in this project).
- Highland No. 2 Pump Station and Transmission Main
  - Two (2) separate contracts working simultaneously:
    - Construct pump station facility at the designated location; civil, architectural, mechanical, electrical and instrumentation work.
    - Construct a new 48-inch main, from the pump station to the point of connection with 48-inch rising mains from the Bruecken Pump Station.
- Start Up
  - Coordinate the shutdown of the Aspinwall Pump Station and WTP to connect the new suction well facility and the rising main.
  - Start-up the Aspinwall pumping facilities.
  - Coordinate the shutdown of the Bruecken Pump Station to connect the new suction well facility.
  - Start up the Bruecken temporary pumping facilities.
  - Start-up the Highland No. 2 Pump Station.

3.5.3.2 Permitting and project implementation schedule

The permitting process will require a close coordination with the permitting agencies. In addition to the standard construction permits, this alternative will require permits from the railroad company and Penn DOT for the crossings of the railroad track and Freeport Road. The construction of the Lanpher Reservoir rising main will require a very close coordination with multiple communities and their agencies for various rights of ways and occupancy permits. The new Highland No. 2 Pump Station will require a building permit.

The following is a list of permits that would have to be obtained prior to construction:

- Public water supply management permit
- Construction permits:
  - NPDES permit (discharge from the construction activities over one acre) (multiple projects).
  - Erosion and Sediment Control (with or without NPDES) (multiple projects).
  - PennDOT Highway Occupancy Permit for crossing Freeport Road and multiple roads and highways for Lanpher reservoir rising main.
  - Local Occupancy Permits from multiple communities for Lanpher Reservoir Rising Main.

- Railroad Crossing Permit.
- Highland No. 2 Pump Station City Building Permit.

Table 20 presents estimated timeline for the implementation of Alternative 4.

Table 20: Alternative 4 implementation timeline

Activity description	Activity duration
Design	Month 0-20
Permitting	Month 21-26
Bidding and project award	Month 27-29
Construction of facilities	Month 30-60

3.5.3.3 Water Quality Impacts

The water age entering the Highland No. 1 service area would be higher which may adversely impact disinfection byproduct formation and cause potential corrosion in this area and those it serves. The water age entering the Highland No. 2 and Lanpher services areas would be reduced, with the exception of the customers currently served by the Lanpher rising main.

3.5.3.4 Operations

a. Operations control and risks

The operation of the water supply system during the clearwell rehabilitation as already described for other alternatives will require a detailed preparation and strict implementation. The limited available pumping volume at the pump stations would require that the pumping rate at each pump station matches the rate of the filters effluent rate. A new programming logic controller (PLC) will be installed at each pump station to ensure that the pumps output match water treatment plant's production. The signal shall be transferred to the main operations desk where the operators would ensure that the system is operating as designed. An emergency overflow will be installed at each station in case of a system failure. During this period the entire city water supply system must be closely monitored for daily and seasonal changes. A controlled pumping sequence and very strict control of the system's demands in the Highland No. 1 and Highland No. 2 Districts will be crucial for the effective implementation of this alternative. The new Highland No. 2 Pump Station would be operated based on the demands in the Highland No. 1 District. It will supply Highland No. 1 Reservoir, providing and maintaining turnover in the reservoir, while at the same time supplementing any additional demand within that supply district. A detailed operations sequence should be developed during the design phase.

b. Maintenance

The maintenance of the proposed system will follow the same standard operating procedures established for the current operations. The addition of a new pump station, chemical booster facilities, and two (2) large diameter force mains will increase the need for regularly scheduled asset maintenance.

3.5.3.5 Sustainability

Implementation of this alternative will, at minimum, improve the quality of life by enhancing public health and safety. However, this alternative will negatively impact Aspinwall and neighboring communities' mobility and access to homes and businesses along the alignments of the proposed Lanpher Rising Main and the Highland No. 2 force main. It will promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration and the extended useful life of the existing clearwell

structure. The sustainable impact of this alternative can be identified in the category of resource allocation; the use of regional materials (this should be developed during the project design phase) and the protection of our fresh water availability.

3.5.3.6 Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefit of the temporary and permanent facilities, including the reservoirs, pipes, process equipment, electrical equipment, and all other facilities. An upgrade of the Aspinwall and Bruecken Pump Stations that would consist of the replacement of the pumps, motors, and the addition of variable speed drives is timely considering the age and condition of the existing equipment and should be carefully selected to account for future inevitable upgrades. The suction well facilities at both stations are primarily temporary structures. It is recommended that during the design phase, a multiple use of the occupied space should be considered. For example, at the Bruecken Pump Station, the suction well could potentially be built to allow for the future addition of some type of super structure that could be used in day to day operations.

The addition of the new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would have a significant impact on reliability and efficiency of the water supply within the Lanpher Reservoir supply district. It would provide redundancy in the water supply for that area, thus significantly lowering risks in the current supply operations due to the age and condition of the existing 60-inch rising main. It will allow selected sections of the existing 60-inch main to be rehabilitated after the clearwell is complete.

The construction of a new Highland No. 2 Pump Station would also improve the system's reliability, provide redundancy in supply (in case of a micro filtration plant failure) and allow for more control over the demand and supply balance.

3.5.4 Cost estimate

Estimated capital cost for the implementation of Alternative 4 is $152,730,000. Summary of capital cost breakdown by construction divisions is presented in Table 21. Detailed opinion of probable construction cost is presented in Appendix D.

Table 21: Alternative 4 capital cost estimate

Division	Cost
Division 0 – General Conditions	$4,160,000
Division 2 – Sitework	$54,980,000
Division 3 – Structural	$4,240,000
Divisions 4 through 10 – Architectural	$1,370,000
Division 11 – Equipment	$10,730,000
Division 13 – I&C	$1,610,000
Division 15 – HVAC, Plumbing, and Fire	$820,000
Division 16 – Electrical	$9,360,000
Subtotal Division 0 through 16	**$87,270,000**
Contingencies @ 40 Percent	$34,910,000
Engineering, CM, Legal, PM @ 25 Percent	$30,550,000
Total estimated capital cost	**$152,730,000**

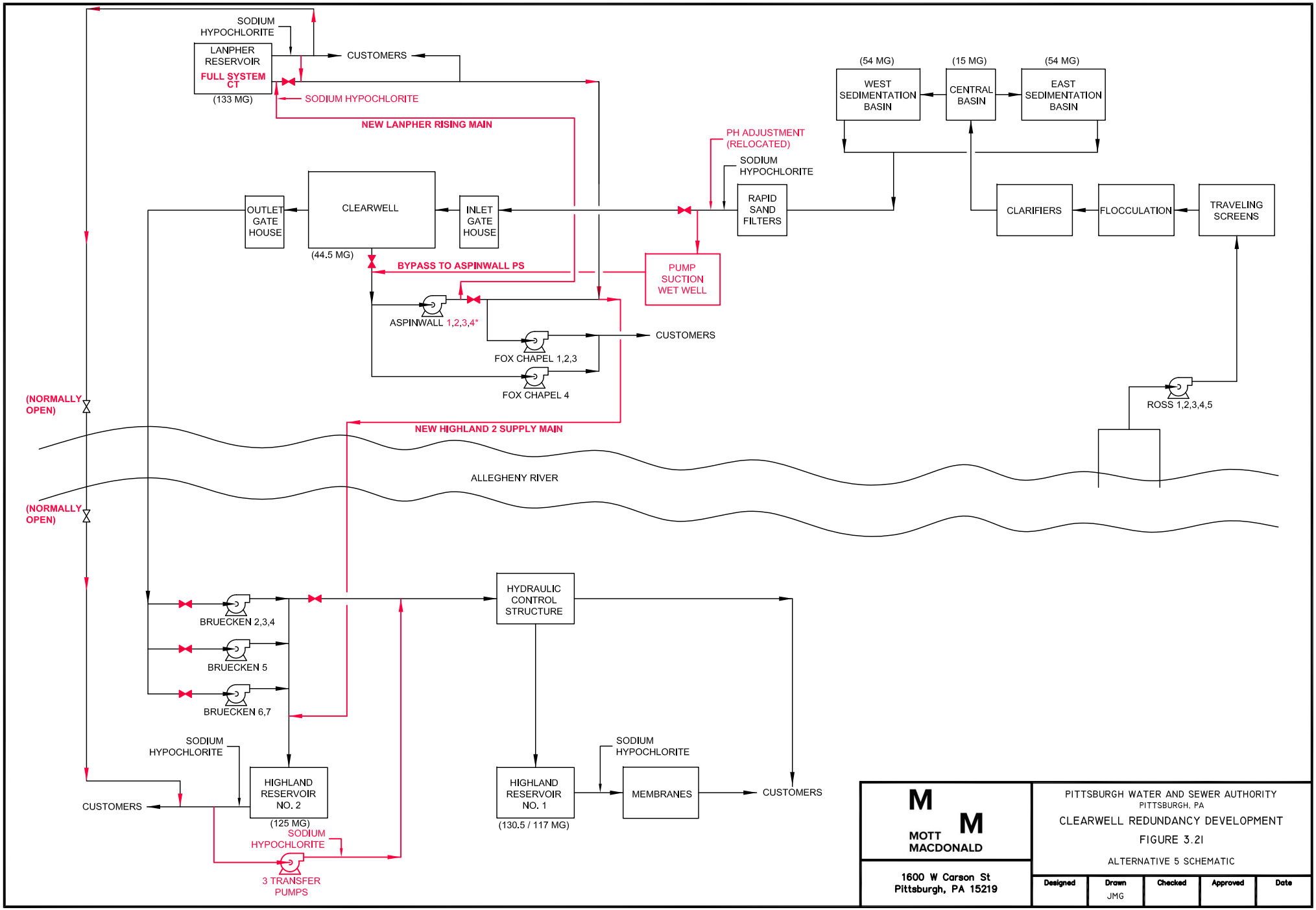
3.6 Alternative 5

Under this alternative, the full system required disinfection CT would be obtained at Lanpher Reservoir. This is a temporary solution while the rehabilitation or replacement of the existing clearwell takes place. The Highland No. 2 Reservoir would float off the Lanpher Reservoir with a new main in conjunction with an existing main below the Allegheny River. The Lanpher Reservoir would require a new dedicated rising main and a new transfer pump station from Highland No. 2 Reservoir to Highland No. 1 Reservoir would be required to supply disinfected water to the Highland No. 1 service area. Similar to Alternative 4, the infrastructure improvements that are required to make this alternative viable hydraulically will have permanent benefits with respect to the reliability and redundancy of the PWSA's distribution system infrastructure. Figure 3.21 presents a schematic of this alternative. Figure 3.22 is a conceptual overview of the planned facilities for this alternative.

3.6.1 Description of disinfection method

This disinfection alternative would use the two-compartment Lanpher Reservoir to achieve the full system disinfection CT requirements. Figure 3.23 is a graph of the required disinfection contact volume for a range of water temperature conditions when the maximum WTP capacity of 117 MGD is pumped to the Lanpher Reservoir. As discussed under Alternative 4, the baffling classification for the Lanpher Reservoir is estimated conservatively to be "unbaffled" which requires the use of a baffling factor of 0.1 in CT requirement calculations. The required contact volume versus chlorine residual curves for each temperature were developed based on the required CT to achieve one-log Giardia inactivation at the associated temperature using free chlorine at a pH of 8.5 and a basin baffling factor of 0.1. The graph in Figure 3.23 shows that with the low baffling factor, the Lanpher Reservoir has adequate volume over the range of temperatures to achieve the required full system disinfection CT, with an effluent chlorine residual maintained above 0.75 mg/L. If greater flexibility in reservoir operating volume is needed then higher effluent chlorine residual could be maintained, or a tracer study could be performed to determine if a higher baffling factor is appropriate.

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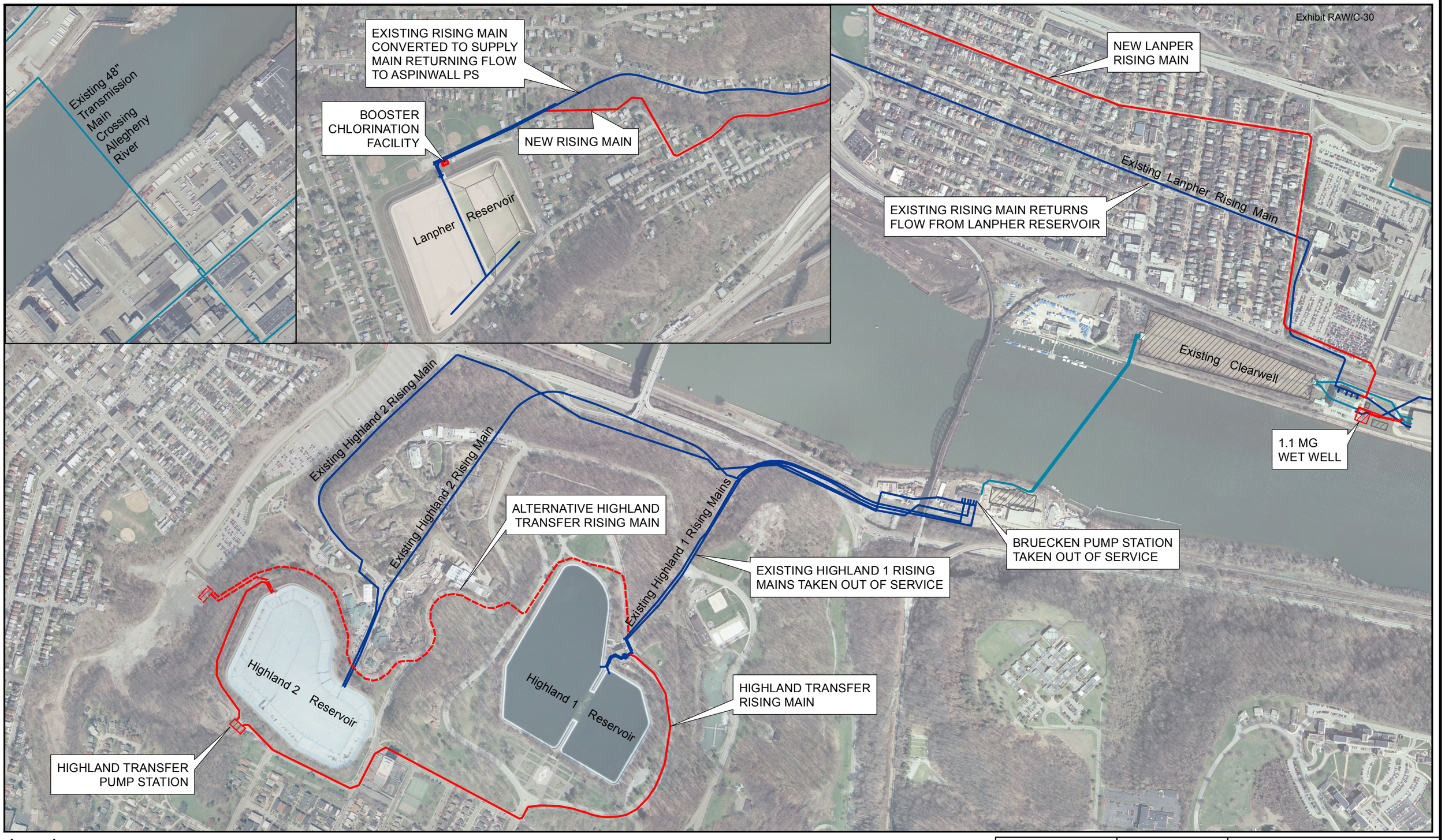
CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 3.21

ALTERNATIVE 5 SCHEMATIC

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Exhibit RAW/C-30



Legend

- Proposed Facilities
- RisingMain
- GravityMain

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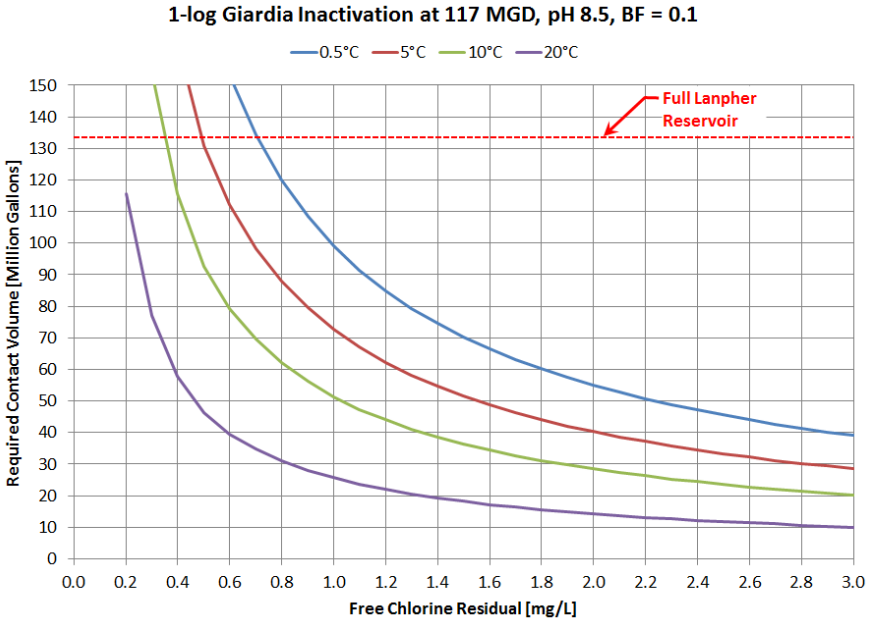
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FIGURE 3.22
ALTERNATIVE 5 CONCEPTUAL PLAN

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Figure 3.23
Lanpher Reservoir Disinfection Contact Volume Requirements



Implementation of primary disinfection at Lanpher Reservoir would require several infrastructure improvements. The first step in the implementation of this alternative at Lanpher Reservoir would be the construction of a new Lanpher Reservoir rising main. Additional required infrastructure for implementing primary disinfection at the Lanpher Reservoir include a water quality sampling system at the inlet and outlet of the Lanpher Reservoir that includes chlorine residual and pH analyzers. Also required are new automated booster chlorination facilities with new sodium hypochlorite storage facilities and metering pumps that can supplement the residual entering or leaving the reservoir as needed to maintain disinfection CT and desired distribution system chlorine residual. Required infrastructure improvements related to conveying potable water from Lanpher to the Highland Nos. 1 and 2 areas, including a new main below the Allegheny River and a new Highland No. 2 Pump Station are discussed in Subsection 3.6.B.

It is proposed that this alternative will require the following improvements for implementation of this reservoir primary disinfection alternative:

- Lanpher Reservoir
  - New rising main.
  - New booster chlorination facilities, housed in a new structure, with two (2) 6,000-gallon bulk storage tanks, a day tank, and feed pumps for 12.5 percent sodium hypochlorite. The use of two (2) bulk tanks instead of one (1) larger tank would provide additional operational flexibility.
  - Online chlorine residual and pH analyzers on reservoir influent and effluent lines.
- Highland No. 2 Reservoir
  - New transfer pump station between Highland No. 2 and Highland No. 1 service areas.

- New booster chlorination facilities, housed in the new pump station, with two (2) 6,000-gallon bulk storage tanks, a day tank, feed pumps for 12.5 percent sodium hypochlorite.
- Online chlorine residual and pH analyzers on reservoir influent and effluent lines.

3.6.2 Description of storage and distribution

A new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would be constructed. Several options regarding the alignment, size, and material of the proposed rising main are currently being evaluated. However, a preliminary analysis indicates that a single 60-inch force main would be required to deliver the required maximum demand of 80,000 gpm. Under this alternative, all four (4) pumps would be replaced with new pumps, each capable of delivering 25,000 gpm at 330 feet TDH. The pumps would be equipped with VFDs and a modern priming system. The new motors would be induction-type, rated for inverter duty controlled by VFDs. The size of the new pumps and their motor ratings will require replacing the main 2400-volt switchgear, more than doubling the size of the main bus. This would provide the opportunity to change the main bus voltage to 4160 volts. New pump motor feeders and disconnects will be required as well. Preliminary evaluations indicate that limited structural improvements would be made to accommodate the installation of new drives and electrical equipment. A temporary suction well would be constructed at one of the proposed locations to provide for adequate pumping volume. The suction well would have to provide at minimum 100,000 gallons of operating pumping volume spanning from an elevation 744 to 748 feet.

The pumping operation for the Fox Chapel service area would use the existing pumps. Motors and VFDs would be added to two (2) pumps to allow for the change in required total dynamic head. Slight adjustments (using multiple pumps) in operations may be required on a temporary basis if available pressure in the Lanpher service area falls below certain set points due to the service area's high demands.

Under this scenario, the Highland No. 2 Reservoir would be floated off Lanpher Reservoir via the existing 48-inch connection under the Allegheny River. According to the PWSA staff, this connection was used in the past on an emergency basis. An alternative approach would be to construct a new pipe across the Allegheny River. Prior to any design work, the existing 48-inch connection must be inspected.

In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer the required volume from the Highland No. 2 to the Highland No. 1 Reservoir via a newly constructed pump station. The capacity of this pump station would match the maximum capacity of the existing Highland No. 1 distribution system. Preliminary investigations indicate that the pump station would be located close to the Highland No. 2 Reservoir outlet and would house three (3) 1,000 HP pumps with the design capacity of 38,000 gpm at approximately 120 feet TDH via a 48-inch supply main. An alternative location is at the site of the existing Highland Pump Station. The pumps would be equipped with VFDs and controlled via a pressure indicating control system. This would require a completely new electrical service for the facility, including a new main and secondary voltage systems switchgear. It would entail the installation of a new medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/208 volts. The secondary voltage system would supply power for all the pumping station's auxiliary equipment, including lighting, ventilation, and low voltage process equipment. The system would incorporate means to provide a second source of power to ensure redundancy.

3.6.3 Project implementation

3.6.3.1 Constructability

Similar to Alternative 4, this alternative is predicated on the construction of a new Aspinwall-Lanpher force main. This will be a high risk, most challenging construction due to the nature of the urban environment and multiple highway crossings.

This alternative would require a complete overhaul of the Aspinwall Pump Station to accommodate the pumping operations for the supply of the entire City of Pittsburgh. This major upgrade includes four (4) new pumps with considerably larger motors. The new motors would be induction-type, rated for inverter duty controlled by VFDs. The size of the new pumps and their motor ratings would require replacing the main 2400-volt switchgear, more than doubling the size of the main bus. This will provide an opportunity to change the main bus voltage to 4160 volts. New pump motor feeders and disconnects would also be required. As explained elsewhere in this report, the temporary clearwell at the Aspinwall Pump Station site will be a challenging task considering the variety of underground and aboveground utilities, railroad spur, driveways, and other existing facilities. A detailed relocation plan must be developed during the early design phase of the project.

In order to implement this alternative, the project team at the earliest phase of design must determine the reliability of the existing interconnection under the Allegheny River. Although it has been used on a few occasions in the past, there is concern that if used for an extended period, it may malfunction or affect the water quality in the system. A new interconnection under the river will require a through preliminary investigation of local conditions presenting significant construction challenge.

Construction of the new Highland No. 2 Pump Station and the force main is anticipated to be within acceptable industry standard risks. Due to the sensitive nature of the area proposed for the force main alignment (recreational area of Highland Park), the construction should be scheduled and implemented to produce minimal disturbance.

A critical component of the construction would be the connection of the new facilities to the existing system. This will be done in close collaboration with the PWSA staff to minimize the production shutdown time.

a. Sequence of construction

The following is a simplified overview of the expected construction sequence:

- Interconnection Feasibility Study
  - Construct a 48-inch interconnection under the Allegheny River (if needed).
- Aspinwall-Lanpher New Rising Main
  - Construct new rising main to the point of connection at the Lanpher Reservoir and the Aspinwall Pump Station.
  - Construct the connection facility and provide system isolation.
  - Construct the chemical addition facilities at Lanpher Reservoir.
- Aspinwall Pump Station Site
  - Relocate all the utilities that interfere with the new construction.
  - Service shutdowns will be needed for extended periods during switchovers.
  - Provide temporary generation to provide backup power during the switchovers.

- Coordinate with the utility company and the railroad.
- Proposed walk in enclosure for the new service outside of the building
- Construct a suction well facility, 96 and 84-inch by-pass piping, with overflow pipe and outfall facility.
- Replace and install a new pump, motor and VFD for Pump No. 1. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC-related instrumentation and supporting wiring for pump operation.
- Coordinate a brief shutdown of the pump station to connect the new motor, drive, and associated PLC.
- Start Pump No. 1.
- Repeat the same sequence for Pump Nos. 2, 3, and 4.
- Construct emergency power facilities (not included in this project).

> Highland No. 2 Pump Station and Transmission Main
  - Two (2) separate contracts working simultaneously.
  - Construct the Highland No. 2 Pump Station Facility at the designated location: civil, architectural, mechanical, electrical, and instrumentation work.
  - Construct the new 48-inch main from the pump station to the point of connection with 48-inch rising mains from the Bruecken Pump Station.
> Start Up
  - Coordinate the shutdown of Aspinwall Pump Station and WTP to connect the new suction well facility and rising main.
  - Start-up the Aspinwall pumping facilities.
  - Start-up the new interconnection under the Allegheny River.
  - Start-up the Highland No. 2 Pump Station.

3.6.3.2 Permitting and Project Implementation Schedule

The following is a list of permits that would have to be obtained prior to construction:

> Public water supply management permit
> Construction permits:
  - NPDES permit (discharge from the construction activities over 1 acre) (multiple projects).
  - Erosion and Sediment Control (with or without NPDES) (multiple projects).
  - PennDOT Highway Occupancy Permit for crossing Freeport Road and multiple roads and highways for Lanpher Reservoir Rising Main.
  - Local Occupancy Permits from multiple communities for Lanpher Reservoir Rising Main.
  - Railroad Crossing Permit.
  - Highland No. 2 Pump Station City Building Permit.
  - USACOE and PADEP Joint Permit for Stream Encroachment (River Crossing).

Table 22 presents estimated timeline for the implementation of Alternative 5.

Table 22: Alternative 5 implementation timeline

Activity description	Activity duration
Design	Month 0-20
Permitting	Month 21-26
Bidding and project award	Month 27-29
Construction of facilities	Month 30-60

3.6.3.3 Water quality impacts

The water age entering the Highland No. 1 and Highland No. 2 service areas would be higher, which may adversely impact disinfection byproduct formation and potential corrosion in these areas and those they serve. The water age entering the Lanpher services area would generally be reduced except for those customers currently served by the Lanpher rising main.

3.6.3.4 Operations

a. Operations controls and risk

The operation of the water supply system during the clearwell rehabilitation as already described for the other alternatives will require detailed preparation and strict implementation. The limited available pumping volume at the Aspinwall Pumping Station would require that the pumping rate match the rate of the filters' effluent rate. A new programming logic controller (PLC) will be installed to ensure that the pumps' output match water treatment plant's production. The signal should be transferred to the main operations desk where the operators would ensure that the system is operating as designed. An emergency overflow would be installed in the case of a system failure. During this period, the entire city water system supply would have to be closely monitored for daily and seasonal changes. A controlled pumping sequence and very strict control of the system's demands in the Highland No. 1 and Highland No. 2 Reservoir Districts would be crucial to the effective implementation of this alternative. The new Highland No. 2 Pump Station would be operated based on the demands in the Highland No. 1 District. It will supply the Highland No. 1 Reservoir, providing and maintaining turnover in the reservoir, while at the same time supplementing any additional demand within that supply district.

A detailed operations sequence should be developed during the design phase.

b. Maintenance

The maintenance of the proposed system would follow the same standard operating procedures established for the current operations. The addition of a new pump station, chemical booster facilities, and two (2) large diameter force mains will increase the need for regularly scheduled asset maintenance.

3.6.3.5 Sustainability

Implementation of this alternative would, at a minimum, improve the quality of life by enhancing public health and safety. However, this alternative will, during construction, negatively impact Aspinwall and its neighboring communities' mobility and access to homes and businesses along the alignments of the proposed Lanpher Rising Main and Highland No. 2 Force Main. It would promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration, and extending the useful life of the existing clearwell structure. The sustainable impact of this alternative can be identified in category of resource allocation; use of regional materials (this should be developed during the project design phase) and the protection of our fresh water availability.

3.6.3.6 Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefits of the temporary and permanent facilities, including reservoirs, pipes, process equipment, electrical equipment, and all the other facilities. An upgrade of the Aspinwall Pump Station consisting of the replacement of the pumps and motors and addition of variable speed drives on selected pumps, is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facility will primarily be a temporary structure.

The addition of a new rising main from the Aspinwall Pump Station to the Lanpher Reservoir would have a significant impact on the reliability and efficiency of water supply within the Lanpher Reservoir supply district. It would provide redundancy in the water supply for that area thus, significantly lowering risks in the current supply operations due to the age and conditions of the existing 60-inch rising main.

The construction of the new Highland No. 2 Pump Station will also improve the system's reliability, provide redundancy in the water supply (micro filtration plant failure), and allow for more control over the demand and supply.

3.6.4 Cost estimate

Estimated capital cost for the implementation of Alternative 5 is $147,860,000. Summary of capital cost breakdown by construction divisions is presented in Table 23.

Table 23: Alternative 5 capital cost estimate

Division	Cost
Division 0 – General Conditions	$4,020,000
Division 2 – Sitework	$57,960,000
Division 3 – Structural	$2,140,000
Divisions 4 through 10 – Architectural	$2,170,000
Division 11 – Equipment	$7,210,000
Division 13 – I&C	$1,080,000
Division 15 – HVAC, Plumbing, and Fire	$580,000
Division 16 – Electrical	$9,330,000
Subtotal Division 0 through 16	**$84,490,000**
Contingencies @ 40 Percent	$33,800,000
Engineering, CM, Legal, PM @ 25 Percent	$29,570,000
Total estimated capital cost	**$147,860,000**

3.7 Alternative 6

Under this alternative, the full system required disinfection CT would be obtained at Highland No. 2 Reservoir. Lanpher Reservoir would be floated off Highland No. 2 Reservoir via either the existing 48-inch connection or a new connection across the Allegheny River. Prior to any design work, the existing 48-inch connection must be thoroughly inspected. The Aspinwall Pump Station pumps that feed the Lanpher Reservoir rising main would not be operated under this alternative and the rising main would be back fed from the Lanpher service area to serve the customers along the rising main and supply the Fox Chapel Pumps at the Aspinwall Pump Station. Prior to any work, due to the significant increase in pressure, the conditions of the existing dual 48-inch rising main must be evaluated and subsequent rehabilitation conducted. A new transfer pump station from Highland No. 2 to Highland No. 1 would be

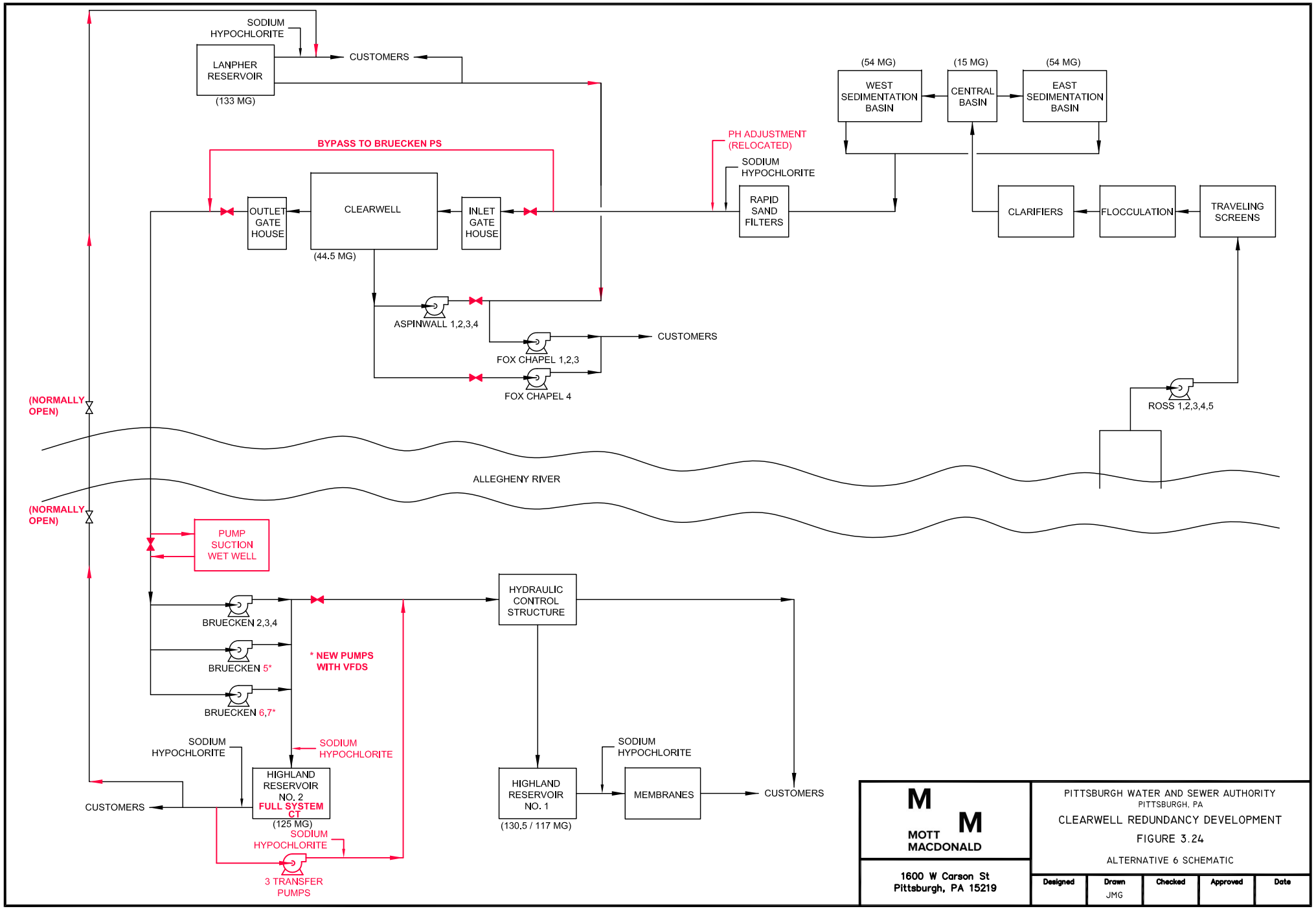
required to supply disinfected water to the Highland No. 1 service area. Like Alternatives 4 and 5, the infrastructure improvements that are required to make this alternative viable hydraulically will have permanent benefits with respect to the reliability and redundancy of the PWSA's distribution system infrastructure. Figure 3.24 presents a schematic of this alternative. Figure 3.25 shows conceptual plan of the facilities presented in this alternative

3.7.1 Description of disinfection method

This disinfection alternative would use the Highland No. 2 Reservoir to achieve the full system disinfection CT requirements. Figure 3.26 is a graph of the required disinfection contact volume for a range of water temperature conditions when the Bruecken Pump Station is delivering a maximum flow of 117 MGD to the Highland No. 2 Reservoir. As discussed under Alternative 4, the baffling classification for the Highland No. 2 Reservoir is estimated conservatively to be "poor," which requires the use of a baffling factor of 0.3 in CT requirement calculations. The required contact volume versus chlorine residual curves for each temperature were developed based on the required CT to achieve one-log Giardia inactivation at the associated temperature using free chlorine at a pH of 8.5 and a basin baffling factor of 0.3. The graph in Figure 3.26 shows that even with the conservative baffling factor, the Highland No. 2 Reservoir has adequate volume to achieve the required disinfection CT at the anticipated maximum flow rate even with a minimal free chlorine effluent residual of 0.3 mg/L. If greater flexibility in reservoir operating volume is needed, then higher effluent chlorine residual could be maintained, or a tracer study could be performed to determine if a higher baffling factor is appropriate.

Exhibit RAW/C-30

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CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 3.24

ALTERNATIVE 6 SCHEMATIC

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Exhibit RAW/C-30

Existing 48" Transmission Main Crossing Allegheny River

EXISTING RISING MAIN CONVERTED TO SUPPLY MAIN RETURNING FLOW TO ASPINWALL PS

Lanpher Reservoir

Existing Lanpher Rising Main

EXISTING RISING MAIN RETURNS FLOW FROM LANPHER RESERVOIR

84" CLEARWELL BYPASS TO BRUECKEN

Existing Clearwell

ASPINWALL PUMP STATION TAKEN OUT OF SERVICE

Existing Highland 2 Rising Main

Existing Highland 2 Rising Main

Existing Highland 1 Rising Mains

2.2 MG WET WELL

EXISTING HIGHLAND 1 RISING MAINS TAKEN OUT OF SERVICE

ALTERNATIVE HIGHLAND TRANSFER RISING MAIN

Highland 2 Reservoir

Highland 1 Reservoir

HIGHLAND TRANSFER RISING MAIN

HIGHLAND TRANSFER PUMP STATION

Legend

- Proposed Facilities
- RisingMain
- GravityMain

N W E S

0 600 1,200 Feet

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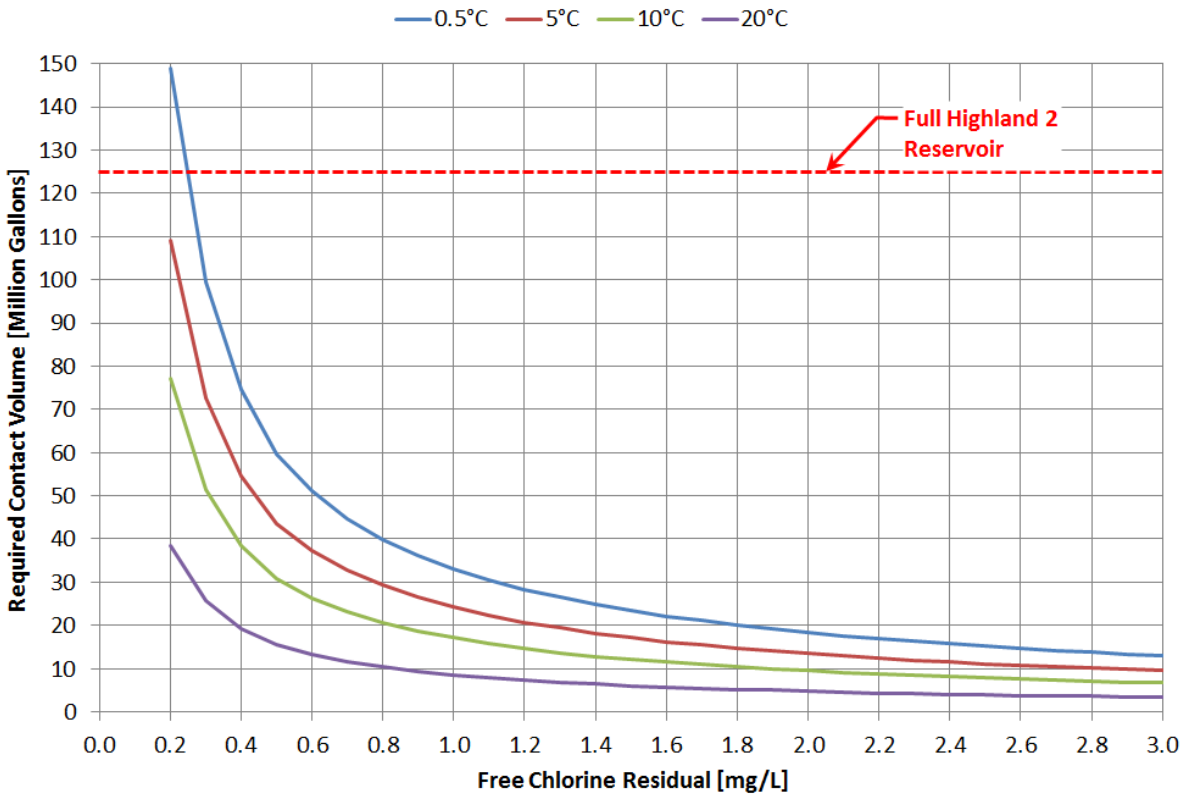
CLEARWELL REDUNDANCY DEVELOPMENT

FIGURE 3.25

ALTERNATIVE 6 CONCEPTUAL PLAN

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		DWW			3/21/2016

Figure 3.26
Highland No. 2 Reservoir Disinfection Contact Volume Requirements
1-log Giardia Inactivation at 117 MGD, pH 8.5, BF = 0.3



Implementation of primary disinfection at Highland No. 2 Reservoir would require infrastructure improvements. A new water quality sampling system at the inlet and outlet of the Highland No. 2 Reservoir that includes chlorine residual and pH analyzers would be required. Also required are new automated booster chlorination facilities with new sodium hypochlorite storage tanks and metering pumps that can supplement the residual entering or leaving the reservoir, as needed to maintain disinfection CT and desired distribution system chlorine residual. The most substantial infrastructure improvement required at this reservoir is a new pump station to transfer the demands of the Highland No. 1 system from the Highland No. 2 Reservoir to the Highland No. 1 service area. The new pump station would house the new booster chlorination facilities. The new Highland No. 2 Pump Station is discussed in further depth below.

In summary, it is proposed that this alternative will require the following improvements for implementation of this reservoir primary disinfection alternative:

- Highland No. 2 Reservoir
  - Rehabilitation of a pair of 48-inch rising mains from the Bruecken Pump Station to Highland 2 Reservoir.
  - New transfer pump station between Highland No. 2 and Highland No. 1 service areas.
  - New booster chlorination facilities, housed in the new pump station, with two (2) 6,000-gallon bulk storage tanks, a day tank, and feed pumps for 12.5 percent sodium hypochlorite

– Online chlorine residual and pH analyzers on reservoir influent and effluent lines.

3.7.2 Description of storage and distribution

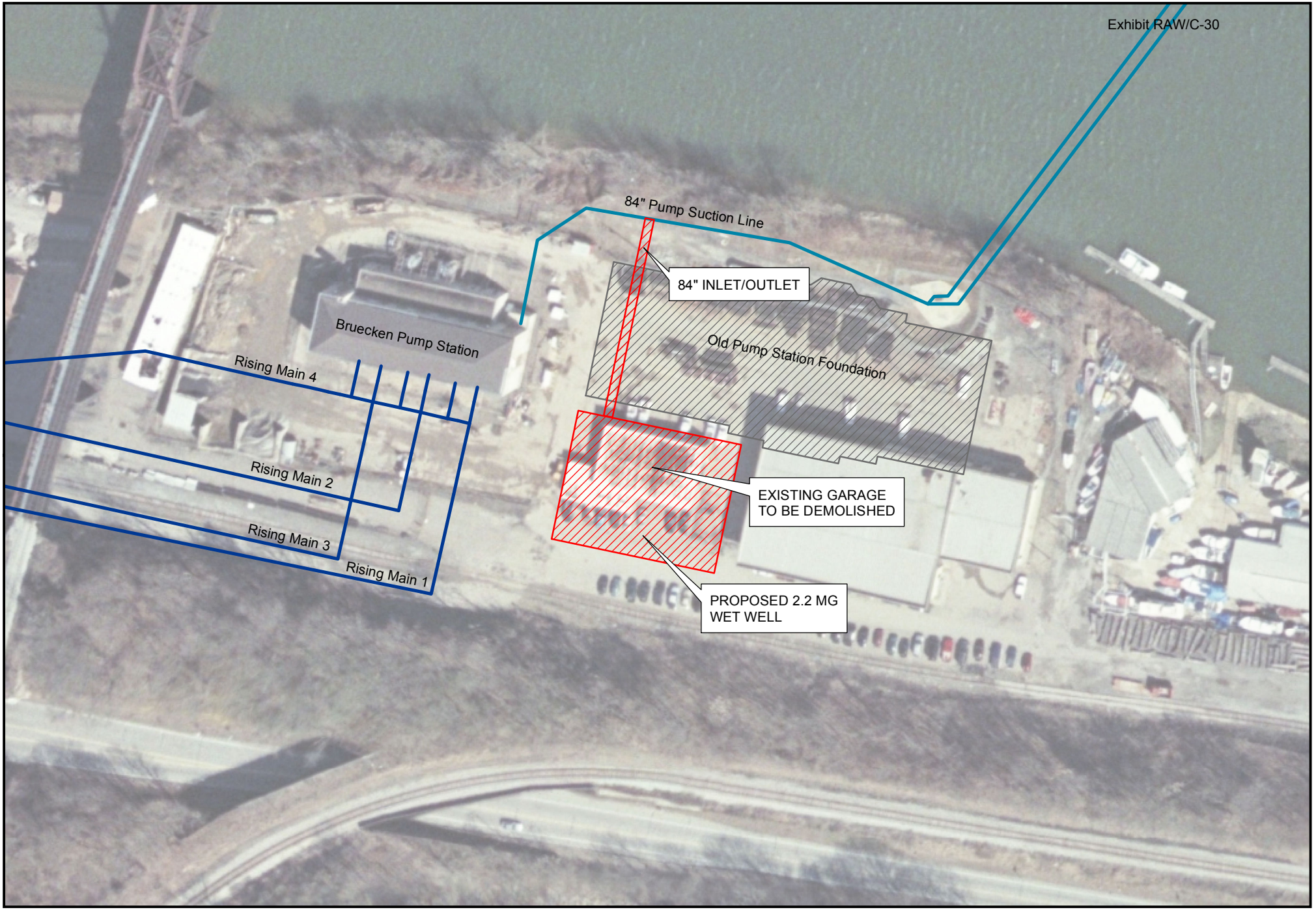
This disinfection alternative would use the Highland No. 2 Reservoir to achieve the full system CT. The Lanpher Reservoir would float off the Highland No. 2 Reservoir with the existing 48-inch interconnecting main below the Allegheny River or a newly constructed parallel connection. A new transfer pump station from Highland No. 2 to Highland No. 1 would be required to supply disinfected water to the Highland No. 1 service area.

An 84-inch bypass around the clearwell would be connected to the pair of 72-inch Bruecken Pump Station suction feed lines. The maximum demand at the Bruecken Pump Station is estimated to be around 80,000 gpm. The entire volume under this alternative would be pumped to the Highland No. 2 Reservoir through a pair of 48-inch rising mains. The increase in flow would result in a higher head loss, ultimately requiring the installation of new pumps. A preliminary analysis indicates that three (3) new pumps designated to pump to Highland No. 2, each with capacity of 26,000 gpm, would replace the existing Pump Nos. 5, 6, and 7. In addition to the replacement of these pumps under this alternative, at least one (1) Highland No. 1 designated pump (Pump Nos. 2, 3, or 4) would be equipped with a new motor and VFD. Modifications in the discharge piping would be made to allow for the utilization of this pump (or pumps) to supplement for peak flow demand.

The new pumps would be driven by VFDs to allow for future operation at decreased capacity (after the rehabilitation of the existing clearwell). The existing synchronous motors would be replaced with inverter duty-rated induction motors with variable frequency drives and new switchgear and feeders. The existing medium voltage switchgear and the feeders to the pump motors would have to be replaced. It is recommended that this service be provided at 4160 volts. The new switchgear could then be permanently connected to the standby generator/generators.

In order to provide for a smooth and reliable operation of the pumps at the pump station, a suction well of sufficient pumping volume would be constructed in the yard next to the pump station. The pumping volume would be determined to allow for a smooth pumping operation, maintaining the level in the suction well between 744 and 748 feet. This would require the construction of, at a minimum, a 14,000 ft^2 structure as shown in Figure 3.27.

As discussed earlier, the Highland No. 2 Reservoir would be used to obtain the required disinfection contact time. In order to meet the demands of the Highland No. 1 Reservoir service area, it would be necessary to continuously transfer the required volume from Highland No. 2 to Highland No. 1 Reservoir via a newly constructed pump station. The capacity of this pump station would match the maximum capacity of the existing Highland No. 1 distribution system. Preliminary investigations indicate that the pump station would be located close to the Highland No. 2 Reservoir outlet and would house three 1,000 HP pumps capable of delivering a total of 38,000 gpm at approximately 120 feet of TDH via a new 48-foot supply main. The pumps would be equipped with VFDs and controlled via a pressure-indicating control system. As indicated in Alternative 4, this would require a completely new electrical service. It would entail the design of the main medium voltage system including switchgear and feeders supplying power to the main pumps and auxiliary equipment as well as to a lower secondary voltage system at either 480 volts or 120/208 volts. The secondary voltage system would supply power for all pumping station's auxiliary equipment including lighting, ventilation, and low voltage process equipment. In addition, the PWSA System generator capacity will be reviewed and a recommendation made as to possible upgrades to meet newer conditions.



Legend

- Proposed Facilities
- Existing Facilities

0 100 200 Feet

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CLEARWELL REDUNDANCY DEVELOPMENT
FIGURE 3.27
BRUECKEN PS PROPOSED FACILITIES FOR ALT 6

	Designed	Drawn	Checked	Approved	Date
		DWW			3/21/2016

Under this scenario, the Lanpher Reservoir would be floated off the Highland No. 2 Reservoir via the new or existing 48-inch connection under the Allegheny River. According to the PWSA staff, this connection was used in the past on an emergency basis. An alternative approach would be to construct a new pipe across the Allegheny River. The existing 48" main must be inspected prior to any design work.

3.7.3 Project implementation

3.7.3.1 Constructability

In addition to all the challenges related to the construction of suction well facility at the Bruecken Pump Station site, the replacement of Pump Nos. 5, 6, and 7 with new pumps with an increased capacity (along with new drives and related electrical infrastructure) will require very close coordination and meticulous planning.

The condition of the existing pair of 48-inch rising mains from the Bruecken Pump Station to the Highland No. 2 Reservoir must be evaluated prior to any work and adequate remediation action implemented.

Construction of the new Highland No. 2 Pump Station and the force main is anticipated to be within acceptable industry standard risks. Due to the sensitive nature of the area proposed for the force main alignment, the construction should be scheduled and implemented to produce minimal disturbance in the recreational area of Highland Park.

In order to implement this alternative, the project team at the earliest phase of design must determine the reliability of the existing connection line under the Allegheny River. Although it has been used on a few occasions in the past, there is concern that if used for the extended period, it may malfunction or affect the water quality in the system. A new connection line under the river would require a through preliminary investigation of local conditions to minimize risks related to construction.

A critical component of the construction will be the connection of new facilities to the existing system. This would be done through a close collaboration with the PWSA staff in order to minimize the production shutdown time.

a. Sequence of Construction

The following is a simplified overview of the expected construction sequence:

- Construct a new pipe connection under the Allegheny River (assume that the existing connection line cannot be used).
- Construct facilities at the Bruecken Pump Station Site.
  - Relocate all utilities that interfere with the new construction.
  - Construct a walk-in enclosure for new service on west side of building.
  - Will need shutdowns of selected pumps for switchovers to new service.
  - Construct suction well facility at the Bruecken Pump Station site, with an overflow pipe and outfall facilities.
  - Replace and install new pumps and motors and VFD for pump No. 5. Install all ancillary electrical equipment and wiring needed for the installation. Install PLC related instrumentation and supporting wiring for pump operation.
  - Coordinate the pump station's brief shutdown to connect the new motor, drive, and associated PLC.

  - Start Pump No. 5.
  - Repeat construction sequence for Pumps Nos. 4, 6 and 7.
  - Construct emergency power facilities.
- Highland No. 2 Pump Station and Force Main
  - Two (2) separate contracts working simultaneously.
  - Construct the pump station facility at the designated location: civil, architectural, mechanical, electrical and instrumentation work.
  - Construct the new 48-inch main from the pump station to the point of connection with 48-inch rising mains from Bruecken Pump Station.
- Start Up
  - Coordinate the shutdown of the Bruecken Pump Station and the WTP to connect the new suction well facility.
  - Start up the Highland No. 2 Pump Station.
  - Start up the Bruecken temporary pumping facilities.

3.7.3.2 Permitting and project implementation schedule

The following is a list of permits that would have to be obtained prior to construction:

- Public Water Supply Management Permit
- Construction Permits:
  - NPDES permit (discharge from the construction activities over one acre) (multiple projects).
  - Erosion and Sediment Control (with or without NPDES) (multiple projects).
  - Highland No. 2 Pump Station City Building Permit.
  - USACOE and PADEP Joint Permit for Stream Encroachment (River Crossing and Outfall).

Table 24 presents estimated timeline for the implementation of Alternative 6.

Table 24: Alternative 6 implementation timeline

Activity description	Activity duration
Design	Month 0-20
Permitting	Month 21-26
Bidding and project award	Month 27-29
Construction of facilities	Month 30-60

3.7.3.3 Water quality impacts

The water age entering the Lanpher (including Fox Chapel) and Highland No. 1 service areas would be higher, which may adversely impact disinfection byproduct formation and potential corrosion in these areas and those they serve. The water age entering the Highland No. 2 service area would be reduced.

3.7.3.4 Operations

a. Operations controls and risks

The operation of the water supply system during the clearwell rehabilitation as already described for other alternatives would require detailed preparation and strict implementation. The limited available pumping volume at the pump stations would require that the pumping rate at each pump station matches the rate of the filters effluent rate. A new programming logic controller (PLC) will be installed at each pump station to ensure that the pumps output match the water treatment plant production. The signal shall be transferred to the main operations desk where the operators will ensure that the system is operating as designed. An emergency overflow will be installed at the Bruecken Pump Station in the case of a system failure. During this period the entire city water system supply would have to be closely monitored for daily and seasonal changes. A controlled pumping sequence and a very strict control of system demands in the Highland No. 1 and Highland No. 2 Reservoir Districts would be crucial for an effective implementation of this alternative. The new Highland No. 2 Pump Station would be operated based on the demands in the Highland No. 1 District. It would supply the Highland No. 1 Reservoir, providing and maintaining turnover in the reservoir, while at the same time supplementing any additional demand within that supply district. A detailed operations sequence should be developed during the design phase.

b. Maintenance

The maintenance of the proposed system will follow the same standard operating procedures established for the current operations. The addition of a new pump station, chemical booster facilities, and the new force main would increase the need for regularly scheduled asset maintenance.

3.7.3.5 Sustainability

The implementation of this alternative would, at a minimum, improve the quality of life by enhancing public health and safety. It will promote leadership on many levels by fostering collaboration and team work, improving infrastructure integration, and extending the useful life of the existing clearwell structure. The sustainable impact of this alternative can be identified in the category of resource allocation; use of regional materials (this should be developed during the project design phase), and the protection of our fresh water availability.

3.7.3.6 Long-term benefits

One of the main criteria in evaluating the alternatives presented in this report is the long-term benefits of the temporary and permanent facilities, including reservoirs, pipes, process equipment, electrical equipment, and all the other facilities. An upgrade of the Bruecken Pump Stations consisting of a replacement of the Highland No. 2 designated pumps, motors, and the addition of variable speed drives on selected pumps is timely considering the age and condition of the existing equipment and should be carefully considered to account for inevitable future upgrades. The suction well facility is a temporary structure.

The construction of the new Highland No. 2 Pump Station would also improve system's reliability, provide redundancy in supply (micro filtration plant failure) and allow for more control over the demand and supply.

3.7.4 Cost estimate

Estimated capital cost for the implementation of Alternative 6 is $84,050,000. Summary of capital cost breakdown by construction divisions is presented in Table 25. Detailed opinion of probable construction cost is presented in Appendix D.

Table 25: Alternative 6 capital cost estimate

Division	Cost
Division 0 – General Conditions	$2,280,000
Division 2 – Sitework	$20,730,000
Division 3 – Structural	$3,050,000
Divisions 4 through 10 – Architectural	$1,870,000
Division 11 – Equipment	$9,250,000
Division 13 – I&C	$1,390,000
Division 15 – HVAC, Plumbing, and Fire	$710,000
Division 16 – Electrical	$8,530,000
Subtotal Division 0 through 16	**$47,810,000**
Contingencies @ 40 Percent	$19,120,000
Engineering, CM, Legal, PM @ 25 Percent	$16,730,000
Total estimated capital cost	**$83,660,000**

4 ALTERNATIVES EVLUATION

As explained in Section 3, the optimum solution will be based on a cost benefit analysis which will include analysis of economic and non-economic factors. The following paragraphs summarize the procedures and the implementation of the point assignment process, compare assign values for each alternative, define the ranking, and provide a discussion of ranking results.

Table 26: Alternative ranking matrix

Criteria	Alternatives					
	1	2	3	4	5	6
Economic						
Project cost						
Economic score						
Non-economic						
Permitting and implementation schedule						
Water quality impact						
Operation and Maintenance						
Sustainability						
Long-term benefits and infrastructure renewal						
Constructability						
Operations risk						
Total non-economic score						
Total score						

4.1 Evaluation process and procedures

The ultimate objective of the alternatives evaluation process is the development of a ranking matrix as shown in Table 26. A score will be assigned to each alternative based on the methodology described in Section 3. The following presents an in-depth discussion and evaluation of the alternatives for each criterion.

4.1.1 Economic factors

The economic factors used in evaluation of each alternative are capital (project construction costs and operation and maintenance cost (O&M). Standard industry practice is to convert these costs to a present-worth value applying a 20-year project-life and certain percentage interest rate. Due to the mix of temporary and permanent solutions needed to achieve the project objectives and the limited time of their utilization (until the rehabilitation of the existing clearwell is completed), the 20-year present worth evaluation would not provide beneficial input to the decision-making process.

Table 27: Economic score

Criteria	Alternatives					
	1	2	3	4	5	6
Economic						
Project cost*	50.3	38.5	72	152.7	147.9	83.7
Economic score	34	45	24	11	12	21
*$Million						

The maximum number of points allocated to the economic scores is 45. The alternative that has the lowest project cost is assigned this maximum economic score of 45. The remaining alternatives receive economic scores prorated based the proportion of the lowest project cost alternative to the given alternatives project cost.

4.1.2 Non-economic factors

The first step in the evaluation of the alternatives based on non-economic criteria was to assess the degree of importance of each non-economic criterion which would result in assigning the maximum point value to each of them. A detailed description of each criterion is presented in Section 3. This was a collaborative process that included all groups within the PWSA staff; Management, Water Quality and Operations and Maintenance. Table 28 summarizes this assessment by providing each of the criteria with the maximum allocated points based on a determined degree of importance.

Table 28: Non-economic score explanation

Criteria	Maximum Points
Permitting and implementation schedule	3
Water quality impact	5
Operation and maintenance	5
Sustainability	5
Long-term benefits and infrastructure renewal	25
Constructability	5
Operations risk	7
Total	**55**

The maximum number of points allocated to the non-economic scores is 55. The criterion with the highest number of points is long-term benefits and infrastructure renewal. Most of the equipment and infrastructure directly affected by the activities in the proposed alternatives are approaching the end of their designed life. Pumps, motors, electrical equipment, and other ancillary equipment have become increasingly more difficult to maintain in designed conditions, and spare parts are not readily available, exposing the day-to-day operation to a greater risk of failing or underperforming. In addition, some of the proposed new infrastructure items, such as new rising mains, pumping stations, etc., would have a significant, long-term positive impact on the security and efficiency of the City of Pittsburgh's water supply system and may be necessary and long-needed regardless of the need for the clearwell rehabilitation.

In determining the most acceptable alternative, another criterion identified as highly important is operations risk. This criterion defines the risks associated with any factors that could potentially impact the safe and reliable distribution of system's daily demands, at all times, during and post construction.

Table 29 summarizes non-economic criteria values (points) assigned to each alternative.

Table 29: Non-economic criteria ranking summary

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Permitting and implementation schedule	1	2	2	3	2	3
Water quality impact	1	5	2	4	3	3
Operation and maintenance	4	2	3	2	2	2
Sustainability	5	3	1	3	3	3
Long-term benefits and infrastructure renewal	3	7	10	25	25	14
Constructability	5	5	3	1	1	2
Operations risk	4	4	5	3	3	2
Total non-economic score	**23**	**28**	**26**	**41**	**39**	**29**

The following is a summary of the evaluation of factors that went into the final decision making process when assigning points to each non-economic factor.

4.1.2.1 Permitting and implementation schedule

Considering the risks associated with the age and current conditions of the existing clearwell, it is imperative that any selected alternative is implemented in the shortest period of time. There are three (3) main factors that will influence the duration of each project; permitting requirements, design, and construction complexity. Section 3 discusses the requirements and nature of these factors. Under Alternative 1, multi-seasonal water quality testing is required prior to the start of the permitting and design process. Alternative 2 may also require an extended permitting process due to introduction of a new treatment process (UV disinfection). Alternative 3, in addition to standard construction permits, will need a utility crossing permit for the installation of a 60-inch force main and 96-inch supply main in and under the local and state roads and the railroad. Alternatives 4 and 5 presume construction of a 22,000-foot rising main through an urban environment, including additional crossings of major state and local roads. Alternatives 5 and 6 include the construction of, at minimum, a new 48-inch Allegheny River crossing pipe that may require an extensive permitting process.

Although there could be different ways to approach the design and construction of the selected alternative, it is assumed that, prior to the development of the final design, a basis of design report will be developed for all the different contracts. If the scope of work is extensive, the construction can be split into separate contracts to meet target completion dates.

In summary, the report estimates that, in the end, the project should be implemented from 53 months (Alternatives 2 and 6), up to 60 months for all other alternatives.

Table 30 is shows points assigned to each alternative.

Table 30: Alternative permitting and implementation schedule ranking

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Permitting and implementation schedule	1	2	2	3	2	3

4.1.2.2 Water quality impact

Each alternative has been evaluated for the ability to maintain or enhance water quality during and post construction. In Alternative 1, the relocation of the chlorine application point will result in the formation of additional disinfection by-products. The formation may or may not result in an exceedance of the Stage 2 D/DBP rule and additional bench and pilot testing would be needed to quantify the increase in DBPs. Therefore, Alternative 1 received the lowest score. Alternative 2 involves the use of UV for primary disinfection and UV provides much greater inactivation of Giardia and Cryptospordium as compared to chlorine; and therefore, Alternative 2 received the highest score. Alternative 3 involves the conversions of a sedimentation basin to a clearwell and an associated reduction of sedimentation capacity that could adversely impact plant performance in terms of higher settled water turbidity and more frequent filter backwashing. In addition, the issue of varying impacts on water age for Alternatives 4, 5 and 6 may have an adverse impact on formation of DBPs and potential corrosion in the served areas.

Table 31 is shows points assigned to each alternative.

Table 31: Alternative water quality impact ranking

Non-economic criteria	Alternatives					
	1	2	3	4	5	6
Water quality impact	1	5	2	4	3	3

4.1.2.3 Operation and maintenance

Operations of the system, whether temporary during the clearwell rehabilitation or permanently after the new system is up and running, must be well-designed, prepared, and meticulously executed to ensure a reliable production of water with highest quality standards. The alternatives that include temporary facilities (Alternative 1, 4, 5, and 6) propose the construction of temporary suction wells at Aspinwall and Bruecken Pump Station sites with limited pumping volumes. This will require carefully monitored operation, matching filter effluent with the flow delivered to the primary reservoirs. The operators must pay special attention to all fluctuations in City wide water demands and carefully manage volumes in those reservoirs with the production of the water treatment plant. Alternatives 4, 5, and 6 propose the construction of a new Highland 2 Pump Station which would ultimately require additional effort for operation and maintenance of this brand-new facility.

Alternative 2 introduces UV as a new process which would require extensive training and attention to data monitoring and review of the new system's operation and the maintenance of the newly installed equipment. Alternative 3 will also add a new facility (low lift pump station) to the operation of the water treatment plant.

The lowest number of points assigned for this criterion is assigned to Alternative 2 due to potential problems in the operation and maintenance of the UV equipment, all while operating the Aspinwall and Bruecken Pump Stations with a limited number of pumps equipped with the VFDs and a limited pumping volume from the temporary suction wells.

Table 32 is shows the points assigned to each alternative.

Table 32: Alternative operation and maintenance ranking

Non-economic criteria	Alternatives					
	1	2	3	4	5	6
Operation and maintenance	4	2	3	2	2	2

4.1.2.4 Sustainability

Section 3 of this report lists several factors that contribute to the assessment of any project's sustainability values. In order to apply these factors to the development of this project, each of the factors was reviewed for its applicability, not just during the construction of temporary facilities and the potential rehabilitation of the existing clearwell, but also for the long-term operation of this part of the PWSA's water supply system. Table 33 summarizes the findings of this assessment.

Table 33: Alternative sustainability rankings

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Quality of life						
Enhance public health and safety	√	√	√	√	√	√
Minimize noise and vibration[1]	√					
Minimize light pollution						
Improve community mobility and access[2]						
Improve site accessibility, safety, and wayfinding						
Preserve historic and cultural resources						
Leadership						
Establish sustainability management system						
Foster collaboration and teamwork	√	√	√	√	√	√
Stakeholder involvement						
Pursue by-product synergy opportunities						
Improve infrastructure integration	√	√	√	√	√	√
Address conflicting regulations and policies						
Extend useful life[3]	√	√		√	√	√
Resource allocation						
Reduce net embodied energy[4]	√	√		√	√	√
Support sustainable procurement practices[5]						
Use recycled material						
Use regional materials[5]	√	√	√	√	√	√
Reduce energy consumption	√					
Protect fresh water availability	√	√	√	√	√	√
Reduce water consumption						
Monitor water systems						
Climate and risk						
Reduce greenhouse gas emission	√			√	√	√
Reduce air pollution emission						

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Prepare for long-term adaptability						
Prepare for short-term hazards	√	√	√	√	√	√
Sustainability ranking						
Sustainability factor totals	12	8	6	9	9	9
Points assigned	5	3	1	3	3	3

Notes:

1. Work on Alternative 1 is limited inside the PWSA property and will not have that impact during construction period.
2. Alternatives Nos. 3, 4, 5, and 6 will have a temporary negative impact on community's mobility and access.
3. Only Alternative No. 3 permanently reduces utilization of the existing clearwell, while all other alternatives presume that the clearwell will be rehabilitated and its useful life extended.
4. Use of VFD.
5. Decision to be made during the design phase.

4.1.2.5 Long-term benefits and infrastructure renewal

The main objective of the clearwell redundancy development project is to mitigate the risks associated with the age and condition of the existing clearwell. In order to develop and implement viable alternatives, many of the existing facilities must be modified and updated, along with the construction and installation of new transmission mains, pump stations, and treatment facilities. As explained in Section 3, many of the upgrades and new facilities will not only accommodate temporary operation during the clearwell rehabilitation, but significantly improve reliability and efficiency of the PWSA's water supply system. Compared to other non-economic factors, this criterion should be assigned the greatest weighing factor due to the extreme importance that the proposed facilities will have on the future operations and management of the system. The report allocates a maximum of 20 points to this criterion. As shown in Table 34, the minimum number of points are allocated to Alternative 1, with minimal long-term benefits, while the maximum number of points are allocated to Alternatives 4 and 5 which require the construction of several facilities that would have a significantly positive impact on future operations.

The discussion in Section 3 clearly identifies these long-term benefits for each alternative. To summarize, the construction of the new Aspinwall-Lanpher Rising Main (Alternatives 4 and 5) would be the most important upgrade, eliminating the risks associated with the failure of the aging, existing rising main, improving the reliability of supply and pressure to main customers in the Lanpher Reservoir supply grid, and providing the means for the potential expansion of the system. Another significant improvement that would be merited with or without the rehabilitation of the clearwell would be construction of a new Highland No. 2 Pumps Station (Alternatives 4, 5 and 6). This pump station would significantly improve the reliability and efficiency of water distribution for the Highland No. 1 supply service area and provide much needed flexibility in the operation of the Highland No. 1 service area. The addition of a new crossing line under the Allegheny River (Alternatives 5 and 6) would also provide flexibility in the system's operation allowing for periodic inspections and upgrades to Lanpher and Highland No. 2 Reservoirs.

The allocation of points for this non-economic factors, just as for others, is based on a collective consensus of subjective opinions on the importance of the proposed improvements. Table 34 shows the points assigned for each alternative.

Table 34: Alternative long-term benefits and infrastructure renewal ranking

Non-economic criteria	Alternatives					
	1	2	3	4	5	6
Long-term benefits and infrastructure renewal	3	7	10	25	25	14

4.1.2.6 Constructability

This criterion attempts to capture the risks associated with the construction of the proposed alternatives. The implementation of any alternative would require very meticulous planning and the precise execution of all the construction work to minimize any negative impact on day-to-day operations. All the alternatives have proposed extensive work at the Aspinwall and Bruecken Pump Station sites that will require the relocation of many aboveground and underground facilities and utilities. In addition, all the tie-ins to the existing system will pose a serious challenge that will require production shutdowns regardless of how successfully planned and executed. Specific constructability issues for each alternative are summarized below.

a. Alternative 1

> Covering sedimentation basins

> Aspinwall Pump Station Site

- Construction of deep suction wet well will require utility relocation.
- Suction well will be located in between existing structures.
- Construction of 84-inch by-pass in proximity of several underground utilities.
- Connection to the existing 96-inch filter effluent will require production shutdown and railroad spur demolition.
- New motors and VFD in Aspinwall PS will require temporary shutdown of each pump for connection, one at the time.

> Bruecken Pump Station Site

- Construction of the deep suction wet well will require facilities relocation.
- Connection to the existing 84-inch Bruecken Pump Station suction line will require production shutdown.
- New motors and VFDs will require temporary shutdown for connection one at a time.

b. Alternative 2

> Aspinwall Pump Station Site

- Same issues as Alternative 1, with an additional challenge of fitting the UV facility within the limited space between the WTP and Aspinwall Pump Station.

> Bruecken Pump Station Site, same as for Alternative 1

- Construction of deep suction wet well will require facilities relocation.
- Connection to the existing 84-inch Bruecken Pump Station suction line will require production shutdown.
- New motors and VFD in Aspinwall Pump Station will require temporary shutdown of each pump for connection, one at a time.

c. Alternative 3

- Conversion of Sedimentation Basin
  - Construction of Central/West Basin. After the draining, cleaning, and disposal of sediment, the construction of a new liner may require additional investigation and major structural overhaul. The mobilization of dredging equipment and liner and cover installation will be challenging.
- Construction of Low Service Pump Station
  - Construction faces all limitation of Aspinwall Pump Station site. Connection to the filter effluent will require production shutdown.
- Construction of conveyance utilities
  - It appears that the only feasible alignment for the proposed 60-inch force main and 96-inch gravity feedback pipe would be along Delafield Avenue. The construction of this dual pipeline would be a great challenge, starting with obtaining all the permits, utility coordination, traffic control, unforeseen site conditions, and trenchless construction for the road and railroad crossing.
  - Connection to the pump station suction lines will require another temporary shutdown along with issues related to the construction of an 86-inch by-pass line in proximity to the other utilities.

d. Alternative 4:

- Aspinwall Pump Site
  - Same issues as Alternative 1.
- Aspinwall – Lanpher Rising Main
  - The construction of approximately 22,000 feet of a 48-inch force main through an urban area of multiple municipalities with multiple crossings of major roads, railroads, and highways will present a serious challenge. This kind of construction requires a superb organization, preparation, coordination, and execution.
- Bruecken Pump Station Site similar as for Alternative 1
  - Construction of deep suction wet well will require facilities relocation.
  - Connection to the existing 84-inch Bruecken Pump Station suction line will require a production shutdown.
  - New motors and VFDs in Aspinwall Pump Station will require temporary shutdown for connection, one at a time.
- Highland No. 2 Pump Station and transmission main
  - The construction of a brand-new pump station that may house the existing Highland Pump Station in an urban area will face issues related to the construction in urban areas, predominantly traffic control and disturbance. The force main alignment will be through a highly-attended area of Highland Park and will be closely monitored and inspected.

e. Alternative 5

- Aspinwall Pump Station Site
  - Same issues as Alternative 1. In addition, a partial or complete overhaul of the Aspinwall Pump Station will require multiple production shutdown.
- Aspinwall – Lanpher Rising Main same issues as for Alternative 4

- Highland No. 2 Pump Station and transmission main same as Alternative 4
  - The construction of a brand-new pump station that may house the existing Highland Pump Station in an urban area will face issues related to the construction in urban areas, predominantly traffic control and disturbance. The force main alignment will be through highly attended area of Highland Park and will be closely monitored and inspected.
- River crossing
  - The construction of a 48-inch pipe under the Allegheny River would be one of the most challenging parts of any projects discussed in this report. Construction mobilization, material and equipment staging, pipe installation utilizing trenchless technologies, and connection to the existing network will require a proven designer and specialized contractor to ensure the successful completion of this project.

f. Alternative 6

- Bruecken Pump Station Site similar to Alternative 1
  - Construction of deep suction wet well will require facilities relocation.
  - Connection to the existing 84-inch Bruecken Pump Station suction line will require production shutdown.
  - New pumps motors and VFDs in Aspinwall Pump Station will require temporary shutdown for connection, one at a time.
- Highland No. 2 Pump Station and transmission main
  - The construction of a brand-new pump station that may house the existing Highland Pump Station in an urban area will face issues related to the construction in urban areas, predominantly traffic control and disturbance. The force main alignment will be through highly attended area of Highland Park and will be closely monitored and inspected.
- River crossing
  - The construction of a 48-inch pipe under the Allegheny River would be one of the most challenging parts of any of the projects discussed in this report. Construction mobilization, material and equipment staging, pipe installation utilizing trenchless technologies, and connection to the existing network will require a proven designer and a specialized contractor to ensure the successful completion of this project.

Tables 29 through 35 assigns points to each alternative based on constructability challenges and issues discussed above. The least challenging, Alternatives 1 and 2, are assigned maximum of 5 points, while the most challenging alternatives 4 and 5 are assigned the least amount of points.

Table 35: Alternative constructability ranking

Non-economic criteria	Alternatives					
	1	2	3	4	5	6
Constructability	5	5	3	1	1	2

4.1.2.7 Operations risk

This criterion captures risks associated with the possibilities that the water production and water quality will be jeopardized due to potential failures of equipment, weather related factors, or any other local or outside factors during and after the construction of the proposed alternative and clearwell rehabilitation.

The main operation risk for many of the alternatives is based on the inability of the temporary system to provide an immediate response to a sudden increase in water demand or change in pressure such as needed for emergency fire flow, water main breaks, sports, or cultural events, etc. All alternatives except Alternative 3 will require the close monitoring of system demands and changes in operation procedures and an ability to promptly increase water production at the Aspinwall WTP.

Extreme weather conditions may also affect timely system supply. An example of such conditions would be a power loss at the Bruecken Pump Station for Alternative 6. Since the entire system is fed through Bruecken and Highland No. 2 Reservoir, a prolonged disruption in the power supply would cause significant difficulties in the system's supply that would rely solely on the volume at only one of the reservoirs, Highland No. 2. Similarly, if Bruecken Pump Station power supply fails, as it did in 2006 for an extended period, the entire system would have to be fed from Lanpher Reservoir, meaning that the old, unreliable 48-inch cross connection pipe would have to be used which could potentially negatively impact water quality. The feasibility of the installation of sufficient capacity of an emergency power supply must be reviewed along with any attempt to implement the proposed alternative.

Table 36 is shows points assigned to each alternative based on operations risk.

Table 36: Alternative operations risk ranking

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Operations risk	4	4	5	3	3	2

4.2 Alternative rankings

As per the methodology described in Section 3 and throughout Section 4 and based on the assignment of points for economic and non-economic factors, Table 37 presents the final matrix of values for each alternative.

Table 37: Alternatives ranking

Non-economic criteria	Alternatives					
	1	**2**	**3**	**4**	**5**	**6**
Economic						
Project cost	50.3	38.5	72	152.7	147.9	83.7
Economic score	**34**	**45**	**24**	**11**	**12**	**21**
Non-economic						
Permitting and implementation schedule	1	2	2	3	2	3
Water quality impact	1	5	2	4	3	3
Operation and maintenance	4	2	3	2	2	2
Sustainability	5	3	1	3	3	3
Long-term benefits and infrastructure renewal	3	7	10	25	25	14
Constructability	5	5	3	1	1	2
Operations risk	4	4	5	3	3	2
Total non-economic score	**23**	**28**	**26**	**41**	**39**	**29**
Total score	**57**	**73**	**50**	**52**	**51**	**50**

5 CONCLUSIONS AND RECOMMENDATIONS

The ranking of alternatives, as described in details in Section 4, followed criteria and ranking procedures set by an initial screening process, based on similar project evaluations. However, each project has its own set of conditions, circumstances, and specific requirements. Table 37 shows that for the set of assumed values for each ranking criteria, Alternative 2 – Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine has the highest score and may be considered as the selected alternative. It is apparent that this alternative highest score derives from the significantly lower capital construction cost than any other alternative. However, as explained earlier in the report, the capital cost needed to implement other alternatives also includes the cost associated with either items that could be considered regular maintenance such as in the case of Alternatives 1 and 3, cleaning and deposing of sludge sediment at an estimated cost of nearly $15 million or items that could be considered long-term assets that are needed to ensure the reliability and redundancy of the City of Pittsburgh's water supply system. An example of such items are the construction of a new Aspinwall – Lanpher Rising Main (Alternatives 4 and 5) which would ensure the much needed reliability of the aging water supply system at the Lanpher Reservoir supply area (estimated planning level value of $55 million) and the construction of the new Highland No. 2 Pump Station and the transmission main, which would increase the reliability of the Highland No. 1 Reservoir supply area at an estimated planning value of $29 million (Alternatives 4, 5, 6).

Since these items are not only needed during the clearwell rehabilitation but also would significantly improve the reliability and efficiency of the entire water supply system, the following pages present a discussion of the alternatives' ranking evaluation and decision making process when a higher importance is assigned to the long-term benefits and infrastructure improvements.

A simple sensitivity analysis was performed to determine the rankings of the alternatives when more points are assigned to the long-term system benefits and infrastructure renewal factors. Table 38 shows the development of the ranking system for the alternatives' evaluation when the economic factors are worth 45 points and non-economic factors 55 points and with the long-term benefits factor worth total of 25 points. As shown in Section 4 and in Table 38, this point assignment system favors Alternative 2.

Table 39 presents the ranking of alternatives when the number of points assigned to Long-Term Benefits and Infrastructure Renewal increases to 35 while the total number of points for economic score decreases to 35, giving these two criteria same importance. Alternative 2 is still the highest ranking alternative although Alternative 4 – Obtain Disinfection CT in Lanpher Reservoir and Highland No. 2 Reservoir comes closer in ranking. This means that when a higher relevance and importance is given to the system's long-term benefits, the final score changes and other alternatives become more desirable.

Table 40 shows that assigning the Long-Term Benefits and Infrastructure Renewal criteria an additional 5 points for a total of 40 points, and decreasing the economic factors' total value for 5 points to a total of 30 points, brings Alternatives 4 and 5 to the top of ranking with the highest assigned score of 63 points for Alternative 4.

In conclusion, this analysis shows that if the economic factor (construction capital cost) is deemed the most important factor Alternative 2 appears as the highest ranking alternative. If the decision-making process considers the water supply system's long-term benefits and infrastructure renewal factor as significant or even more significant, other alternatives, especially Alternatives 4 and 6, emerge as the highest ranking alternatives.

Finally, Table 41 compares the costs for each alternative, provides a breakdown of costs for long-term system beneficial infrastructure improvements, and highlights some tangible and intangible benefits for each alternative.

Table 38: Alternative ranking sensitivity analysis 45 to 55 non-economic to economic ratio

ECONOMIC SCORE		max	45				
			Economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Project cost	50.3	38.5	72	153	148	84	
Economic score	**34**	**45**	**24**	**11**	**12**	**21**	
							max points
NON ECONOMIC SCORE							
		Permitting and implementation					3
		Water quality impact					5
		Operation and maintenance					5
		Sustainability					5
		Long-term benefits and infrastructure renewal					25
		Constructability					5
		Operations risk					7
						TOTAL	55
			Factor of max points				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	0.33	0.67	0.67	1.00	0.67	1.00	
Water quality impact	0.2	1	0.4	0.8	0.6	0.6	
Operation and maintenance	0.8	0.4	0.6	0.4	0.4	0.4	
Sustainability	1	0.6	0.2	0.6	0.6	0.6	
Long-term benefits and Infrastructure renewal	0.12	0.28	0.4	1	1	0.56	
Constructability	1	1	0.6	0.2	0.2	0.4	
Operations risk	0.57	0.57	0.71	0.43	0.43	0.29	
			Non-economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	1	2	2	3	2	3	
Water quality impact	1	5	2	4	3	3	
Operation and maintenance	4	2	3	2	2	2	
Sustainability	5	3	1	3	3	3	
Long-term benefits and Infrastructure renewal	3	7	10	25	25	14	
Constructability	5	5	3	1	1	2	
Operations risk	4	4	5	3	3	2	
TOTAL Non-economic score	**23**	**28**	**26**	**41**	**39**	**29**	
TOTAL SCORE	**57**	**73**	**50**	**52**	**51**	**50**	

Table 39: Alternative ranking sensitivity analysis 35 to 65 non-economic to economic ratio

ECONOMIC SCORE		max	35				
			Economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Project cost	50.3	38.5	72	153	148	84	
Economic score	**27**	**35**	**19**	**9**	**9**	**16**	
NON-ECONOMIC SCORE							max points
			Permitting and implementation				3
			Water quality impact				5
			Operation and maintenance				5
			Sustainability				5
			Long-term benefits and infrastructure renewal				35
			Constructability				5
			Operations risk				7
						TOTAL	65
			Factor of max points				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	0.33	0.67	0.67	1.00	0.67	1.00	
Water quality impact	0.20	1.00	0.40	0.80	0.60	0.60	
Operation and maintenance	0.80	0.40	0.60	0.40	0.40	0.40	
Sustainability	1.00	0.60	0.20	0.60	0.60	0.60	
Long-term benefits and infrastructure renewal	0.12	0.28	0.40	1.00	1.00	0.56	
Constructability	1.00	1.00	0.60	0.20	0.20	0.40	
Operations risk	0.57	0.57	0.71	0.43	0.43	0.29	
			Non-economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	1	2	2	3	2	3	
Water quality impact	1	5	2	4	3	3	
Operation and maintenance	4	2	3	2	2	2	
Sustainability	5	3	1	3	3	3	
Long-term benefits and infrastructure renewal	4	10	14	35	35	20	
Constructability	5	5	3	1	1	2	
Operations risk	4	4	5	3	3	2	
TOTAL Non-economic score	**24**	**31**	**30**	**51**	**49**	**35**	
TOTAL SCORE	**51**	**66**	**49**	**60**	**58**	**51**	

Table 40: Alternative ranking sensitivity analysis 30 to 70 non-economic to economic ratio

ECONOMIC SCORE		max	30				
			Economic Score				
	1	**2**	**3**	**4**	**5**	**6**	
Project cost	50.3	38.5	72	153	148	84	
Economic score	**23**	**30**	**16**	**8**	**8**	**14**	
NON ECONOMIC SCORE							max points
			Permitting and implementation				3
			Water quality impact				5
			Operation and maintenance				5
			Sustainability				5
			Long-term benefits and infrastructure renewal				40
			Constructability				5
			Operations risk				7
						TOTAL	70
			Factor of max points				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	0.33	0.67	0.67	1.00	0.67	1.00	
Water quality impact	0.20	1.00	0.40	0.80	0.60	0.60	
Operation and maintenance	0.80	0.40	0.60	0.40	0.40	0.40	
Sustainability	1.00	0.60	0.20	0.60	0.60	0.60	
Long-term benefits and infrastructure renewal	0.12	0.28	0.40	1.00	1.00	0.56	
Constructability	1.00	1.00	0.60	0.20	0.20	0.40	
Operations risk	0.57	0.57	0.71	0.43	0.43	0.29	
			Non-economic score				
	1	**2**	**3**	**4**	**5**	**6**	
Permitting and implementation	1	2	2	3	2	3	
Water quality impact	1	5	2	4	3	3	
Operation and maintenance	4	2	3	2	2	2	
Sustainability	5	3	1	3	3	3	
Long-term benefits and infrastructure renewal	5	11	16	40	40	22	
Constructability	5	5	3	1	1	2	
Operations risk	4	4	5	3	3	2	
TOTAL Non-economic score	**25**	**32**	**32**	**56**	**54**	**37**	
TOTAL SCORE	**48**	**62**	**48**	**64**	**62**	**51**	

Table 41: Alternatives overview – comparison of costs and intangible factors

Alternative	1	2	3	4	5	6
Alternative Description	Obtain Disinfection CT in Sedimentation Basins	Obtain Giardia Inactivation Credit Using UV and Virus Inactivation Credit Using Free Chlorine	Obtain Disinfection CT in New Filtered Water Clearwell at Sedimentation Basin	Obtain Disinfection CT in Lanpher Reservoir and Highland 2 Reservoir	Obtain Disinfection CT in Lanpher Reservoir	Obtain Disinfection CT in Highland 2 Reservoir
Estimated Project Cost	**$50.3 M**	**$38.5 M**	**$72 M**	**$153 M**	**$148 M**	**$84.1 M**
Temporary Facilities Estimated Cost These are the type of facilities that have to be done but won't be used continuously after the Clearwell rehabilitation.	**19.7 M**	**$35 M** It is assumed that UV will be part of the treatment process that will include the reuse of the clearwell.	**$0** All facilities permanent. No need for clearwell rehabilitation.	**$21 M** Work associated with temporary wet wells both at the Aspinwall PS and Bruecken PS including emergency by-pass lines.	**$21.9 M** Work associated with temporary wet well at Aspinwall, including emergency by-pass lines.	**$18.5 M** Work associated with the temporary wet well at Bruecken PS, including emergency by-pass lines.
Clearwell Rehabilitation The rehabilitation of the clearwell is not covered in this report. The limited inspections conducted in 1998 indicated that the clearwell is structurally sound; however, the rehabilitation of the clearwell is estimated to be around $30 M. Alternatives 2 and 3, if implemented, would reduce if not eliminate importance of the clearwell in disinfection process. However, the 44-million-gallon clearwell provides reliability in the system's operation in case of extreme changes in system demand.						
Estimated Future Clearwell Rehabilitation Cost	**$30**	**$30**	**Not priority**	**$30**	**$30**	**$30**
OVERVIEW OF THE PROPOSED LONG-TERM BENEFITIAL, PERMANENT FACILITIES WITH HIGH IMPACT ON PWSA WATER SUPPLY SYSTEM RELIABILITY AND ITS REDUNDANCY						
New Aspinwall-Lanpher Rising Main: The construction of a new 48-inch (or 60-foot) Aspinwall Lanpher Rising Main would provide much needed redundancy and reliability in supply of Lanpher Reservoir. The existing rising in current years shows signs of significant deterioration due to age and corrosive conditions.						

Alternative	1	2	3	4	5	6
New Aspinwall-Lanpher Rising Main Estimated Cost	**$55 M** Not Included	**$55 M** Not Included	**$55** Not Included	**$55 M**	**$70 M** The rising main will be larger in size to accommodate delivering maximum capacity of 100 MGD.	**$55 M** Not Included
Aspinwall and Bruecken Pump Station Upgrades Aspinwall and Bruecken Pump Stations are 60 and 80 years old respectively. The operation of these two (2) pump stations are crucial for the system operation. A limited inspection indicates that the pumps and associated equipment is near the end of their useful life expectancy and their replacement with new equipment should be a priority. The improvements to the pump stations in this report are limited to only the equipment needed for the rehabilitation of the clearwell. However, these improvements and upgrades are designed to be permanent.						
Aspinwall and Bruecken Pump Stations Upgrade Estimated Cost The cost includes the upgrades needed to accommodate clearwell rehabilitation phase. The complete upgrade of both pump stations is not presented in this report.	**$6M** Aspinwall PS: Pumps 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,5, and 6 and add VFDs and ancillary equipment.	**$6M** Aspinwall PS: Pumps 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,5, and 6 and, add VFDs and ancillary equipment.	**$11.4M** Aspinwall PS: Pumps 1,2, 3 and 4 replace motors and add VFDs and ancillary equipment. Bruecken PS: Replace motors 2,3,4, 5,6, 7 and associated motors, add VFDs and ancillary equipment	**$38.1M** Aspinwall PS: Total replacement of all four (4) pumps including electrical equipment to accommodate new rising main Bruecken PS: Complete replacement of Pumps 5, 6, 7 that pump to Highland 2 reservoir including electrical equipment due to increased flow.	**$24.1M** Aspinwall PS: Complete upgrade with new pumps motors and associated electrical equipment to accommodate pumping maximum flow to Lanpher Reservoir.	**$23.8M** Bruecken PS: Upgrade includes new pumps 5, 6, and 7 including motors and associated electrical equipment.
New Highland Transfer Pump Station and Rising Main New Highland Transfer Pump Station is needed to provide the redundant source of supply to the Highland No. 1 Reservoir supply area. It is evident that there are many issues related to reliability of Highland No. 2 Reservoir as an open water reservoir. The limited capacity of the Micro Filtration Plant, unfavourable hydraulic conditions at the reservoir, and age of the distribution system are some of the reasons that the construction of the Highland Transfer Pump Station and the rising main should be one of the priorities to ensure sound and reliable water supply system.						

Alternative	1	2	3	4	5	6
New Highland 2 Transfer Pump Station and Rising Main Estimated Cost	**$29 M** Not Included	**$29 M** Not Included	**$29 M** Not Included	**$29 M**	**$29 M**	**$29 M**
Rehabilitation of Two (2) 48-Inch Rising Mains Bruecken PS to Highland No. 2 Reservoir The two (2) 48-inch rising mains that supply water to Highland No. 2 Reservoir is another example of a crucial piece of water supply system's infrastructure that is showing signs of deterioration due to age and corrosive environment. Considering its importance in current operations and the operation during the clearwell rehabilitation as explained in each alternative, the rising mains must be at minimum thoroughly inspected and rehabilitated as required for the alternatives where the supply to Highland No. 2 Reservoir is crucial.						
Rehabilitation of Two (2) 48-Inch Rising Mains Bruecken PS to Highland No. 2 Estimated Cost	**$8.8 M** Not Included	**$8.8 M** Not Included	**$8.8 M** Not Included	**$8.8 M**	**$8.8 M** Not Included	**$8.8M**
Stand-By Power The cost for the stand-by emergency power has not been evaluated in this report. However, it must be noted that the emergency power generation for all key components of the water supply system must be thoroughly evaluated.						
Standby Power Estimated Cost	Not Included	Not Included	Not Included	Not Included	Not Included	Not Included
48-Inch New River Crossing In order to ensure the redundant supply to all three (3) of the major reservoirs, it is necessary to periodically supply Lanpher and Highland No. 2 Reservoirs "floating them off" of each other via the existing 48-inch river crossing connections. The condition of the existing river crossing pipes and ability to direct the flow in each direction have become increasingly a risk factor in the system's strategic operation plans. A new crossing in this report is considered only for the alternatives where supplying Lanpher and Highland No. 2 Reservoirs off of each other is part of the plan.						
48-Inch New River Crossing Estimated Cost	**$4 M** Not Included	**$4 M** Not Included	**$4 M** Not Included	**$4 M** Not Included	**$4 M**	**$4 M**
Sedimentation Basins Rehabilitation It has been reported that the sedimentation basins have not been cleaned in over 25 years. It is assumed that a large portion of the 123 million gallons of available volume has been significantly reduced due to the accumulated sludge. In addition, a serious consideration should be given to covering these reservoirs due to proximity of State Route 28 and its vulnerability to potential spill from State Route 28. Only Alternatives 1 and 3 are directly impacted by the current conditions. Both alternatives will require cleaning/dredging and covering of the reservoirs, while Alternative 3 would only require upgrades to western and central basin.						

Alternative	1	2	3	4	5	6
Sedimentation Basins Rehabilitation Estimated Cost	**$22 M** Includes dredging and PPE covers.	**$22 M** Not Included	**$16 M** Includes dredging only. The cost for the conversion of the existing sedimentation basin to clearwell, lining and covering not included in this cost.	**$22 M** Not Included	**$22 M** Not Included	**$22 M** Not Included
Total Cost Comparison						
Long-Term Beneficial Infrastructure (LTBI) Estimated Cost	**$28 M**	**$6 M**	**$11.4 M**	**$131 M**	**$127.1 M**	**$65.6 M**
Percentage of Cost of LTBI vs the Total Project Cost	**55.7%**	**15.6%**	**15.8%**	**85.6%**	**85.9%**	**78%**
Total Cost of the Project + All Recognized LTBIs* Estimated Cost	$50.3 M+ $128.8 M **$179.1 M**	$38.5 M+ $150.9 M **$189.4 M**	$72 M+ $129.5 M **$201.5 M**	$153 M+ $26 M **$179 M**	$148 M+ $54.8 M **$202.8 M**	$84 M+ $91.4 M **$175.4 M**
*Assuming Pumps 5,6,7 at Bruecken PS and 1,2,3,4 at Aspinwall PS are replaced along with VFDs and Electrical Equipment at cost of $38M if applicable)						
Review of Intangibles						
Intangible Benefits	Low constructability and management risks. Lowest impact on community.	Low constructability and management risk. Enhanced water quality with double barrier treatment.	New clearwell allows for different use of the current clearwell utility.	Long-term benefits, fastest to address current operations risks.	Addresses current operations risks.	Similar to addressing the operations risks, but not as good as Alternatives 4 or 5.
Intangible Disadvantages	Water quality risks through change in disinfection process. Permitting uncertainties.	Additional operation and maintenance of UV facilities. Learning curve in O&M.	Low score on sustainable practices rankings.	Multiple contracts. Management and constructability risks.	Multiple contracts. Management and constructability risks.	Multiple contracts. Management and constructability risks.

Alternative	1	2	3	4	5	6
Permitting and Implementation Schedule	Clearwell risk addressed. Intermediate (pending on water quality permitting process)	Clearwell risk addressed. Intermediate	Clearwell risk addressed. Intermediate	Clearwell risk addressed. Longer	Clearwell risk addressed. Longer	Clearwell risk addressed. Intermediate

Appendices

A. Pump, motor, and equipment information

RAM INDUSTRIAL SERVICES, LLC
Since 1947
An ISS Company

1095 Montour West Industrial Park • Coraopolis, PA 15108
Phone: 724.695.5333 • Fax: 724.695.5336

January 13, 2016

Proposal No.: DL 0113-888

Kemal Niksic, P.E
Hatch Mott MacDonald
Engineering Consultant
1600 W Carson St # 1
(412) 497-2000

Pittsburgh Water and Sewer Authority

Attn. Mr. Kemal Niksic

Reference: Pump Station Replacement Pumps

New Highland Reservoir
Quantity (2) Xylem Flygt split case pump(s), model 36x30 WSDD rated at 34,722gpm at 100ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (2) 1100 hp, 891 rpm motor(s) are also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 941,177.00

Brilliant PS (New Pumps) P2-P4
Quantity (3) Xylem Flygt split case pump(s), model 24x16 WSID rated at 19,444gpm at 365ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (3) 2300 hp, 891 rpm motor(s) are also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 1,341,177.00

P5-P7
Quantity (3) Xylem Flygt split case pump(s), model 24x16 WSID rated at 16,667 at 272ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (3) 1500 hp, 891 rpm motor(s) are also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 1,211,765.00

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Phone: 724.695.5333 • Fax: 724.695.5336

Alternative P5-P7

Quantity (3) Xylem Flygt split case pump(s), model 30x20 WSGD rated at 16,667gpm at 272ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (3) 1450 hp, 891 rpm motor(s) are also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 1,211,765.00

Brilliant PS (Replacement 2-Stage) - P2-4

Quantity (3) Xylem Flygt split case 2-stage pump(s), model 30x24 WSG rated at 19,444gpm at 365ft of TDH while running at 720 rpm. Replacement pumps are quoted without a new baseplate. Price does not include new motors. Pricing is FOB jobsite.

Total price for the above.....$ 1,523,530.00

P5-7

Quantity (3) Xylem Flygt split case 2-stage pump(s), model 30x24 WSG rated at 16,667gpm at 272ft of TDH while running at 720 rpm. Replacement pumps are quoted without a new baseplate. Price does not include new motors. Pricing is FOB jobsite.

Total price for the above.....$ 1,523,530.00

Aspinwell PS - P1

Quantity (1) Xylem Flygt split case pump, model 18x16 WSHD rated at 8500gpm at 265ft of TDH while running at 1188 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (1) 750 hp, 1188 rpm motor is also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 417,647.00

P2

Quantity (1) Xylem Flygt split case pump, model 18x16 WSHD rated at 10,420gpm at 265ft of TDH while running at 1188 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (1) 900 hp, 1188 rpm motor is also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 429,412.00

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P3

Quantity (1) Xylem Flygt split case pump, model 24x18 WSG rated at 15,500gpm at 265ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (1) 1350 hp, 891 rpm motor is also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 435,295.00

P4

Quantity (1) Xylem Flygt split case pump, model 30x20 WSGD rated at 19,500gpm at 265ft of TDH while running at 891 rpm. Each pump is complete with soleplates, hold-down bolts, coupling & guard, and a hydrostatic test. Quantity (1) 1650 hp, 891 rpm motor is also included in the base price. Pricing is FOB jobsite.

Total price for the above.....$ 529,412.00

** start-up assistance cost and delivery leadtime to be determined as project requirements are finalized

Terms: 90% Net 30 Days After Receipt; 10% Retainage Due Net 30 Days After Start-Up
F.O.B. Shipping Point
Freight: Prepaid and Allowed
Pricing: Firm for acceptance within 30 days of quotation

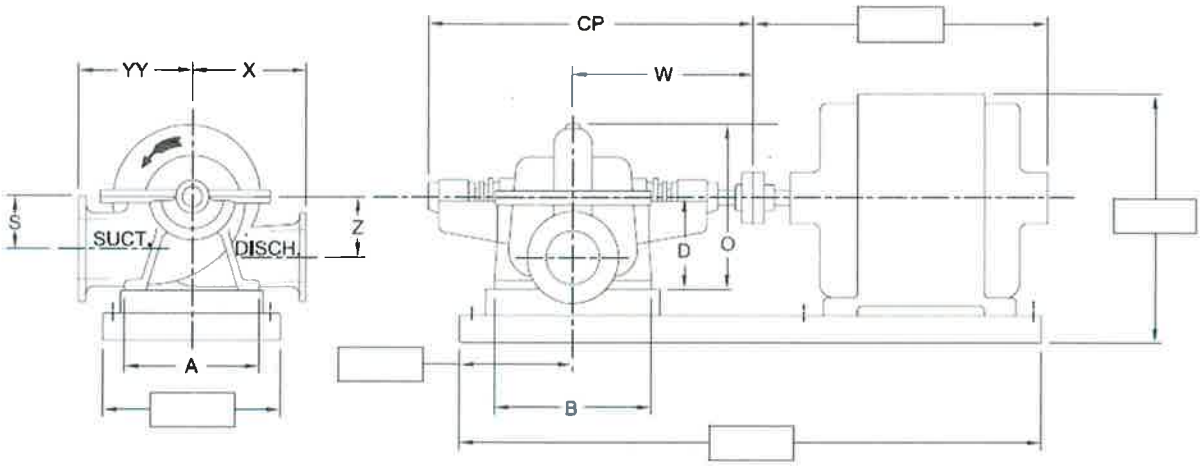
Should you require any additional information, or if we may be of further assistance please do not hesitate to contact us.

Thank you for considering RAM Industrial Services.

Mike Presutti, Municipal Sales Manager – 724-261-2121 (mobile)
Dave Lockard ext. 1614

Ram Industrial Services, LLC

36x30 WSDD (side suction)

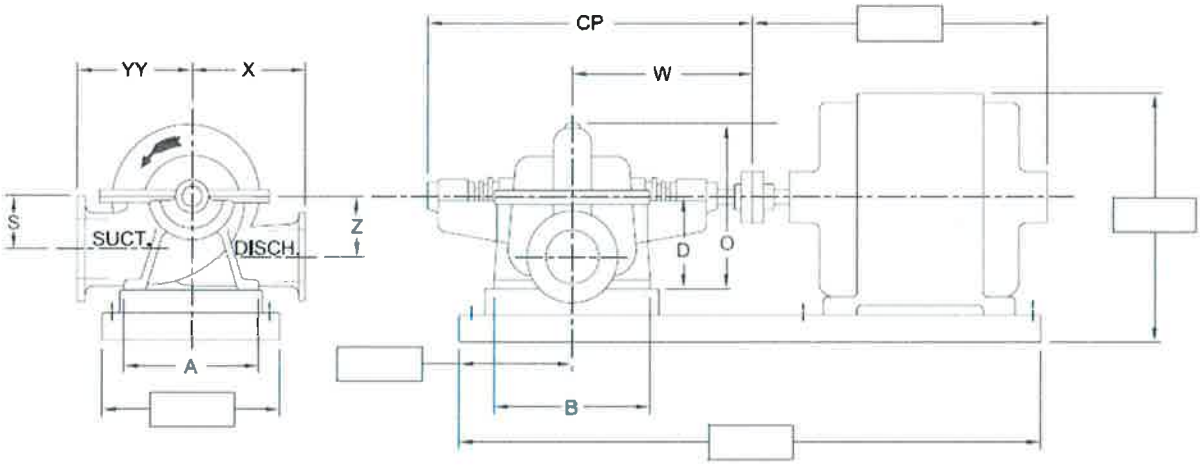


Dimensions in Inches

A	=	57
B	=	72
CP	=	93
D	=	30
O	=	60
S	=	30
W	=	51
X	=	30
YY	=	63
Z	=	30

Dimensions are
Approximate and
Subject to Change

24x16 WSID (Side Suction)

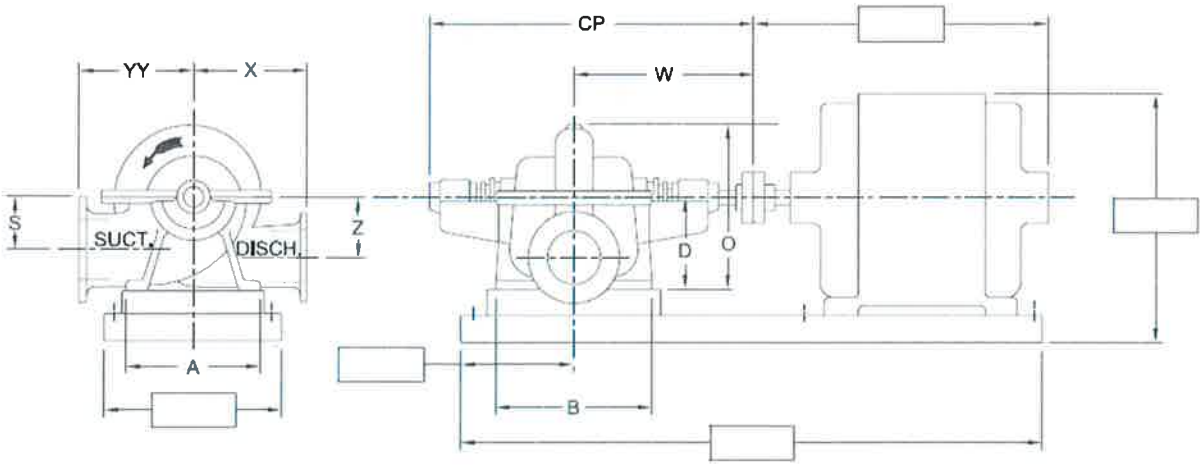


Dimensions in Inches

A	=	70
B	=	59.5
CP	=	105
D	=	39
O	=	73
S	=	30.5
W	=	57
X	=	51.5
YY	=	39
Z	=	32.5

Dimensions are
Approximate and
Subject to Change

30 x 20 WSGD (Side Suction)

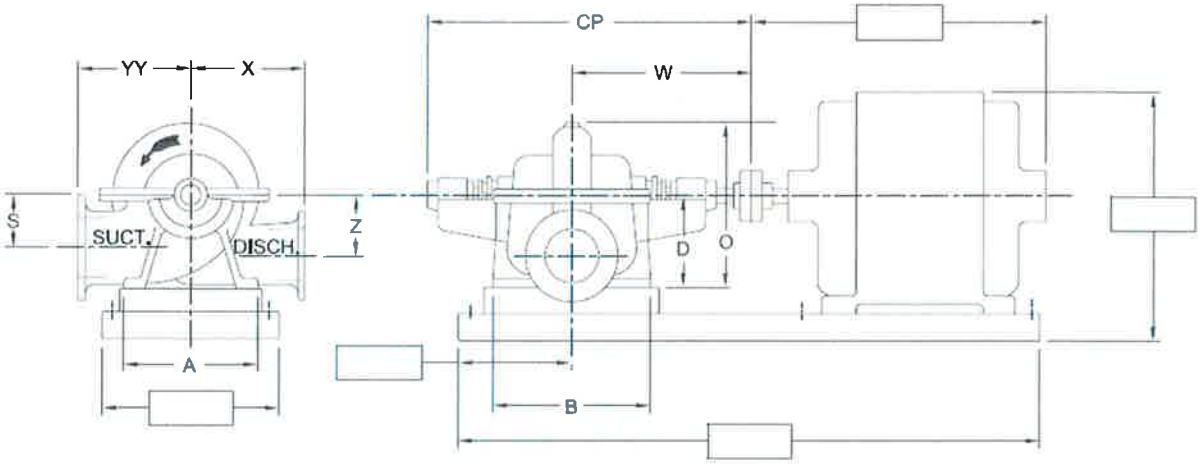


Dimensions in Inches

A	=	58
B	=	52
CP	=	89
D	=	27
O	=	54
S	=	24
W	=	50
X	=	63
YY	=	42
Z	=	29

Dimensions are
Approximate and
Subject to Change

18x16 WSHD (Side Suction)

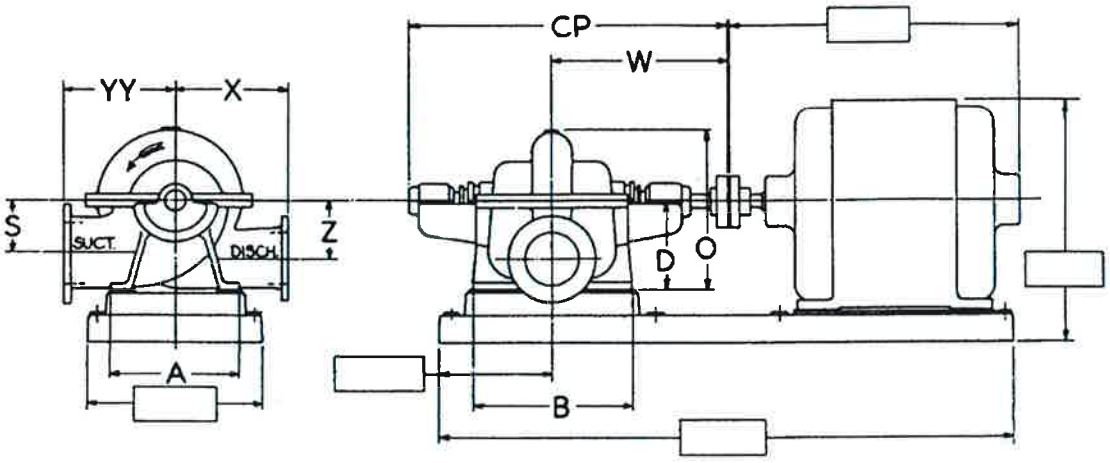


Dimensions in Inches

A	=	51
B	=	42
CP	=	76
D	=	29
O	=	52
S	=	23
W	=	40
X	=	34
YY	=	35
Z	=	22

Dimensions are
Approximate and
Subject to Change

24 X 18 WSG (side suction)



Dimensions in Inches

A	=	56
B	=	50
CP	=	83
D	=	24
O	=	48
S	=	24
W	=	45
X	=	36
YY	=	39
Z	=	21

Dimensions are
Approximate and
Subject to Change

FLYGT
a xylem brand

Axially Split Casing Pump

Parts and Material List

PART NAME	MATERIAL	ASTM #/UNS#
Casing	Cast Iron	A48, CL30
Impeller	316L Stainless Steel	A743, CF3M
Casing Rings	420 Stainless Steel	A743, CA40
Impeller Rings	420 Stainless Steel	A743, CA40
Pump Shaft	Carbon Steel	SAE 1045
Bearing Housings & Caps	Cast Iron	A48, CL 30
Shaft Sleeve	420 Stainless Steel	A743, CA40
Shaft Sleeve - Packing Box	420 Stainless Steel	A743, CA40
Shaft Sleeve Nuts	420 Stainless Steel	A743, CA40
Thrust Bearing	Carbon Steel	Anti-friction/Oil Lube
Radial Bearings	Carbon Steel	Anti-friction/Oil Lube
Packing	PTFE	N/A
O-ring	Rubber	Buna "N"
Glands	Al-Bronze	B148, Alloy 954
Seal Cages	Al-Bronze	B148, Alloy 954
Coupling	Steel	Gear Type
Baseplate	Steel	A36

FLYGT
a xylem brand

Axially Split Casing Pump

(2-Stage Replacements)

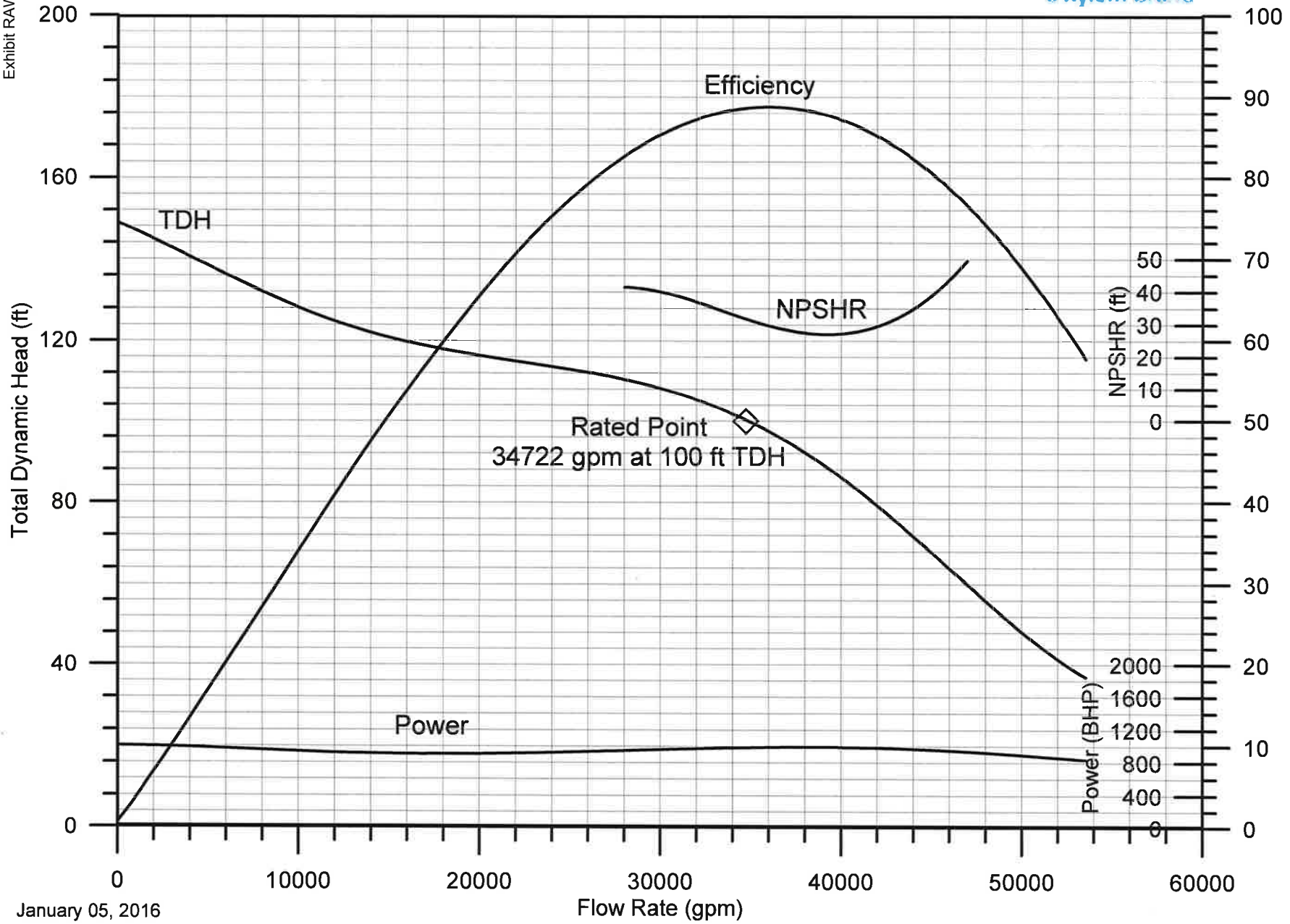
Parts and Material List

PART NAME	MATERIAL	ASTM #/UNS#
Casing	Cast Iron	A48, CL30
Impeller	Al-Bronze	B148, Alloy 954
Casing Rings	Bronze	B854 93200
Impeller Rings	Bronze	B854 95200
Pump Shaft	Carbon Steel	SAE 1045
Bearing Housings & Caps	Cast Iron	A48, CL 30
Shaft Sleeve	Bronze	B148, Alloy 954
Shaft Sleeve - Packing Box	Bronze	B148, Alloy 954
Shaft Sleeve Nuts	Bronze	B148, Alloy 954
Thrust Bearing (Tilting Pad)	Carbon Steel/ Babbit	Oil lub. water cooled
Radial Bearings (Sleeve)	Carbon Steel/Babbit	Oil lub. water cooled
Packing	PTFE	N/A
O-ring	Rubber	Buna "N"
Glands	Al-Bronze	B148, Alloy 954
Seal Cages	Al-Bronze	B148, Alloy 954
Coupling	Steel	Falk

Exhibit RAW/C-30

PWSA Highland Reservoir
Flygt Curve Number 77501
36x30 WSDD at 891 RPM

FLYGT
a xylem brand

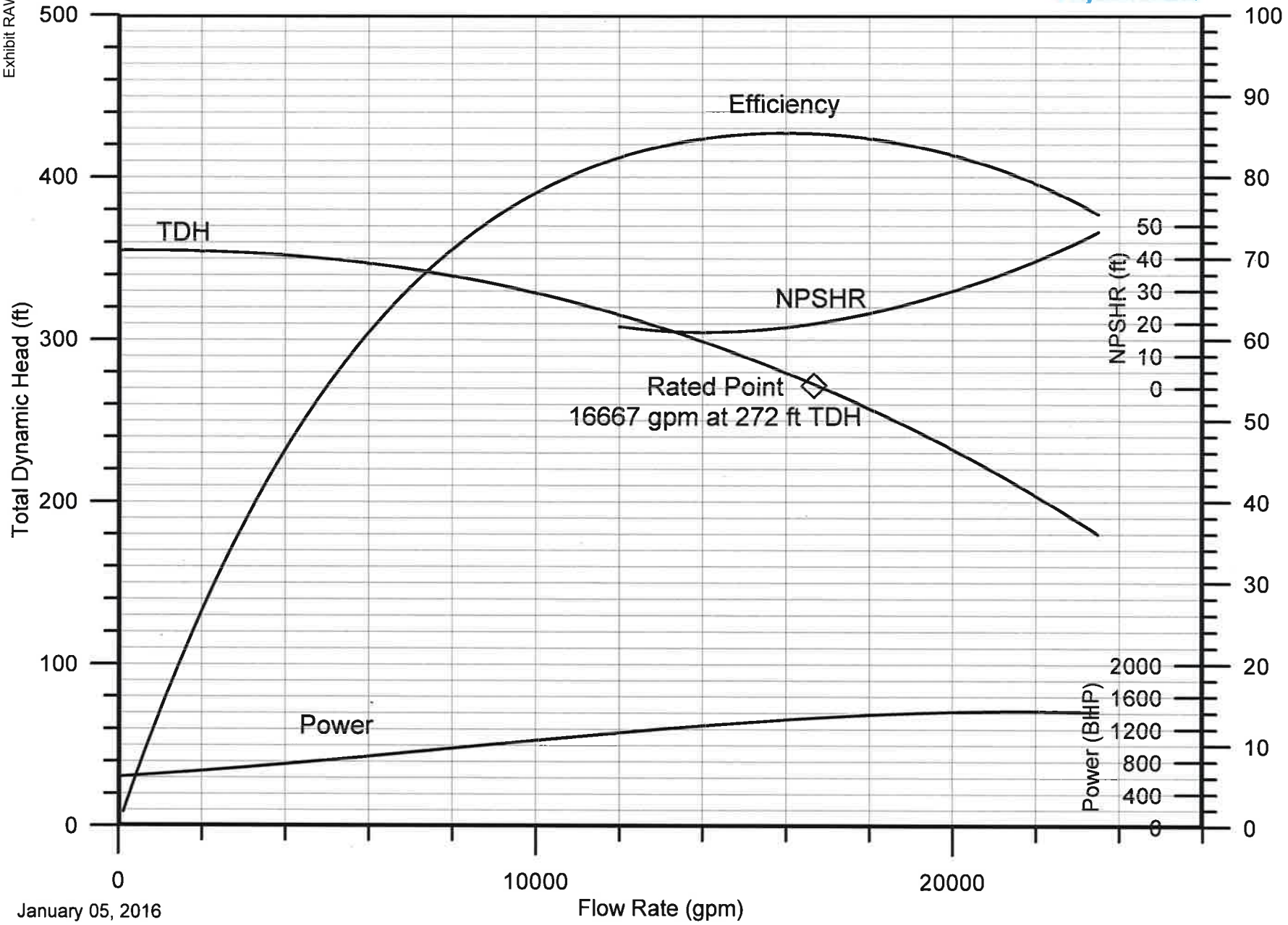


January 05, 2016

Exhibit RAW/C-30

PWSA Brilliant PS
P5-P7
Xylem Flygt Curve Number 77503
24x16 WSID at 891 RPM

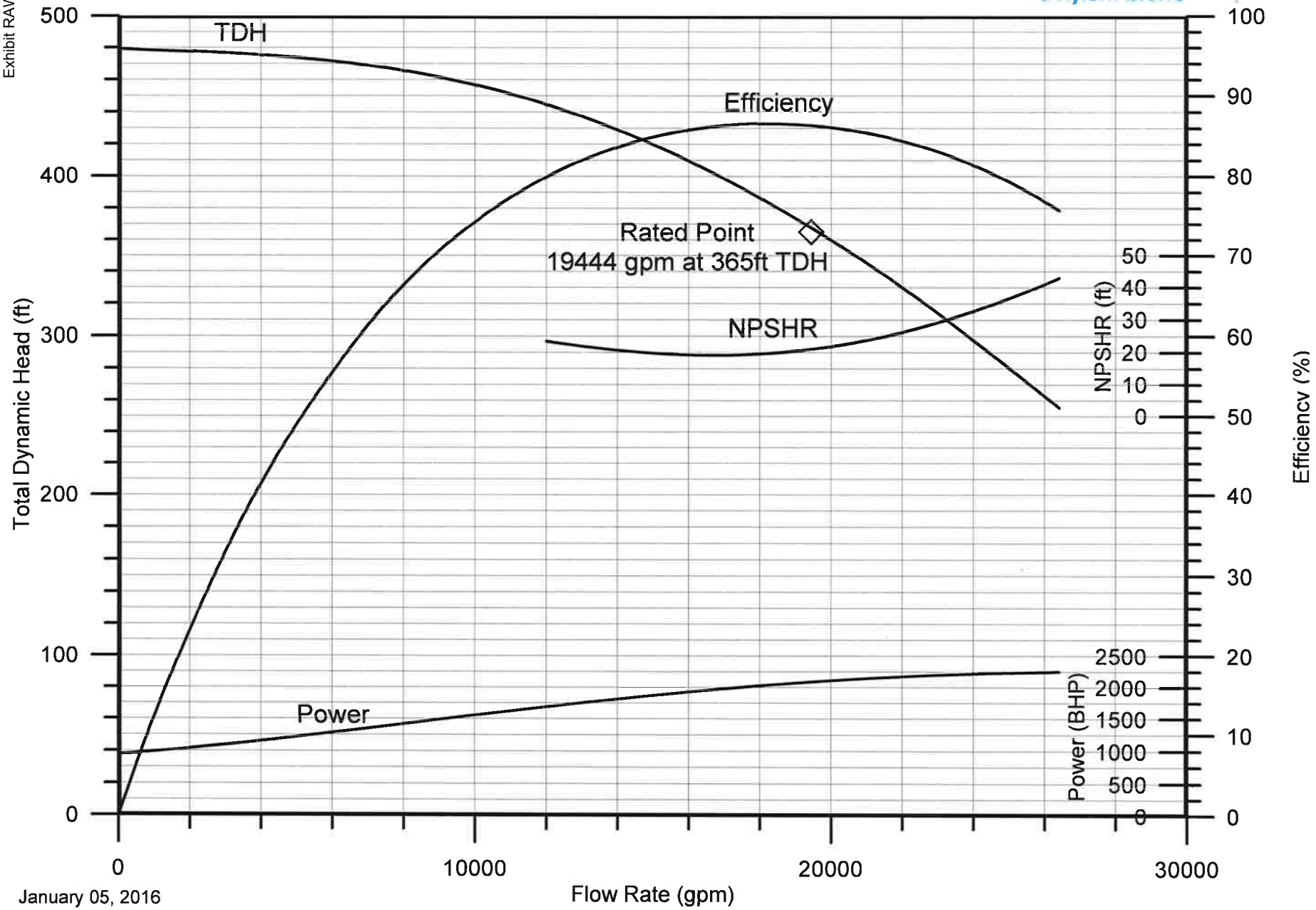
FLYGT
a xylem brand



January 05, 2016

Exhibit RAW/C-30

PWSA Brilliant PS
P2-P4
Xylem Flygt Curve Number 77502
24x16 WSID at 891 RPM

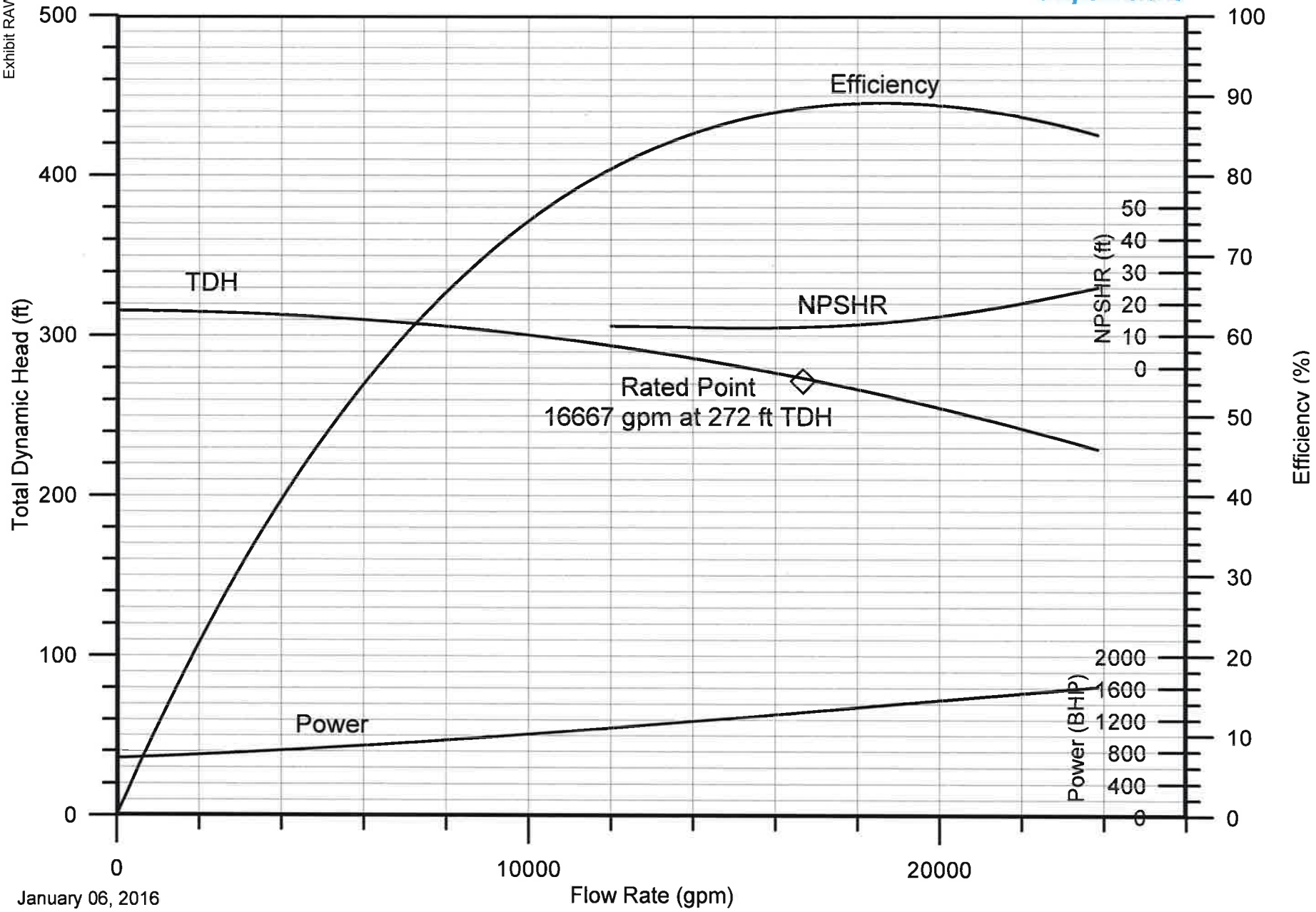


January 05, 2016

Exhibit RAW/C-30

PWSA Brilliant PS
P5-P7 (Alt.)
Xylem Flygt Curve Number 77504
30x20 WSGD at 891 RPM

FLYGT
a xylem brand

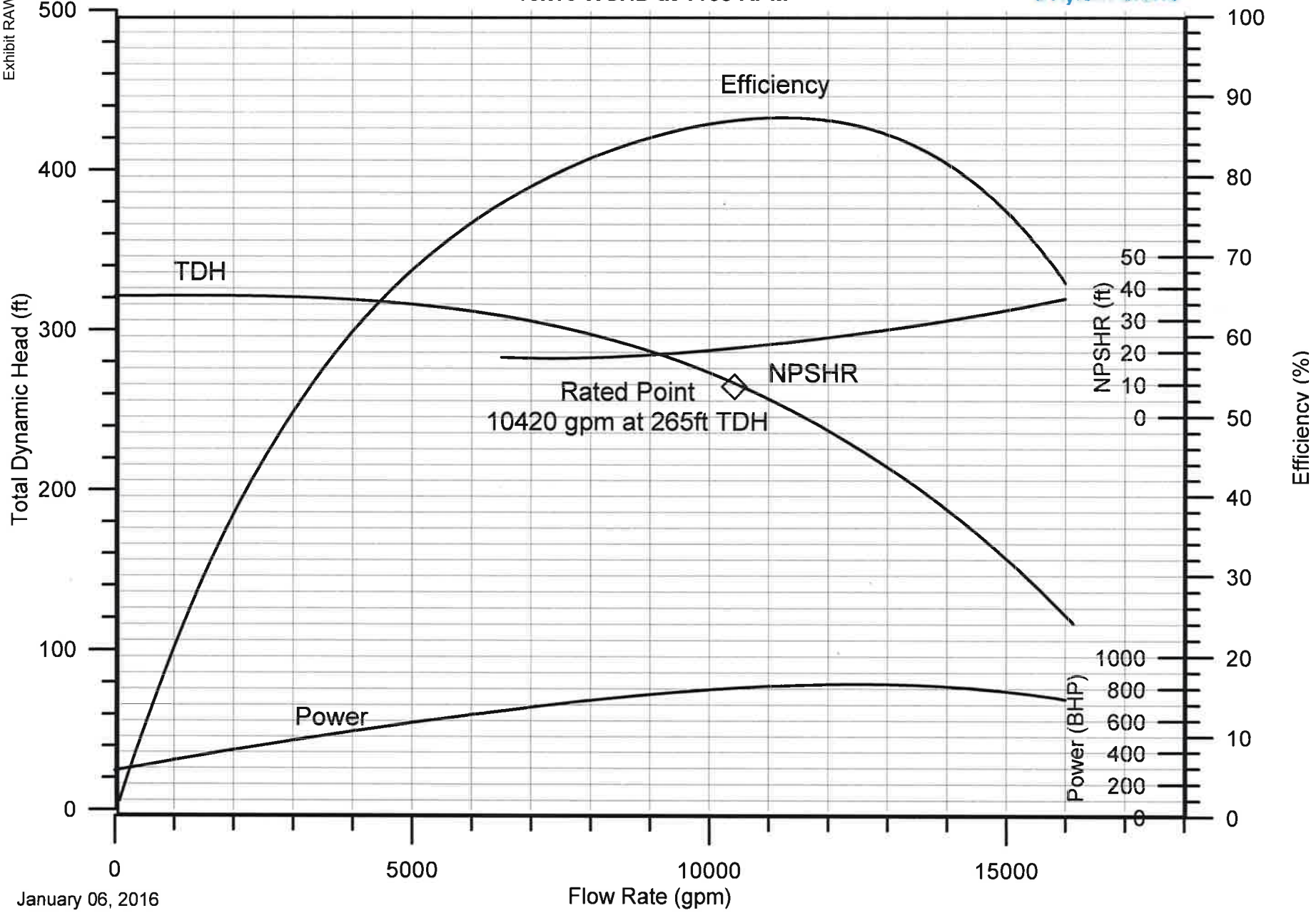


January 06, 2016

Exhibit RAW/C-30

PWSA Aspinwell PS
P2
Xylem Flygt Curve Number 77506
18x16 WSHD at 1188 RPM

FLYGT
a xylem brand

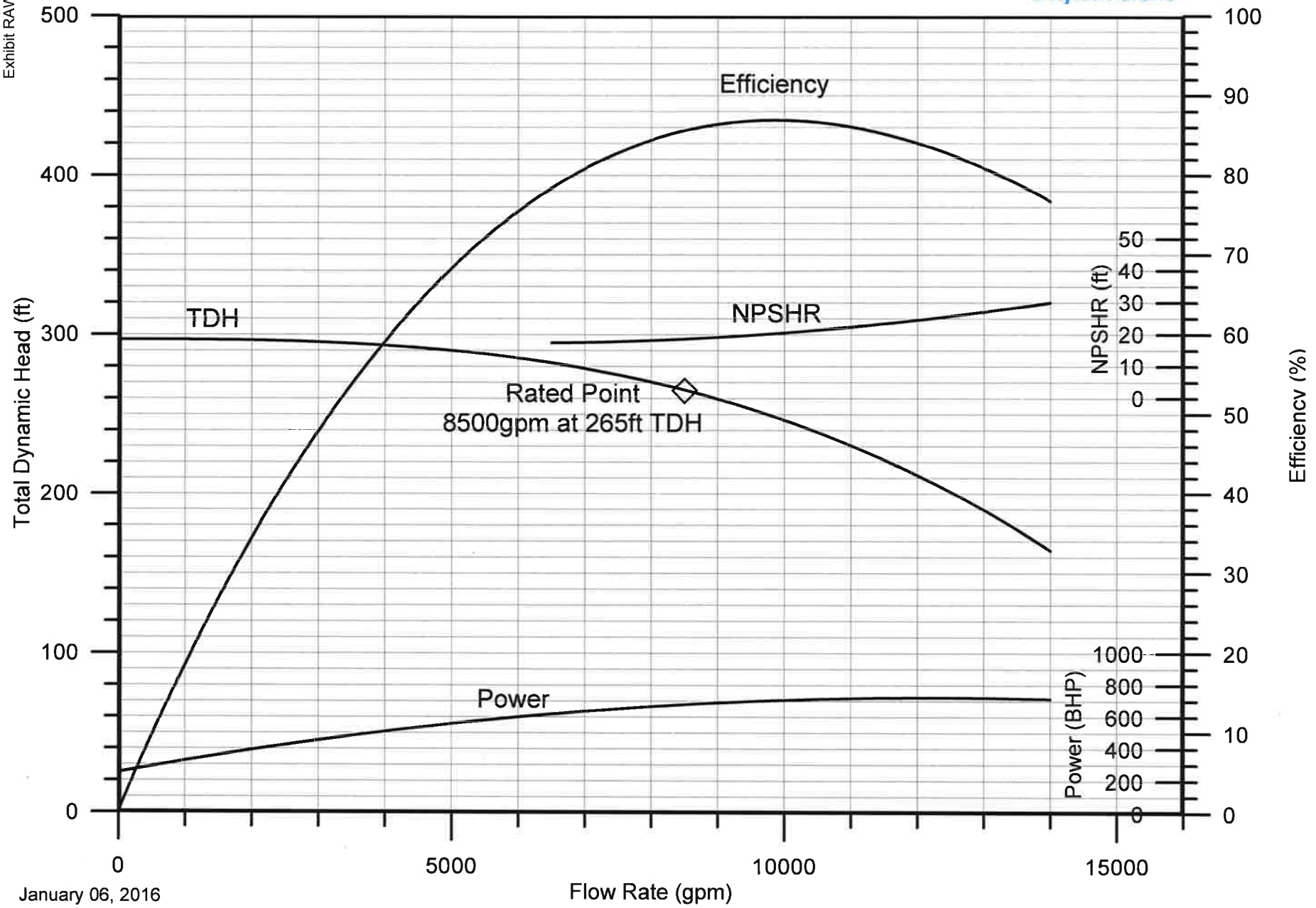


January 06, 2016

Exhibit RAW/C-30

PWSA Aspinwell PS
P1
Xylem Flygt Curve Number 77505
18x16 WSHD at 1188 RPM

FLYGT
a xylem brand

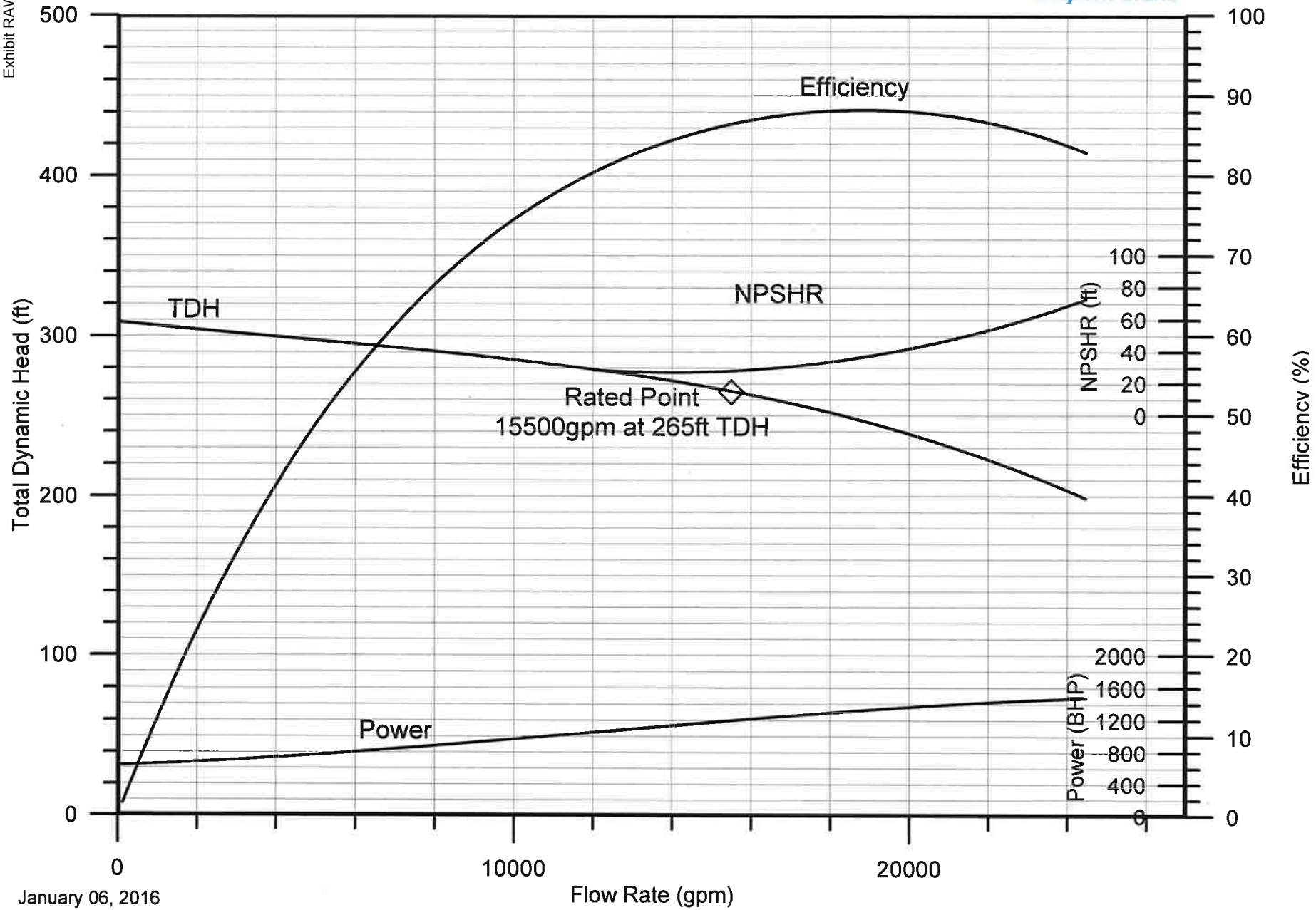


January 06, 2016

Exhibit RAW/C-30

PWSA Aspinwell PS
P3
Xylem Flygt Curve Number 77507
24x18 WSG at 891 RPM

FLYGT
a xylem brand

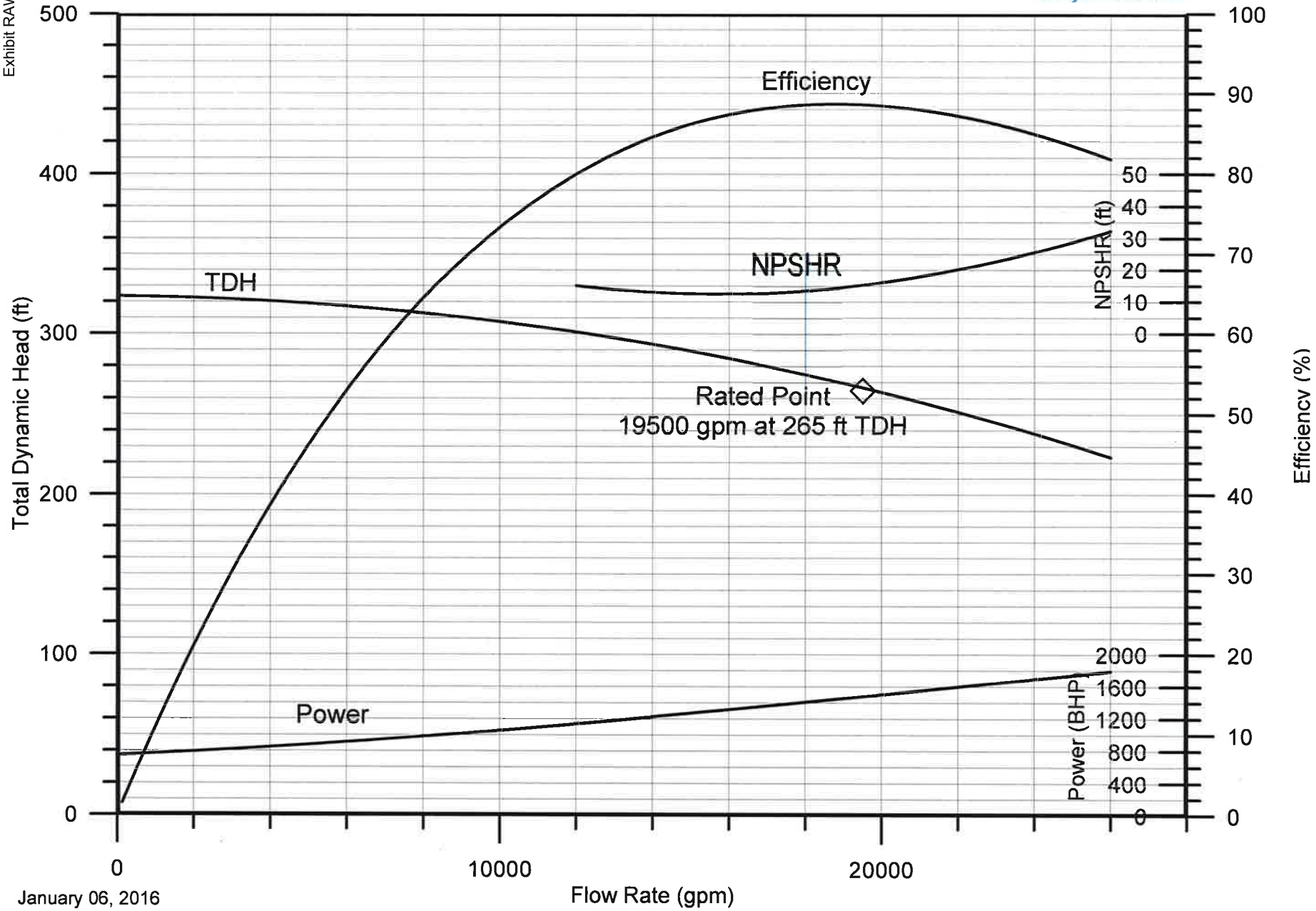


January 06, 2016

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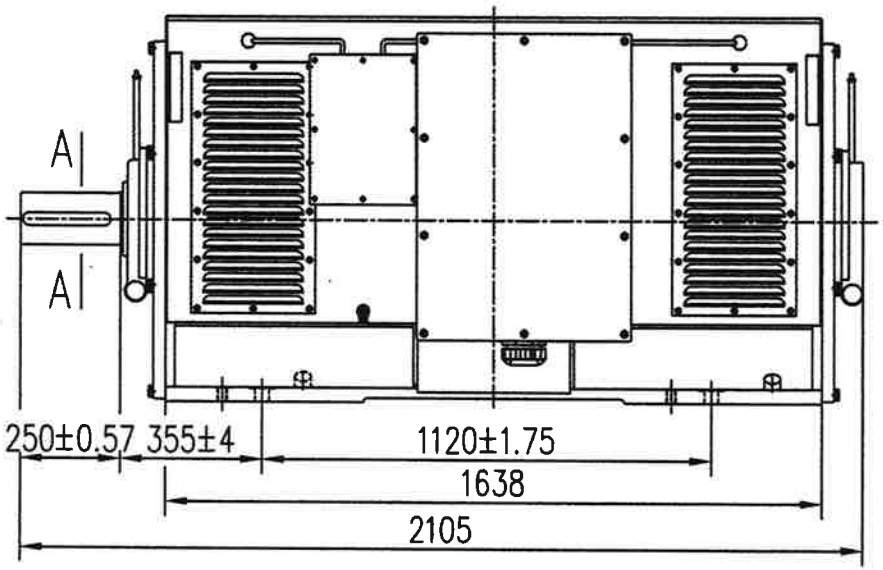
PWSA Aspinwell
P4
Xylem Flygt Curve Number 77508
30x24 WSGD at 891 RPM

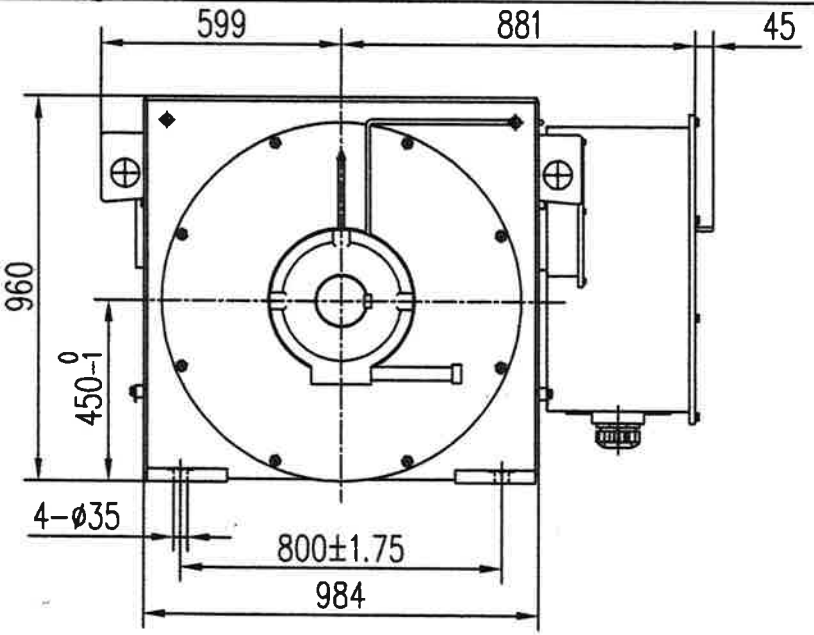
FLYGT
a xylem brand



January 06, 2016

IEC 450 PRELIMINARY FOR RELATIVE SIZE RH 5/13/13





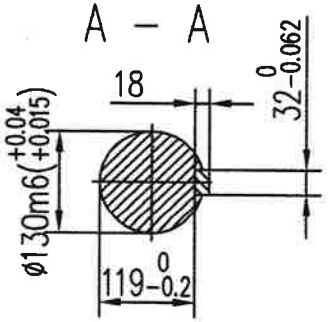
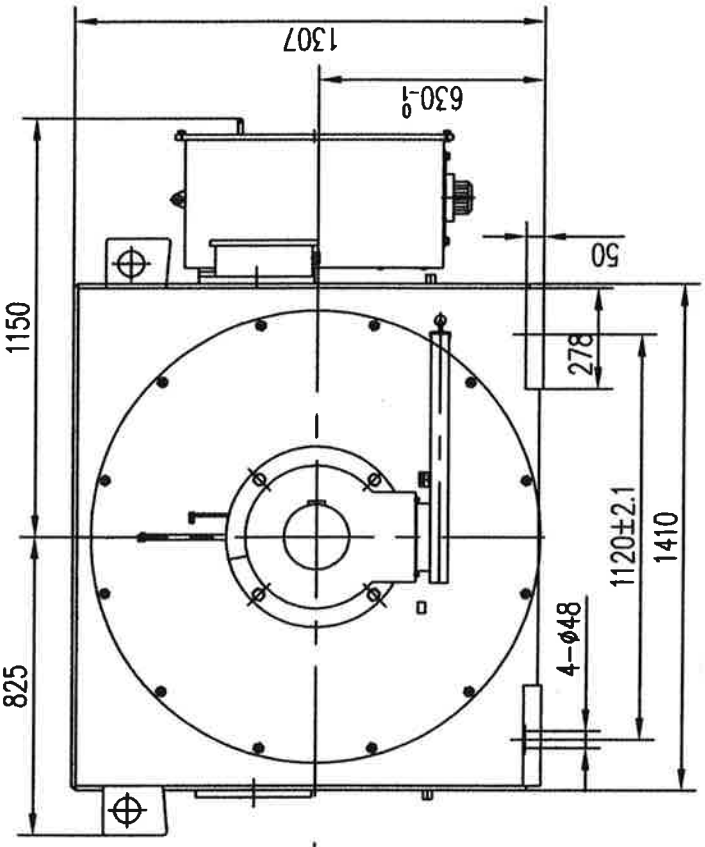
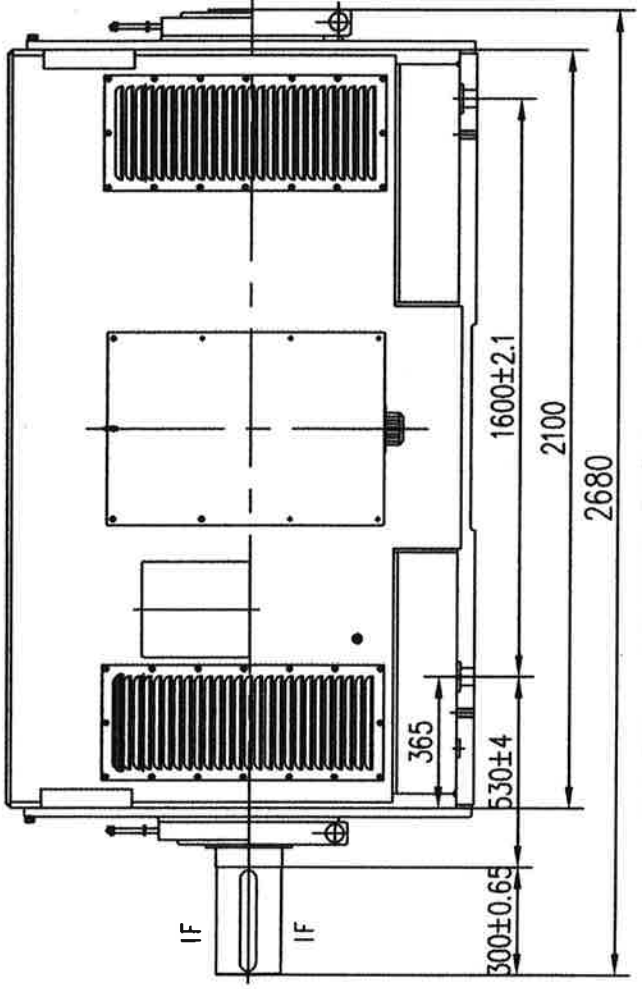
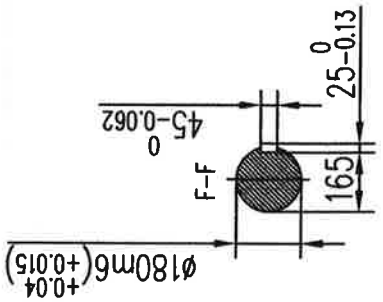


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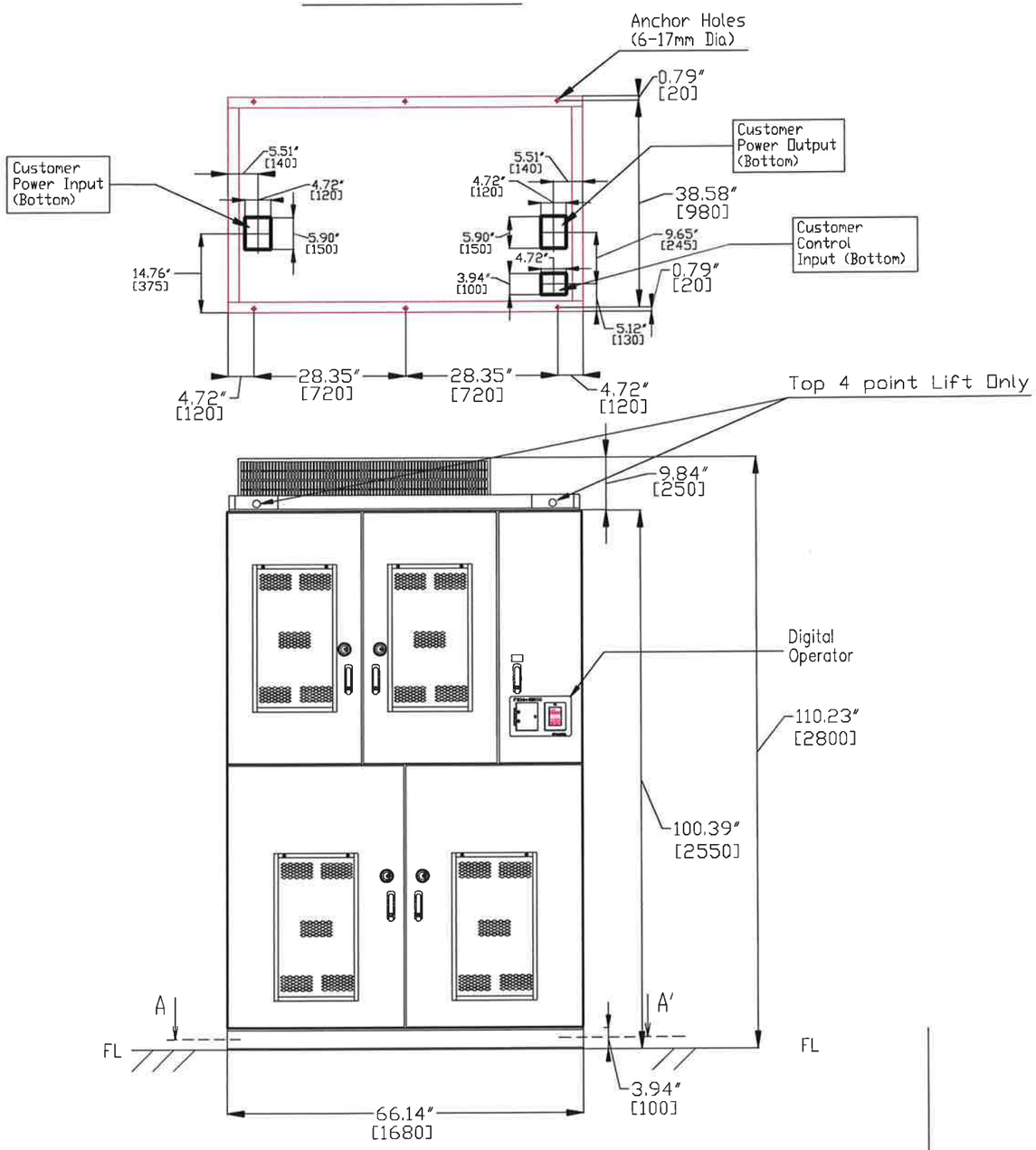
IEC 630 PRELIMINARY FOR RELATIVE SIZE 12# 5/13/13

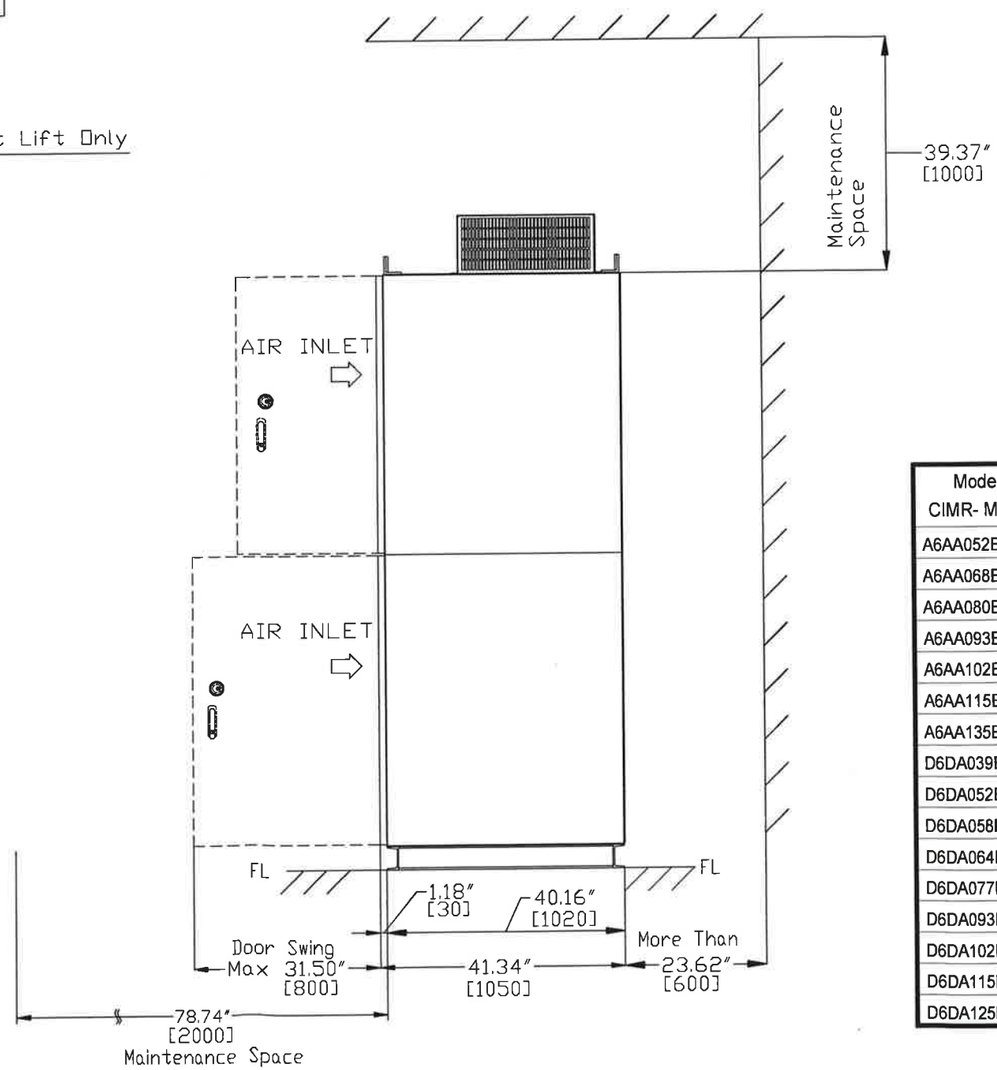






Section A-A'





Model # CIMR- MV2U	Voltage 3 Ph (VAC)	Output Current (A)	Weight Lbs (Kg)	Heat Loss (W)
A6AA052E1AA	2400	52	5291 (2400)	5100
A6AA068E1AA		68		6600
A6AA080E1AA		80	5732 (2600)	7800
A6AA093E1AA		93		9300
A6AA102E1AA		102		10200
A6AA115E1AA		115	6172 (2800)	11400
A6AA135E1AA		135		13500
D6DA039E1AA	4160	39	5291 (2400)	6600
D6DA052E1AA		52		9000
D6DA058E1AA		58		9900
D6DA064E1AA		64		11100
D6DA077E1AA		77	5732 (2600)	13200
D6DA093E1AA		93		16200
D6DA102E1AA		102		17700
D6DA115E1AA		115	6172 (2800)	19800
D6DA125E1AA		125		21600

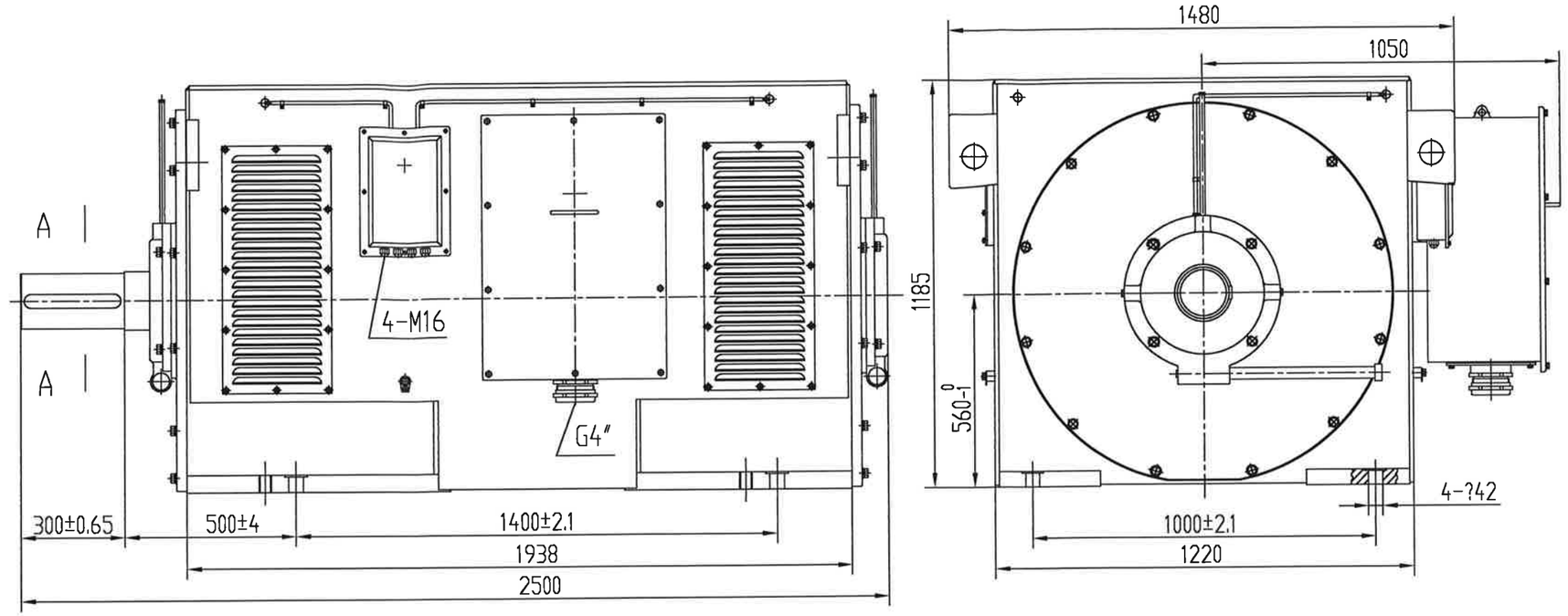
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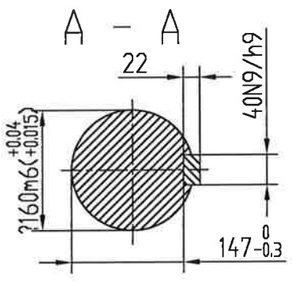
For Reference Only

YASKAWA

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DRAWN: T Sasada	DATE 03/23/12	TITLE: MV1000 Dimension Drawing Frame Size 1 NEMA 1 IP40 ENCLOSURE A6AA052 - 135, D6DA039 - 125
CHECKED: -	DATE -	
TECH: -	DATE -	
APPROVED: -	DATE -	SIZE - REVISION A - PAGE 1 of
		DRAWING #:





Type	HP	V	A	Hz	r/min	η(%)	COSØ	Tmax/Tn	Tst/Tn	Ist/In	Ins.CL	Conn	Rtg	IM	IP	Bearing DE	Bearing NDE	SF
HDP560-10	1500	2300	364	60	710	94.1	0.82	1.8	0.7	6	F	Y	S1	B3	23	NU334 ECM	6334C3	1.15

Winding:6XPT100,Bearing:2XPT100
Heater:220V 4X125W
Temperature Rise:F class

NO.	REVISION	BY & DATE

TOLERANCES UNLESS SPECIFIED

DEC.	METRIC
.X	±2.5
.XX	±.76
.XXX	±.127
.XXXX	±.0127
CHK ANG	±1/2

REGAL Regal-Beloit Corporation

TITLE HDP560-6 1500HP 2.3kV 60Hz

MAT'L. WP13051401-1

FINISH

CAD FILE

RFP

DIST

DRAWN DDQ
CHK
APPD
SCALE 1=20
REF
FMF
PREV

SIZE B | DRAWING NO. 0G56002226 | REV

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ALTERN. 3.
LOW HEAD TRANSFER PUMPS

Exhibit RAW/C-30

RAM INDUSTRIAL SERVICES, LLC
Since 1947
An ISS Company

1095 Montour West Industrial Park • Coraopolis, PA 15108
Phone: 724.695.5333 • Fax: 724.695.5336

February 18, 2016

Hatch Mott MacDonald
1600 W Carson St.
Pittsburgh, PA 15219-1031

Attn. Kemal Niksic, P.E. | Principal Engineer

Reference: Transfer Pumps

In accordance with your request, we are offer as follows:

Application: 50MGD Average Flow / 100 MGD Peak flow Total Estimated Head - 30 ft (no static elevation provided)

Pumps
Two (2) Flygt Submersible Axial Flow Propeller Pumps, Model PL 7105/885 with impeller code 1220. Pumps are standard cast iron construction and are powered by 3 phase, 60 Hz, 460 Volt, 400 HP motors. Pumps are each rated 34,722 gpm at 30 ft TDH and are suitable for operation with a variable frequency drive.

Total budgetary price for the above.....$ 358,640.00

Comments
- Static head not provided at this time – final pump/performance curve selection may change based on static head determination
- Pumps are designed to mount in stainless steel or concrete tubes – pricing not included until depth determined
- Discharge head assembly not included until requirements finalized
- Controls to be determined in future, but as a minimum a MAS 711 monitoring system will need to be incorporated in control panel (MAS 711 specification sheet is included for your reference)
- Power and pilot cable lengths and requirements to be determined after site conditions finalized

Terms: 90% Net 30 Days After Receipt; 10% Retainage Due Net 30 Days After Start-Up
F.O.B. Shipping Point
Freight: Prepaid and Add
Delivery: 4-5 Weeks for Submittals Once Purchase Order Received; 12-15 Weeks after approved submittals
Pricing: Firm for acceptance within 30 days of quotation

Should you require any additional information, or if we may be of further assistance please do not hesitate to contact us.

Thank you for considering RAM Industrial Services, LLC

Mike Presutti, Municipal Manger, mobile (724-261-2121)
Dave Lockard ext. 1614
Ram Industrial Services, LLC

Nusser, Donald O

From: McGrath, Margaret J
Sent: Wednesday, March 01, 2017 1:09 PM
To: Roberts, Matthew H; Nusser, Donald O; Ogier, Joshua S; Patton, Daniel S
Cc: Nicotra, Kristina M
Subject: FW: Quick rough guide to setting up projects in the UAT1B system
Attachments: Quick draft of project creation steps - PH 010317.docx

Team,

fyi

From: Paul Hunt [mailto:PaulHunt@deltek.com]
Sent: Wednesday, March 01, 2017 1:02 PM
To: Valbuena, Marina E <Marina.Valbuena@mottmac.com>; Hough, Steve A <Steve.Hough@mottmac.com>; Beadle, Mark D <Mark.Beadle@mottmac.com>; Shakesheff, Denis <Denis.Shakesheff@mottmac.com>; Viswanath, Jyothi <Jyothi.Viswanath@mottmac.com>; Jaye, Alan P <Alan.Jaye@mottmac.com>; Nicotra, Kristina M <Kristina.Nicotra@mottmacna.com>; McGrath, Margaret J <Margaret.McGrath@mottmac.com>; Lim, Ana <Ana.Lim@mottmac.com>; Smith, Robert <robert.s.smith@mottmac.com>; Bardsley, Steve F <Steve.Bardsley@mottmac.com>
Cc: Paul Tomlin <PaulTomlin@deltek.com>; Max Hulme <MaxHulme@deltek.com>; Amelie Filley <AmelieFilley@deltek.com>; Andre Quina <AndreQuina@deltek.com>; Kees Bisschop <KeesBisschop@deltek.com>; Federico Amendola <FedericoAmendola@deltek.com>; Christian Haastrup <ChristianHaastrup@deltek.com>; Cris Ghioc <CristianGhioc@deltek.com>; Jonathan Andrew <JonathanAndrew@deltek.com>; Baibe Hill <BaibeHill@deltek.com>
Subject: Quick rough guide to setting up projects in the UAT1B system

Hi All

As requested, please find attached a quick rough guide to setting up projects in the UAT1B system (Train env.) now we have lots of new testers and the approvals switched on.

Please note this is just to get over a learning curve in testing and that the formal documentation need to be prepared by Mott MacDonald for its end users.

Please would you forward on to your Workstream Team members as appropriate.

Regards

Paul

Deltek
Know more. Do more.

Paul Hunt
Senior Principal Consultant
PaulHunt@Deltek.com
www.deltek.com

Mobile: +44 (0)7711 163 076
Office: +44 (0)20 7518 5010

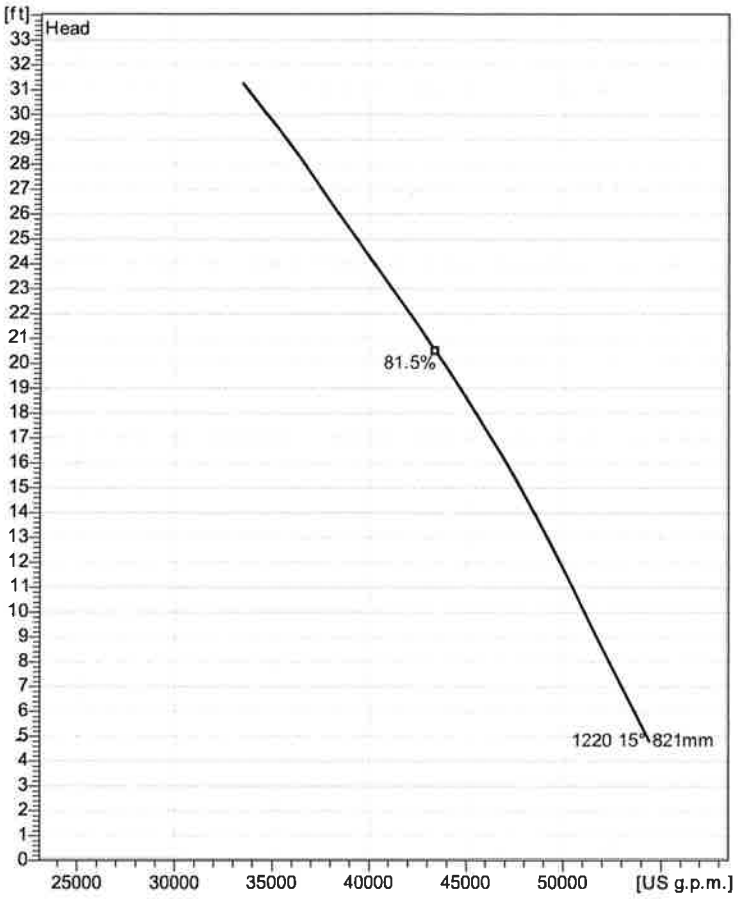
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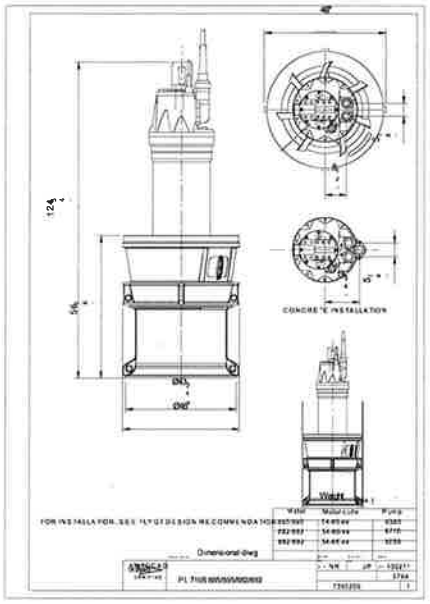
PL 7105/885 3~ 1220

Technical specification



Water, pure *Curve ISO*

Installation: L - Column pipe Semi permanent, Wet



Note: Picture might not correspond to the current configuration.

General

Axial flow propeller pumps with fixed or adjustable pitch blades for high capacity low head pumping of clean or slightly contaminated liquids. Cast iron design optimized for high-flow efficiency.

Impeller

Impeller material	Stainless steel
Column diameter	1200
Inlet diameter	
Impeller diameter	821 mm
Number of blades	4

Motor

Motor #	P0885.000 54-80-12AD-W 400hp
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	12
Phases	3~
Rated power	400 hp
Rated current	535 A
Starting current	2190 A
Rated speed	590 rpm
Power factor	
1/1 Load	0.74
3/4 Load	0.69
1/2 Load	0.59
Efficiency	
1/1 Load	93.5 %
3/4 Load	94.0 %
1/2 Load	93.0 %

Configuration

Project	Project ID	Created by	Created on	Last update
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PL 7105/885 3~ 1220

Performance curve

Pump

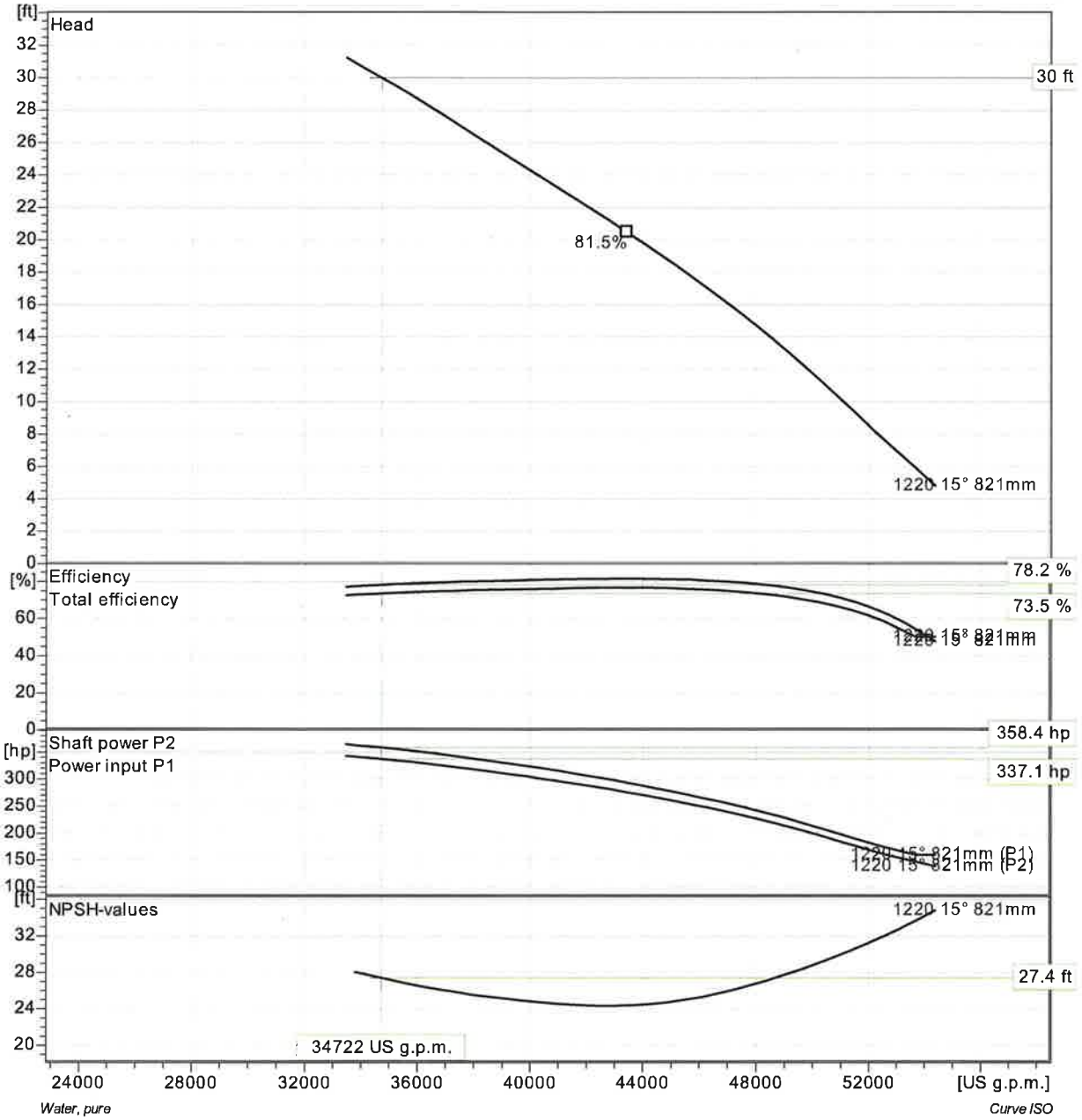
Column diameter	1200
Inlet diameter	
Impeller diameter	$32^{5}/_{16}$"
Number of blades	4

Motor

Motor #	P0885.000 54-80-12AD-W 400hp
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	12
Phases	3~
Rated power	400 hp
Rated current	535 A
Starting current	2190 A
Rated speed	590 rpm

Power factor	
1/1 Load	0.74
3/4 Load	0.69
1/2 Load	0.59

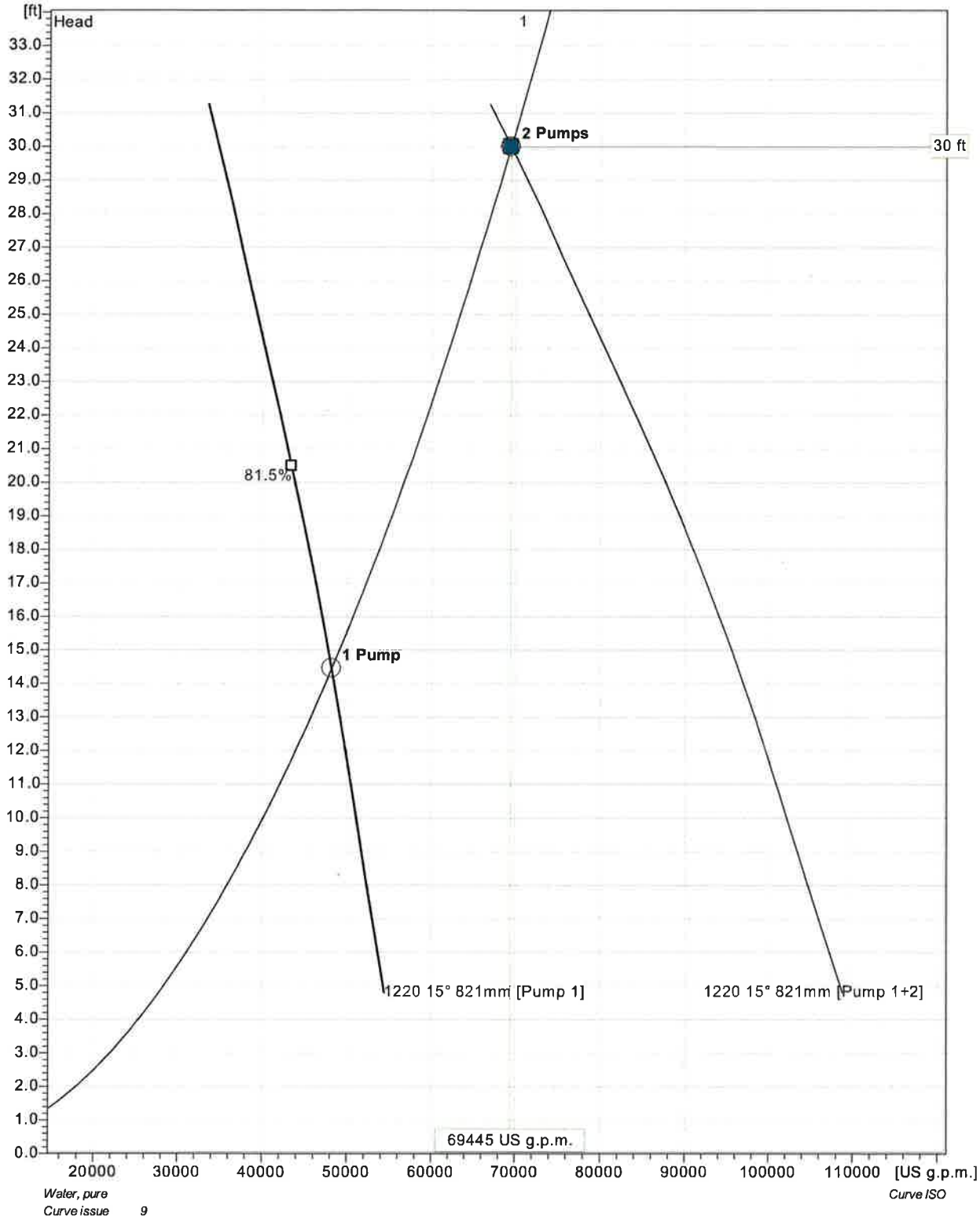
Efficiency	
1/1 Load	93.5 %
3/4 Load	94.0 %
1/2 Load	93.0 %



Project	Project ID	Created by	Created on	Last update
			2016-02-18 14:59:48	

PL 7105/885 3~ 1220

Duty Analysis

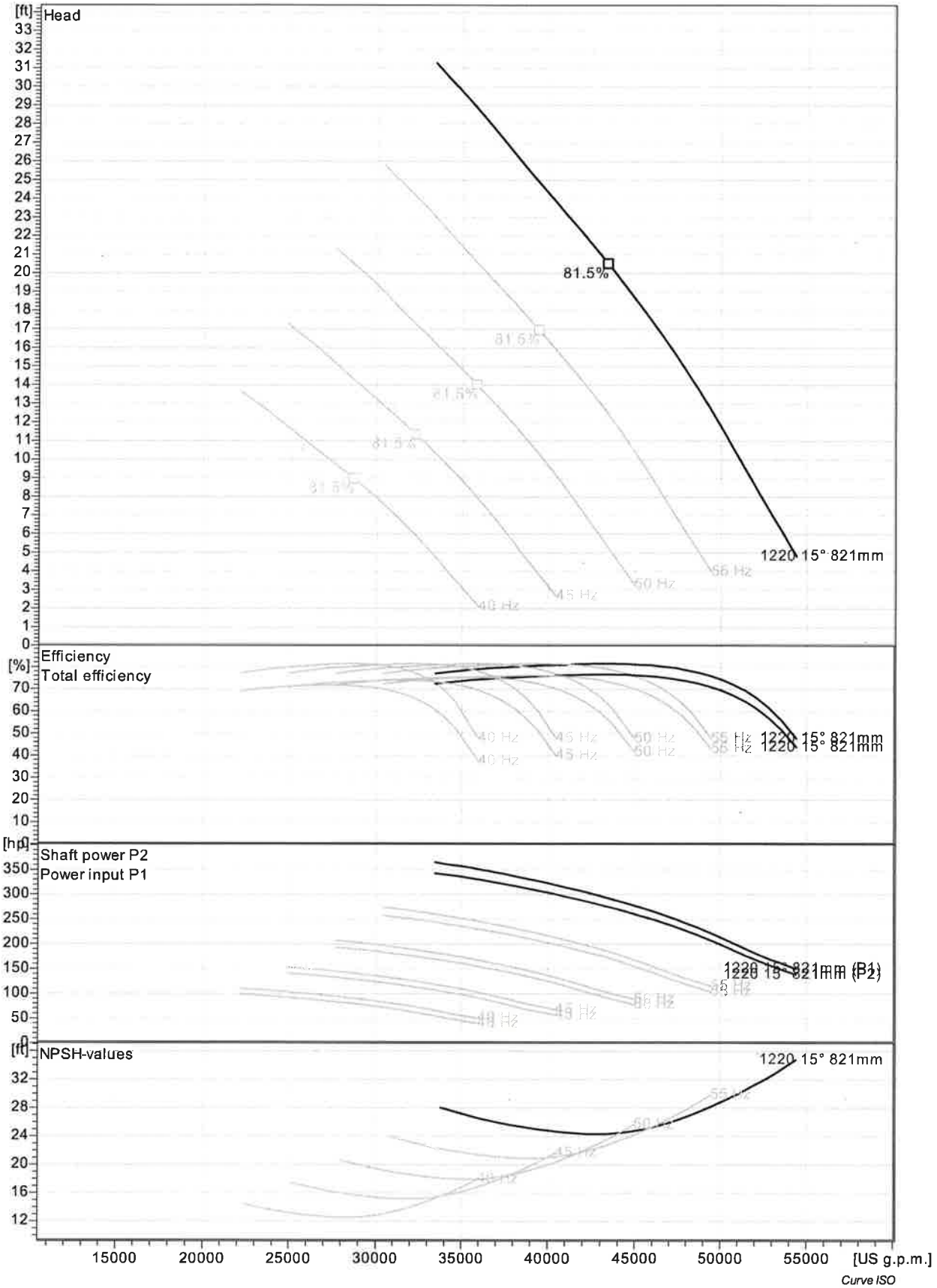


Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
2 / 1	34700 US g.p.m.	30 ft	337 hp	69400 US g.p.m.	30 ft	674 hp	78.2 %	128 kWh/US MG	27.4 ft
1 / 1	48200 US g.p.m.	14.4 ft	225 hp	48200 US g.p.m.	14.4 ft	225 hp	78.4 %		26.9 ft

Project	Project ID	Created by	Created on	Last update
			2016-02-18 14:59:48	

PL 7105/885 3~ 1220

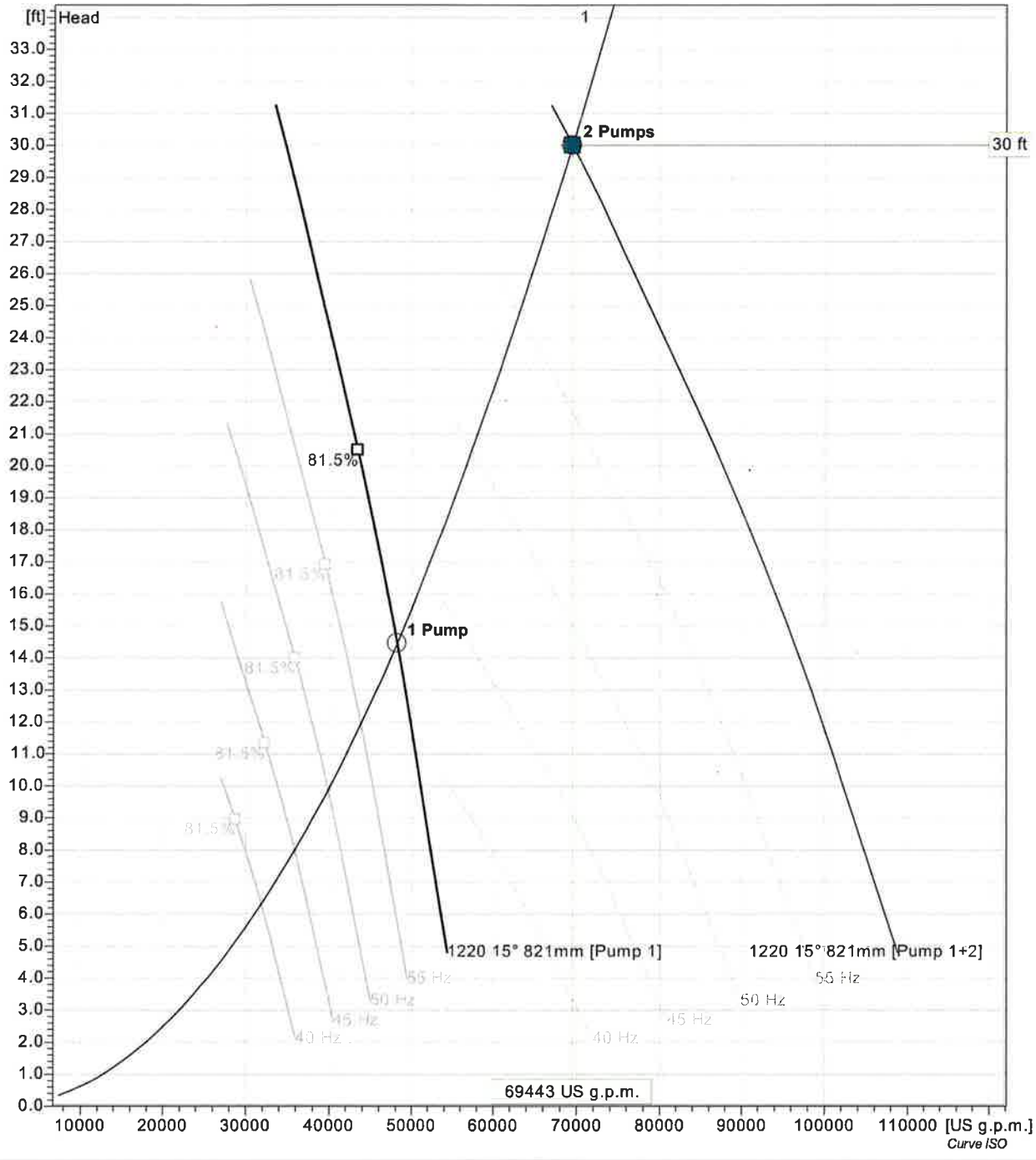
VFD Curve



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			2016-02-18 14:59:48	

PL 7105/885 3~ 1220

VFD Analysis

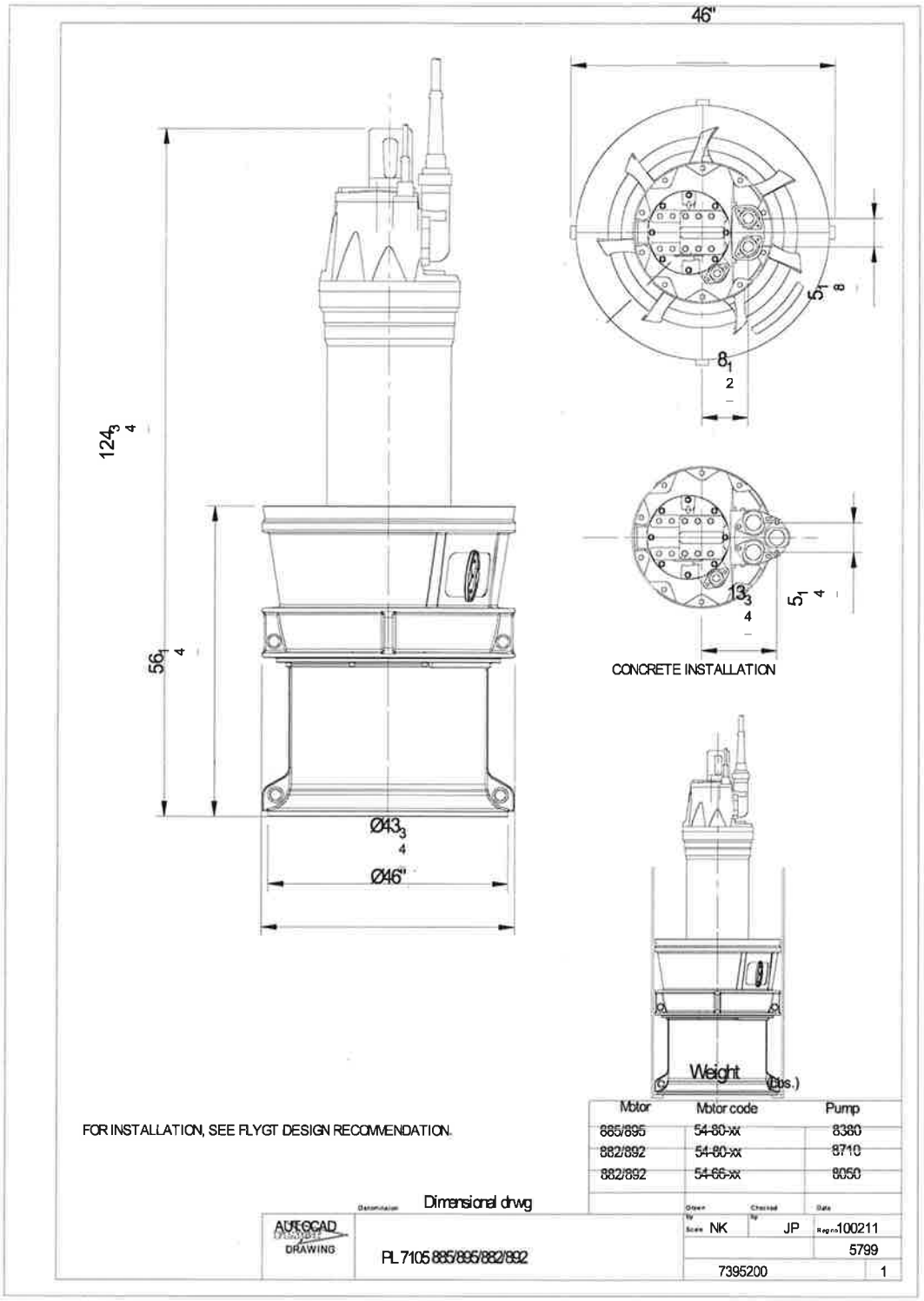


Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
2 / 1	60 Hz	34700 US g.p.m.	30 ft	337 hp	69400 US g.p.m.	30 ft	674 hp	78.2 %	128 kWh/US MG	27.4 ft
2 / 1	55 Hz	31600 US g.p.m.	24.8 ft	253 hp	63100 US g.p.m.	24.8 ft	506 hp	78.2 %	106 kWh/US MG	23.5 ft
2 / 1	50 Hz	28700 US g.p.m.	20.5 ft	190 hp	57400 US g.p.m.	20.5 ft	380 hp	78.2 %	88.4 kWh/US MG	20.2 ft
2 / 1	45 Hz									
2 / 1	40 Hz									
1 / 1	60 Hz	48200 US g.p.m.	14.4 ft	225 hp	48200 US g.p.m.	14.4 ft	225 hp	78.4 %		26.9 ft
1 / 1	55 Hz	43800 US g.p.m.	11.9 ft	169 hp	43800 US g.p.m.	11.9 ft	169 hp	78.4 %		23.1 ft
1 / 1	50 Hz	39800 US g.p.m.	9.86 ft	127 hp	39800 US g.p.m.	9.86 ft	127 hp	78.4 %		19.8 ft
1 / 1	45 Hz	35800 US g.p.m.	7.99 ft	92.4 hp	35800 US g.p.m.	7.99 ft	92.4 hp	78.4 %		16.8 ft
1 / 1	40 Hz	31900 US g.p.m.	6.31 ft	64.9 hp	31900 US g.p.m.	6.31 ft	64.9 hp	78.4 %		13.9 ft

Project	Project ID	Created by	Created on	Last update
			2016-02-18 14:59:48	

PL 7105/885 3~ 1220

Dimensional drawing



Motor	Motor code	Pump
885/895	54-80-xx	8380
882/892	54-80-xx	8710
882/892	54-65-xx	8050

Project	Project ID	Created by	Created on	Last update
			2016-02-18 14:59:48	

PL-7105/885 SPECIFICATION 400 HP, 3/460v 1220 performance curve

SCOPE
Furnish and install ___2___ electrically operated submersible propeller pump/motor unit(s). The pump/motor unit(s) shall be close coupled to form one integrated direct drive unit. The pump/motor unit shall be designed for installation into a discharge column onto a seat at the bottom of the column. The pump/motor unit shall be held in place by its own weight and the pumping head.

Each pump/motor unit, hereafter called pump(s) or unit(s), shall be equipped with a __400__ HP, submersible electric motor connected for operation on a __460____ volt, 3-phase, 60 Hertz With _TBD_ Ft. lengths of power and signal cable. Pump(s) shall be capable of delivering a minimum of __34,722_ GPM at __30__ feet TDH. and shall be non-overloading throughout the specified performance range.

MANUFACTURER REQUIREMENTS
The pump equipment specified herein shall be the design and fabrication of a single manufacturer which shall have sole source responsibility for said equipment. The manufacturer shall have electric submersible equipment of this design and of comparable capacity in successful operation for a minimum of 15 years. References and records of experiences shall be provided if requested by the engineer.

PUMP INSTALLATION
The discharge column shall be permanently installed in the wet well. The design shall be such that the pump unit(s) will be automatically and firmly connected to the discharge tube when lowered into place. A locking device, located on the external surface of the pump housing, shall prohibit rotational movement of the pump/motor unit(s) within the tube(s). The pump(s) shall be easily removable for inspection or service with no need for personnel to enter the wet well. The pump(s) shall not require any bolts, nuts or fasteners for connection to the discharge column. Stiffening and guiding webs shall be provided at the pump support seat to ensure concentric positioning of pump within the discharge column. An O-ring shall be provided on the bottom of the inlet (suction) bell mouth so that the weight of the pump unit, when acting on the O-ring, will provide an effective seal between pump and discharge column.

POWER CABLES
The power cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (SUBmersible CABle). The cable shall be sized according to the National Electrical Code (NEC) and the Insulated Cable Engineers Association (ICEA). The outer jacket shall be lubricant resistant chlorinated polyethylene rubber, and the copper conductors shall be insulated with ethylene-propylene rubber (EPR). The filler and conductor separator materials shall be of non-wicking vulcanized rubber. The cable shall be rated for 600 volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be adequate to reach the junction box without the need for splices.

PILOT CABLE
The pilot cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (SUBmersible CABle). The cable shall be multi-conductor type with stainless steel braided shielding, a chlorinated polyethylene rubber outer jacket and tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be adequate to reach the junction box without the need for splices.

CABLE PROTECTION AND SUSPENSION
Engineer approved cable protection and suspension system shall be provided on all installations with in-tube cable runs over 10 feet in length.

CABLE ENTRY
The cable entry water seal design shall preclude specific torque requirements and ensure a watertight and submersible seal. The cable entry shall be comprised of two cylindrical elastomer grommets, flanked

by four stainless steel washers, a spacer ring and an O-ring; all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. This design shall combine the sealing function with the cable strain relief function so that when the cable entry is mounted onto the junction box, the cable entry will be 100% watertight during immersion of 65 feet or greater, while providing sufficient strain relief to prevent the cable from pulling out when handling, installing, or operating the pump. The assembly shall bear against a shoulder in the pump top and direct the cable axially upwards. **Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable for the cable entry and sealing system.**

CABLE JUNCTION BOX
The junction chamber shall contain two separate terminal boards, one for connecting the signal wires and signal cable, and the second one to connect the stator leads and power cables. The lower terminal board shall use terminal posts equipped with screw type cable terminals to connect the cable conductors and motor stator leads. The junction chamber shall be sealed from the motor housing.

The junction box shall contain a collection cavity placed so that any leakage into the junction box shall terminate in the collection cavity. A mechanical float switch shall be mounted at the lowest point in the collection cavity. This sensor shall be separately wired to provide an alarm in the event of water intrusion into the cable junction box.

ELECTRIC MOTOR
The pump motor shall be specifically designed for submersible operation and be of a 3-phase, squirrel-cage induction, shell type design, housed in an air-filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the current-UV-dip impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The motor shall be designed for continuous duty. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

Each unit shall be provided with an adequately designed cooling system. The motor shall be cooled by the pumped water flowing along the stator housing when the pump is working. A water jacket or any external cooling system shall not be considered acceptable designs.

Thermal switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. One PT-100 type temperature sensor shall be installed in the stator winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. A mechanical float switch (FLS) shall be mounted in the junction chamber to signal if there is water intrusion. A pump memory module shall be provided and mounted in the junction chamber to record pump run time, number of starts as well as contain the motor unit performance and manufacturing data and service history. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

PUMP SHAFT
The motor/propeller shaft shall be a single piece of AISI-431 stainless steel and shall be completely isolated from the pumped liquid. Units with multiple piece shafts or gearboxes are not acceptable.

BEARINGS
The motor shaft shall rotate on four grease-lubricated and sealed bearings. The upper motor bearing shall be a cylindrical roller bearing. The lower bearing arrangement shall consist of two single-row angular

contact ball bearings in tandem together with one cylindrical roller bearing. The bearings shall have a minimum L_{10} bearing life of 100,000 Hrs.

The lower thrust bearing housing shall include a thermal sensor (RTD) of the platinum-100 type to monitor the temperature of the thrust bearing outer race during operation.

PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, Class 35, with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of stainless steel 304. The propeller shall be of a 4-bladed fixed pitch, cast of ASTM A-743 CF8M austenitic stainless steel and shall be factory balanced. The blades shall be noticeably backward curved so that any clogging tendency is minimized. A replaceable wear ring shall be installed in the pump housing to provide sealing between the pump housing and the propeller. Integral to the wear ring shall be one machined relief groove that provides a pathway for any material that travels along the back-swept propeller edge to be released as the blade tip passes the relief groove. A secondary effect is the shearing of debris by the edge of the relief groove. The wear ring shall be of stainless steel ASTM A320 Type (316). The propeller pump shall have guide vanes designed in such a way as to minimize clogging by carrying debris normally prone to clog the guide vanes from the inside of the guide vanes towards the outside of the guide vane. Here the flow shall be partially and deliberately destabilized to help material disengage itself from the vanes, to continue its passage through and out of the pump.

The fastening of the propeller hub assembly shall be made by a locking assembly.

All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

MECHANICAL SEALS

Each propeller pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. The Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable or equal to the dual independent seal specified:

•Seals with steels, carbon or silicon carbide seal rings.

•Seals utilizing bellows type springs.

•Shaft seals without positively driven rotating members.

•Conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units.

Each pump shall be provided with an lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed for lubricant pressure compensation. The lubricant chamber drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside.

Seal lubricant shall be non-hazardous.

PUMP MONITORING
All stators shall incorporate three thermal switches, connected in series, to provide over temperature protection of the motor winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm. The stator shall also include one PT-100 type temperature probe to provide for monitoring of the stator temperature

A lower bearing temperature sensor shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

Two leakage sensors shall be provided to detect water intrusion into the stator chamber and junction chamber. A Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in either the stator chamber or junction chamber. When activated, the FLS will stop the motor and activate an alarm. **USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS SHALL NOT BE ALLOWED.**

The solid-state pump memory unit, three thermal switches, two FLS switches, PT-100 stator temperature monitor and the lower bearing PT-100 temperature monitor shall all be connected to a MAS (Monitoring and Status) monitoring unit. The MAS shall be designed to be mounted in the control panel and shall come with an Operator Panel that is dead-front panel mounted. The Operator Panel shall have soft-touch operator keys and provide local indication of the status of the alarms within the connected pump unit by means of an LCD screen read-out. Local MAS system change shall be made by use of the soft-touch keypad or local connection by means of a laptop computer. Remote indication of pump unit status shall be possible with connection to customer PLC or via LAN.

PUMP TEST
The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

a) Propeller, motor rating and electrical connection shall be checked for compliance to the customer's purchase order and the pump data plates.

b) A motor and cable insulation test for insulation defects shall be made.

c) Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

d) The pump shall be run for 30 minutes submerged.

e) A certified test curve (per HI standards) showing the performance of the pump shall be run and supplied to the engineer upon request.
f) After operational test (d), the insulation test (b) is to be performed again.

The pump cable end shall be sealed with a high quality protective covering to make it impervious to moisture or water seepage prior to electrical installation.

SITE TESTS
The pump shall be tested at startup. Voltage, current, and other significant parameters shall be measured and recorded. The manufacturer shall provide a formal test procedure and forms for recording data.

Issued: 5/10 Supersedes: 4/07

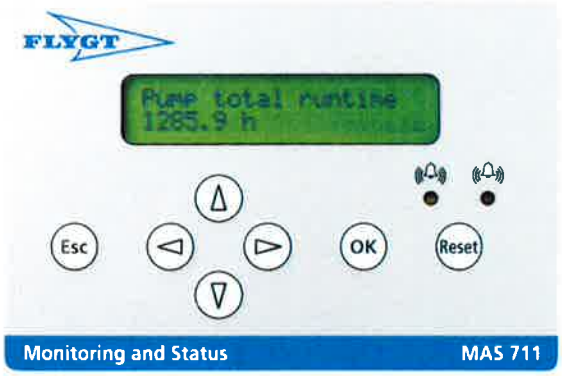
MAS 711

The Flygt MAS 711 is a pump monitoring system designed to remember, record and present pump events fast and easily. As part of a complete Flygt pumping system, it helps reduce costs over the pump's lifetime by facilitating maintenance and assuring safe operation, thereby increasing reliability and availability.



Detailed operation data can be accessed via MAS 711 for immediate analysis using a standard web browser on a PC (no special software required), or alternatively transferred to a higher level system such as a SCADA (Supervision Control and Data Acquisition) system.

Everything you need to know
MAS 711 monitors the pump's temperature, leakage, vibration, current and power (optional). In addition, it has a 'black box' function in case of pump failure.



- **'Plug-n-play' with back-up**
MAS 711 communicates with the pump's memory for fast and easy, 'plug-n-play' installation and routine back-up/synchronization of operation data and settings.

- **Communication options**
With its ethernet, Modbus and modem communications ports, MAS 711 can communicate with most Supervision Control and Data Acquisition (SCADA) systems on the market.

The MAS 711 also contains two relays that can be configured as normally - open or normally - closed, and indicate common pump - stop condition (A - Alarm) and pump - warning condition (B - Alarm).

With the many functions and features of MAS 711, you have Flygt's decades of knowledge and experience in monitoring and control of submersible pumps literally at your fingertips.

Flygt Part #	Description
40-501142	Base Unit & Operator Panel

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Issued: 3/10 Supersedes:

MAS 711

Technical data, Base unit

Power supply	24 V ac/dc +/-10%, (45-65 Hz)
Supply dropout	50 ms without function disruption
Power consumption	max 10 VA
Ambient temperature	-4°F to +140°F
Humidity (non condensing)	RH 85%
Ingress protection	IP20
Outer dimensions	(W x H x D) 6.14" x 4.5" x 2.4"
Approvals	CE, CSA/US UL: E132545

Inputs:

I/O protection	All I/O:s are short circuit protected
Thermal switch/PTC-thermistor	Short circuit warning (thermistor)
Pt100 inputs (5)	Inaccuracy: +/-0.5+0.01T (Temp in °C) Short circuit and interruption warning
Leakage sensor inputs (3)	12 V dc, current sensing Values of operation: I < 3 mA — Interruption 3 < I < 22 mA — OK 22 < I < 55 mA — Leakage I > 55 mA — Short circuit
4-20 mA configurable	Default: VIS 10 (vibration sensor) 18 – 24 V dc Inaccuracy: +/- 1,5%
Current transformer input	for CT with1 A rated secondary output Inaccuracy: +/-1,5%
Reset input (external/remote reset)	Configurable for closing or opening contact
RUN-input (pump run indication)	Pump "on" input, used in case pump current is not measured. Configurable for closing or opening contact

Outputs:

Go relay (pump interlock)	5A/250 V ac, normally opened (NO)
A-alarm relay	5A/250 V ac, (NO), configurable active open or close
B-alarm relay	5A/250 V ac, (NO), configurable active open or close
Supply to Pump memory	12 V dc
Supply to Operator panel	12 V dc

MAS 711

Communication:

Ext 1. - RS-485/Modbus	For communication with central system (Flygt APP700 or PLC). MAS Base unit is slave.
Ext 2. – RS-485/Modbus	For communication with Power analyzer. MAS Base unit is master.
Local – RS-485/Modbus	For communication with Pump memory and Operator panel. MAS Base unit is master.
RS-232, D-sub 9-pole	Female contact, point-to-point protocol (for modem)
Ethernet - RJ45 contact	For direct PC-connection, local area network or the Internet.

Technical data, Operator panel:

Power supply	12 V dc from Base unit
Ambient temperature	-4°F to +140°F
Humidity (non condensing)	RH 85%
Ingress protection	Panel mounted from outside IP67 Backside IP20
Outer dimensions	(WxHxD) 5.7" x 3.8" x 0.87"
Approvals	CE, CSA/US UL: E132545
Communication port	RS-485/Modbus to Base unit

Technical data, Pump memory:

Power supply	12 V dc + (from Base unit)
Communication port	RS-485/Modbus (Two-wire to Base unit)
Operating temperature range	-4°F to +221°F
IP-rating	27 (submersible)
Dimensions	Height 0.787" (including terminals) Width 1.574" Depth 1.574"
Mounting	Large pumps: On terminal plate 685 86 00 with a 4mm screw. Midrange pumps: Part of connector unit 691 83 00.

Part numbers:

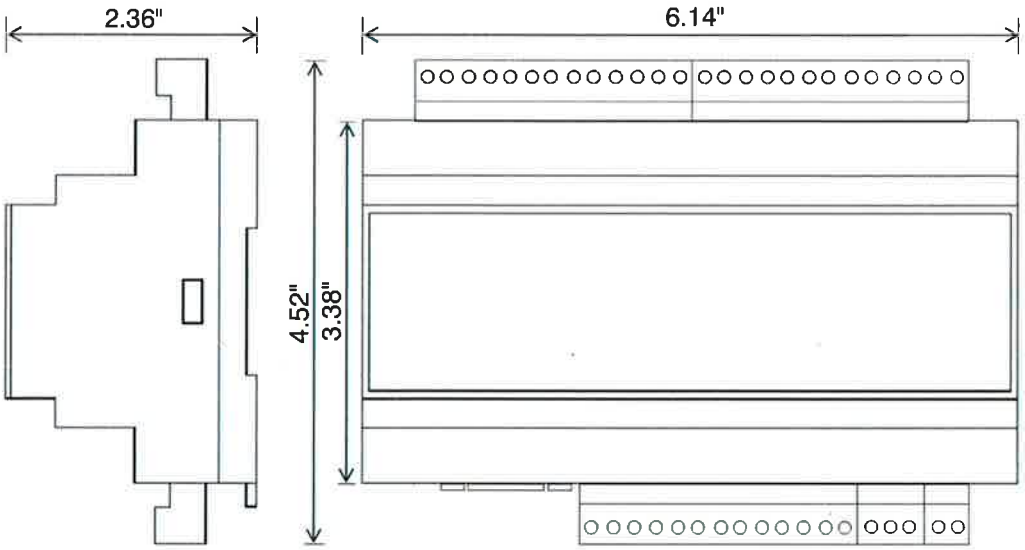
MAS 711 Operator panel	40 501140
MAS 711 Base unit	40 501141
MAS 711 Pump supervision kit (Operator panel and Base unit)	40 501142
Power Analyzer, PAN 312	40 501526

Pump memory ordered as spare part:

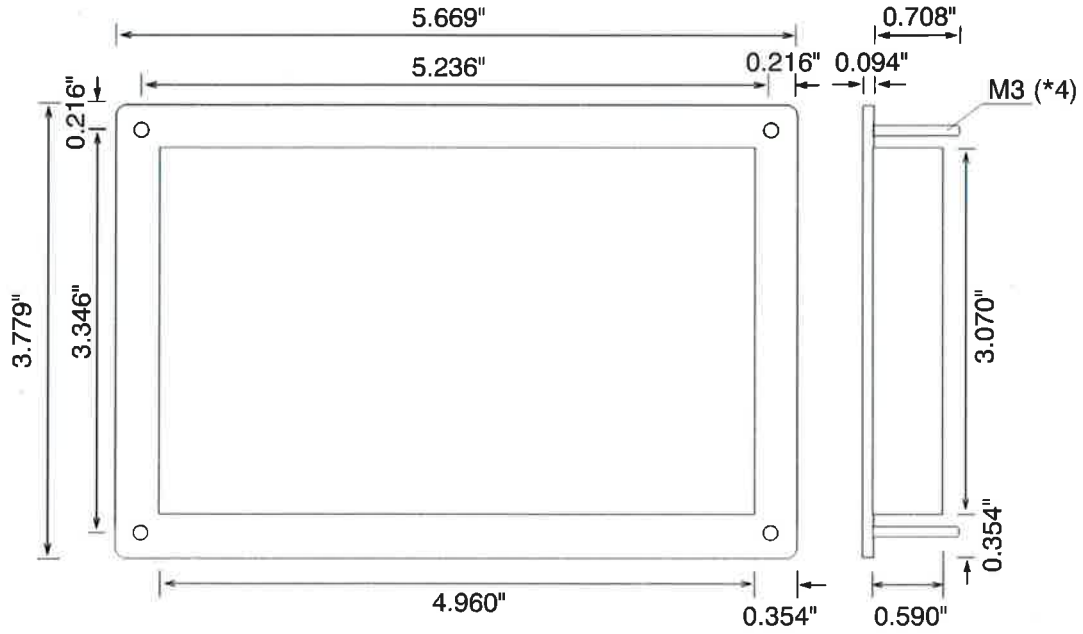
Pump memory	84 00 90
Connector unit with pump memory (associated equipment for Midrange)	691 83 00

MAS 711
Dimensional drawings and mounting

Mount the Base unit on a 35 mm symmetrical DIN-rail.



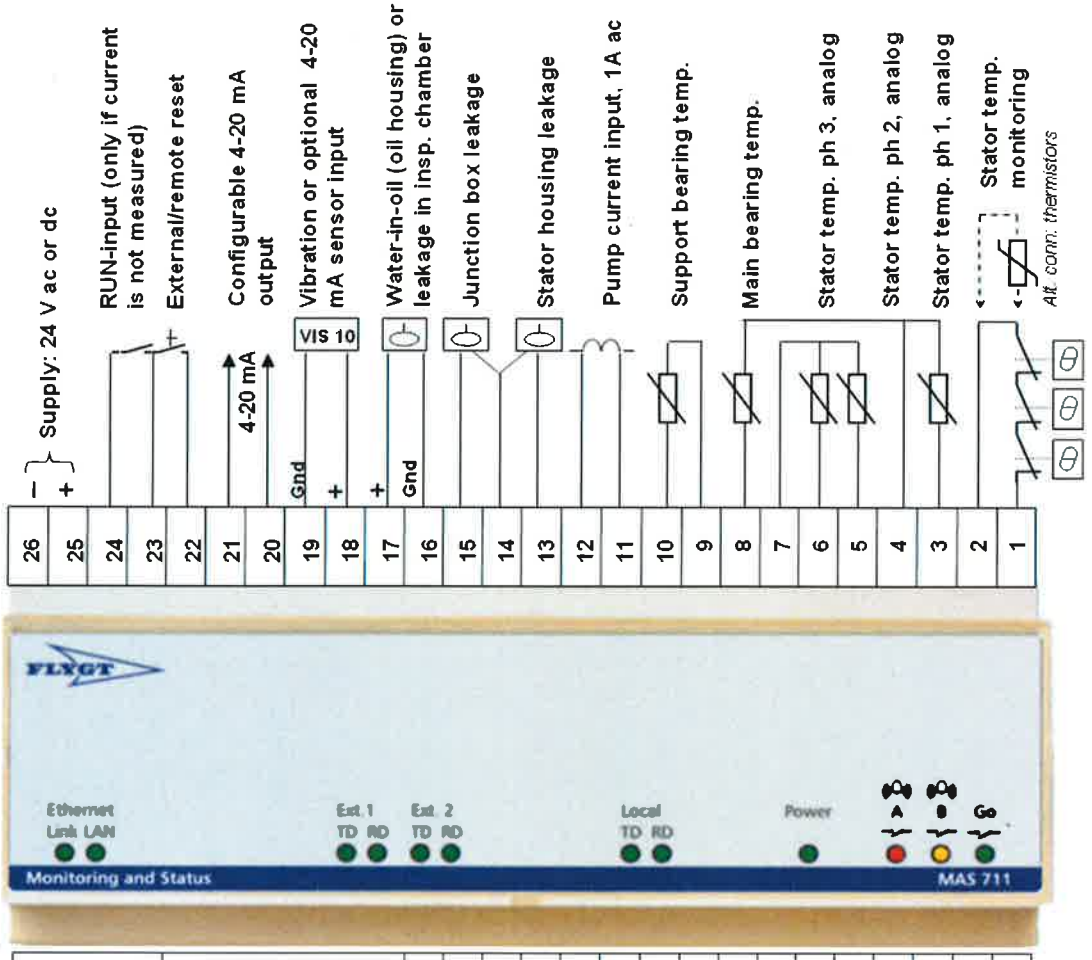
Mount the Operator panel either in a cabinet door or panel front.
An alternative is to attach it on a 35 mm symmetrical DIN-rail.



Note: The maximum thickness of a door or panel skin is 0.118".

MAS 711
Wiring & Installation Guidelines

Wiring of Base unit



Ethernet RJ-45 contact		RS-232 D-sub 9–pole female contact		
			42	
			41	
			40	
			39	
			38	
			37	
			36	
			35	
			34	
			33	
			32	
			31	
			30	
			29	
			28	
			27	
1	Tx+	Transmit data +	Output	
2	Tx-	Transmit data -	Output	
3	Rx+	Receive data +	Input	
4-5		Not connected		
6	Rx-	Receive data -	Input	
7-8		Not connected		
1	DCD	Data Carrier Detect	Input	
2	RD	Receive data	Input	
3	TD	Transmit data	Output	
4	DTR	Data Terminal Ready	Output	
5	Gnd	Signal ground		
6	NC	Not connected		
7	RTS	Request to send	Output	
8	NC	Not connected		
9	NC	Not connected		
Ext. 1. RS-485 (B) – Central system				
Ext. 1. RS-485 (A) (Modbus slave)– Central sys.				
Ext. 2. RS-485 (B) – Power Analyzer				
Ext. 2. RS-485 (A) (Modbus master) – Power An.				
Local. RS-485 (B) (Modbus master) - Operator panel & pump memory				
Local. RS-485 (A) – Op-panel & pump memory				
Supply to Pump memory			Ground	
			+12 V	
Supply to Operator panel			Ground	
			+12 V	
A-alarm relay, 5A/250V ac normally open				
A/B-alarm relay, common terminal				
B-alarm relay, 5A/250V ac, normally open				
Not used				
Go-relay (pump interlock), 5A/250V ac. (normally open)				

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Issued: 7/08 Supersedes:

MAS 711
Wiring & Installation Guidelines

This guideline is intended to define the required installation practice of the MAS711 equipment. It should be noted that these commonly used communications wiring guidelines need to be adhered to eliminate electromagnetic interference (EMI) or other electrical interference associated primarily with VFD applications.

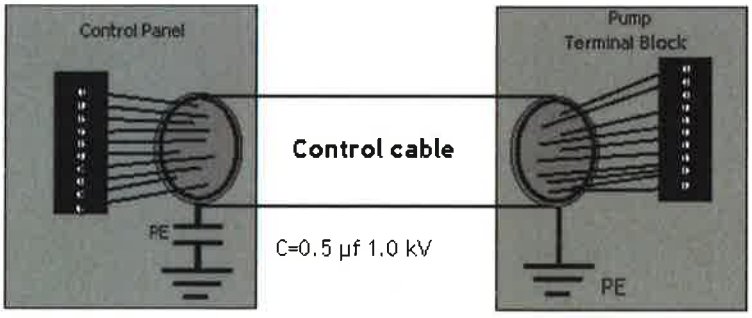
All MAS711 circuits must be installed in accordance with NEC guidelines, including but not limited to articles 250, 310,500, 725, and all local and governmental regulations that may apply. Additionally, the following installation practices must be performed:

Flygt follows FCC and CE requirements when providing control equipment and pumps. Our pumps are CE-marked according to EMC directive 2006/108/EG; all cables (power cable and control cable) must be shielded when connected to a VFD drive.

PROPER GROUNDING AND CABLE ROUTING

Always use Shielded Monitoring/Sensor cables when extending Flygt Pilot Cable conductors. The following practices shall be used when terminating the shields:

- The motor cable should be shielded and grounded at both ends (Shielded SUBCAB where shield also acts as protected earth) to prevent undesired electrical interference from the VFD (range between 1 MHz and 10MHz).
- Use EMC cable gland and assure that the shield is connected 360° in the gland or connect the shield pigtail as short as possible in the panel.
- Ensure that all control conductors are twisted together, and do not separate the conductor when cable is peeled until reaching the connection point. If possible place the control conductors in separate cable channel in the control panel to avoid coupling to other interference sources.
- Conductor Shields to connect to a 'signal ground' and not the protective ground. Protective ground and signal ground should be separate and is olated from each other. They are then connected together only once at the main supply point. Parallel grounding is not allowed per NEC Art. 250.
- If ground loops, current or magnetic disturbances occur in the cable shield open the shield connection in the control panel and connect a capacitor in series between the shield and ground (e.g. 0.5µf, 1kV).



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Issued: 7/08 Supersedes:

MAS 711
Wiring & Installation Guidelines

The ground system must have one system ground, where all ground connections should be connected from the control panel and various control units. Avoid ground loops through gland plates and cable gland bonding and ensure that there is no potential difference in the ground system.

Monitoring cables must be segregated from all power cables by at least 12 inches by use of separate metal conduits / cable trays grounded per NEC Article 250.

Monitoring cables should not cross power cables unless absolutely necessary and then only at 90 degree angles.

MAS711 UNIT LOCATION PRACTICES

MAS711 base unit and operator panel need to be isolated from the VFD unit, ideally in a separate MCC compartment or Control cabinet. Do not place any MAS components close to any component of a VFD (a minimum distance of 18 inches should be maintained from any VFD component or termination point)

If applicable, the primary of the supply transformer, assuming a 24 VAC supply is being utilized, should not be connected across 2 phases which are directly connected to the VFD input.

Using a 24 VDC supply is preferred since this will reduce the possibility of any interference from the power supply reaching the MAS unit.

Output reactors are to be fitted to the VFD when long cable lengths between the drive and the pump motor are utilized. The maximum length of power cable between the drive and the load will usually be advised by the VFD manufacturer, but will typically be between 50 and 300 feet.

MAS 711 Specifications

PUMP/MOTOR PROTECTION
All of the pump/motor unit protective and monitoring sensors shall be connected to a Flygt MAS, (Monitoring and Status) module. Each pump/motor unit shall be equipped with a MAS unit. The MAS shall be a two-piece product including the base module and an operator panel.

The operator panel shall be mounted on the dead-front panel. The operator panel shall include soft-touch type navigation keypad, alarm acknowledgement keypad, amber warning lamp, red alarm lamp and a 2-line by 20-character LCD digital display. The digital display shall provide the local readout of pump/motor sensor and alarm status and aid in navigation through the system during set-up.

The base module shall contain a processor unit having a minimum of 2Mb of memory for the logging of measurements and alarm events, two communications ports, sufficient terminals for pump/motor unit sensor connection and a Web tool. The Web tool shall be able to be accessed in the following manners; directly connected at the site with a personal computer, remotely accessed over the owner's LAN or internet or by the use of a telephone modem.

Base System Sensors
Each pump/motor unit(s) shall be equipped with the following Base Level protection and monitoring sensors:

1. Three (3) motor winding thermal switches, one installed in each motor phase winding, and connected in series to monitor and protect the winding from over temperature operation. The thermal switches shall open, activating an alarm and stopping the motor should a high temperature event occur.
2. One (1) PT-100 temperature probe shall be installed in the motor winding to provide direct stator temperature read-out.
3. One (1) PT-100 temperature probe shall be installed to directly contact the outer race of the thrust bearing to provide for accurate temperature monitoring of the bearing.
4. One (1) Float-type Leakage Sensor (FLS) shall be provided to detect water intrusion into the motor stator chamber. If activated, the FLS will activate an alarm and stop the motor.
5. One (1) Float-type Leakage Sensor (FLS) shall be provided to detect water intrusion into the power cable junction chamber of the pump/motor unit. If activated, the FLS will activate an alarm and stop the motor.
6. One (1) Pump Memory unit shall be installed in the cable junction chamber of the pump/motor unit. The Pump Memory with 32kb of memory shall store unit data plate information, listing of pump/motor unit installed sensors and statistical operational data including number of starts, unit accumulated running time, unit service data and histogram data of motor temperature.

Optional System Sensors
Each pump/motor unit(s) can be further equipped with each of the following Optional sensors in addition to the Basic Level sensors listed above:

1. Three (3) PT-100 temperature probes, one installed in each motor stator phase winding, to provide direct stator temperature read-out of each phase winding.
2. One (1) PT-100 temperature probe shall be installed to directly contact the outer race of the upper support bearing to provide for accurate temperature monitoring of the bearing.
3. One (1) VIS-10 vibration sensor shall be installed in the power cable junction chamber of the pump/motor unit. The vibration sensor shall be capable of monitoring displacement in one plane.
4. One (1) CLS-10 water-in-oil sensor installed in the mechanical seal lubrication chamber to alarm should there be intrusion of water into the chamber.
5. One (1) Power Analyzer module. The Power analyzer shall provide additional input channels to monitor the following:
    a. System pump/motor current
    b. Individual phase pump/motor current (each of 3-phases)
    c. Current imbalance
    d. System voltage
    e. Individual line voltage (each of 3-lines)
    f. Voltage imbalance
    g. System power
    h. Power factor
    i. Energy consumption

B. UV information

From: Faber, John
To: Gray, Margie
Cc: Civardi, John F; "Chris Burde (cburde@gafleet.com)"; Crawford, Fiona
Subject: RE: Disinfection Experience in PA and update on Action Spectra Correction - Pittsburgh PA
Date: Wednesday, October 28, 2015 11:10:20 AM
Attachments: image001.png
Scenario 1 (Alternate) Drawing_Swift 2L12.pdf
Scenario 1 (Alternate) Drawing_Swift 2L12_Panel.pdf
Scenario 1 Drawing_Swift 2L24.pdf
Scenario 1 Drawing_Swift 2L24_Panel.pdf
Scenario 2a Drawing_Torrent 8SL48 (16SL48).pdf
Scenario 2b Drawing_Swift 4L30.pdf
Scenario 2b Drawing_Swift 4L30_Panel.pdf

Margie,

See below for a summary of the requested information.

Corresponding layouts also attached.

Let us know if there are any questions.

John

Item	Description	Scenario 1	Scenario 2a	Scenario 2b	Scenario 1 (Alternate) – Individual Filter Maximum Flow = 6.5 MGD
1	System Type	Swift 2L24 (18 Filters)	Torrent 8L48 – 16 Sleeve Chamber (3 Duty + 1 Redundant)	Swift 4L30 (3 Duty+1 Redundant)	Swift 2L12 (18 Filters)
2	Budget Cost (Including Redundant Units)	$130,500 Per Unit	$300,000 Per Unit	$192,000 Per Unit	$62,000 Per Unit
3	Head Loss	Design Flow = 1.7 in Average Flow = 0.5 in	Design = 8.2 Average = 5.4 in	Design = 23.6 Average = 15.9 in	Design = 20.2 Average = 6.3 in
4	Dimensions	Scenario 1 Drawing Attached	Scenario 2a Drawing Attached	Scenario 2b Drawing Attached	Scenario 1 (Alternate) Drawing Attached
5	UV Dose (ASCF Included for MP Systems)	T1-RED = 5.47 mJ/cm2	Giardia RED = 3.04 mJ/cm2	Q-Beta RED = 8.70 mJ/cm2	T1-RED = 4.63 mJ/cm2
6	Total Connected Load	19.8 kW	8.8 kW	47 kW	6.7 kW
7	Average Power Load (ASCF Included for MP	8.7 kW	3.4 kW	16.9 kW	2.3 kW

	Systems)				
8	Validation	Off-Site 3rd Party Validation to UVDGM Standards	Off-Site 3rd Party Validation to UVDGM Standards	Off-Site 3rd Party Validation to UVDGM Standards	Off-Site 3rd Party Validation to UVDGM Standards
9	Lamp Life	9,000 Hours	15,000 Hours	9,000 Hours	5,000 Hours
10	Lamp Cost	$499	$550	$599	$399
11	Lamp Aging Factor	0.949	0.86	0.941	0.9
12	Fouling Factor	0.98	0.98	0.98	0.98
13	Power Quality Tolerance	Input voltage should be within the tolerance of the ITIC (CBEMA) curve referenced in IEEE 1100-2005	Input voltage should be within the tolerance of the ITIC (CBEMA) curve referenced in IEEE 1100-2005	Input voltage should be within the tolerance of the ITIC (CBEMA) curve referenced in IEEE 1100-2005	Input voltage should be within the tolerance of the ITIC (CBEMA) curve referenced in IEEE 1100-2005
14	Time To Reach Full Power after a power event	5 min lamp cool down. 3 min lamp warm up to 80% output for disinfection. 7 min operational delay until the lamp reaches 100% output. Total time is 15mins (including lamp cool down)	0 mins lamp cool down. 7 min warm up to 80% output for disinfection. 8 min operational delay until the lamp reaches 100% output. Total time is 15 mins (no lamp cool down for the Solo Lamps)	5 min lamp cool down. 3 min lamp warm up to 80% output for disinfection. 7 min operational delay until the lamp reaches 100% output. Total time is 15mins (including lamp cool down)	5 min lamp cool down. 5 min lamp warm up to 80% output for disinfection. 5 min operational delay until the lamp reaches 100% output. Total time is 15mins (including lamp cool down)
15	Cooling Water Requirements	150 gpm if zero flow for greater than 20 minutes	None	300 gpm if zero flow for greater than 12 minutes	70 gpm if zero flow for greater than 10 minutes

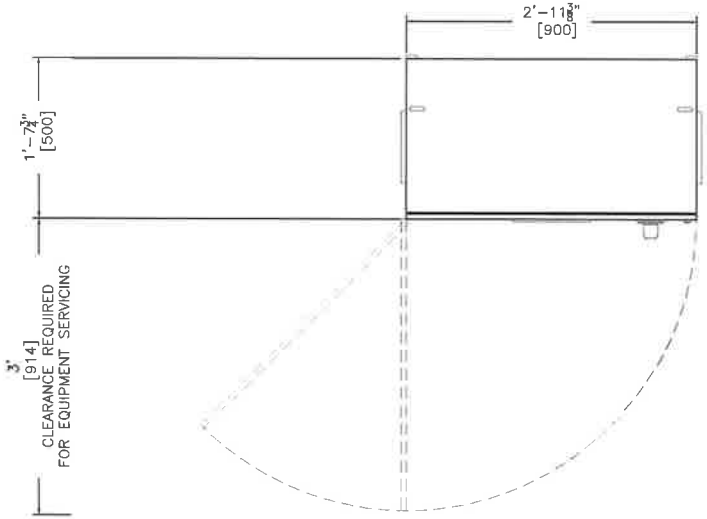
From: Gray, Margie [mailto:margie.gray@hatchmott.com]
Sent: Tuesday, October 20, 2015 11:33 AM
To: Faber, John
Cc: Crawford, Fiona; 'Chris Burde (cburde@gafleet.com)'; Civardi, John F; Niksic, Kemal
Subject: RE: Disinfection Experience in PA and update on Action Spectra Correction

John – A quick follow up…I added a few items in red below that I should have included.

Thanks,

Margie

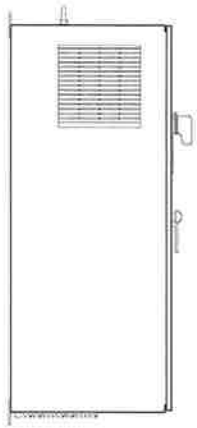
From: Gray, Margie
Sent: Tuesday, October 20, 2015 10:52 AM
To: 'Faber, John'
Cc: Crawford, Fiona; 'Chris Burde (cburde@gafleet.com)'; Civardi, John F; Niksic, Kemal
Subject: RE: Disinfection Experience in PA and update on Action Spectra Correction



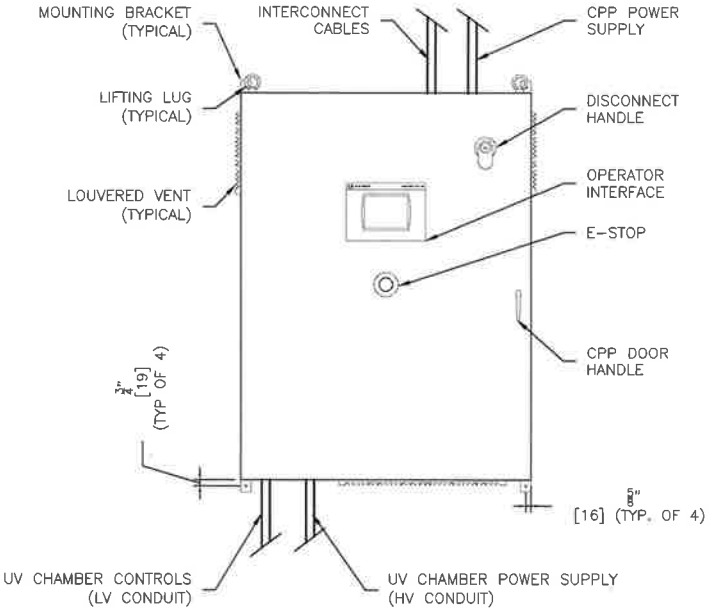
TOP VIEW

NOTES:

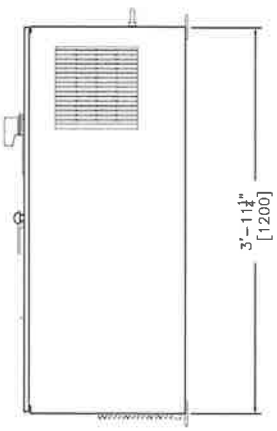
1. [ ] INDICATES DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. CONTROL POWER PANEL TO BE E-COAT POWDER COATED RAL7035 (LIGHT GREY) OR SIMILAR. MATERIAL TO BE MILD STEEL, TYPE 12
3. PANEL IS TO BE WALL MOUNTED.
4. MAXIMUM CABLING DISTANCE BETWEEN CONTROL POWER PANEL AND UV CHAMBER SHALL BE NO GREATER THAN 6.1m (20') OR 12.2m (40'), OR 18.3m (60'), AND WILL BE SUPPLIED WITH THE SYSTEM.
5. PANEL WEIGHT #L12 = 136kg (300lbs)
6. METRIC DIMENSIONS SHOWN ARE STRAIGHT CONVERSIONS FROM IMPERIAL.
7. FOR CORRESPONDING UV CHAMBER DRAWING, SEE DRAWING SW0003D01 FOR A UV CHAMBER IN A HORIZONTAL ORIENTATION OR SW0013D01 FOR A UV CHAMBER IN A VERTICAL ORIENTATION.
8. MOUNTING HARDWARE TO BE PROVIDED BY OTHERS.



LEFT SIDE VIEW



FRONT VIEW

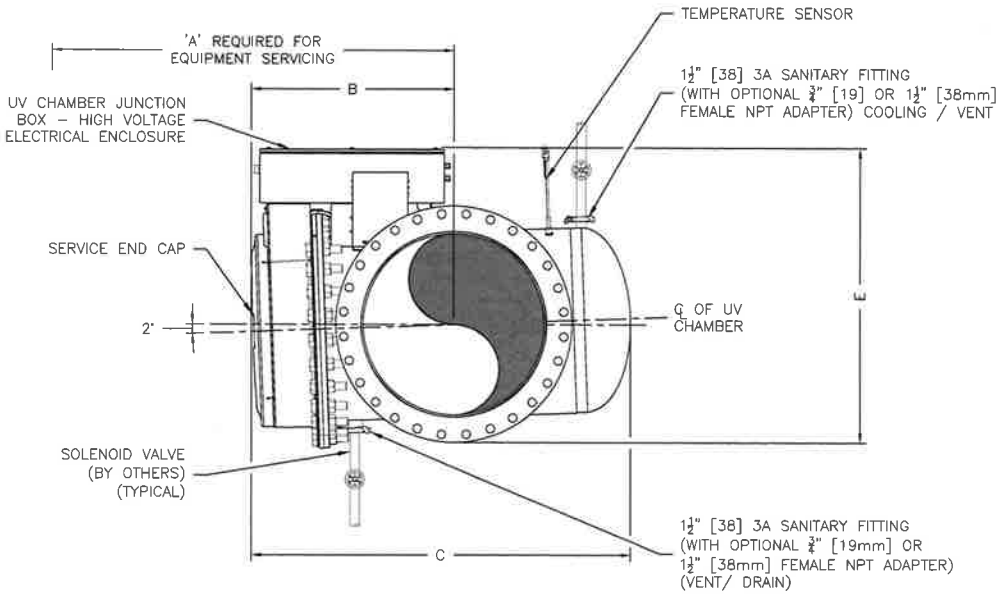


RIGHT SIDE VIEW

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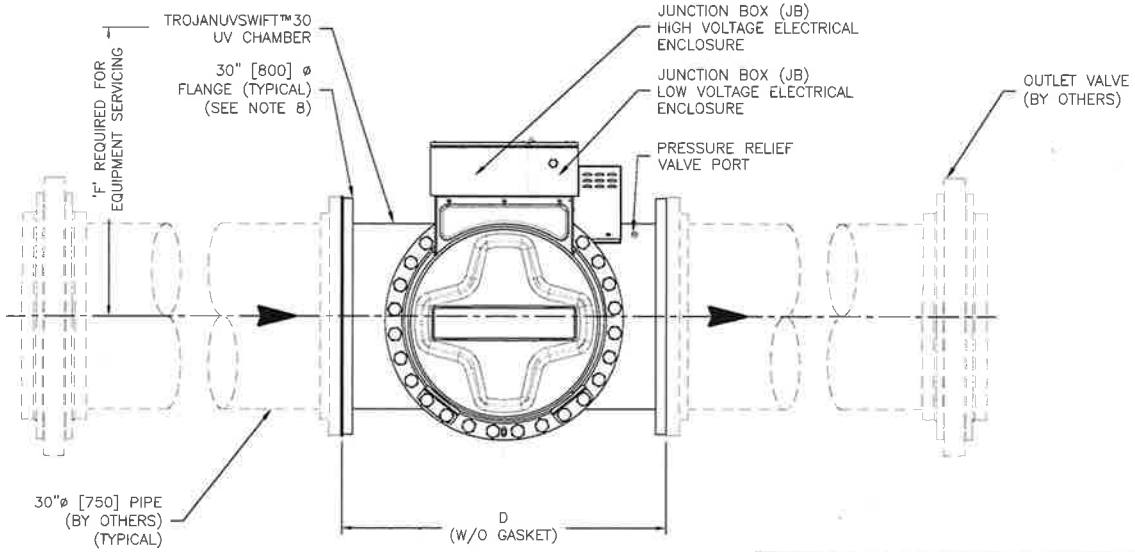
DESCRIPTION: STD, TROJANUVSWIFT 12 CONTROL POWER PANEL (CPP)			STD. DRAWING NO. SW0002
DRAWN BY : SAH		DATE : 14MR20	REFERENCE NO. N/A
CHECKED BY : SLO		DATE : 14MR21	
APPROVED BY : AMP		DATE : 14MR21	DWG NO. D01 / REV. H
SCALE (8.5x11) : NOT TO SCALE		LOG NUMBER : N/A	

Exhibit RAW/C-30



SIDE VIEW

SCALE: NOT TO SCALE



FRONT VIEW

SCALE: NOT TO SCALE

NOTES:

1. UV CHAMBER MATERIAL TO BE TYPE 316L STAINLESS STEEL.
2. MAXIMUM OPERATING PRESSURE: 75 PSI OR 150 PSI.
3. TROJAN TECHNOLOGIES RECOMMENDS THAT VALVES ARE USED TO ISOLATE THE UV CHAMBER FROM PLANT FLOW FOR SERVICING. (NOTE: LAMP CHANGE OUT CAN BE DONE ON-LINE) ALL VALVES ARE TO BE SUPPLIED BY OTHERS.
4. ALL PIPE, VALVES AND TURNING VANES ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.
5. ACTUAL SYSTEM LAYOUT TO BE CONFIRMED BY TROJAN.
6. #L30 UV CHAMBER WEIGHT: DRY 2178 lbs [990kg].
7. METRIC DIMENSIONS SHOWN ARE STRAIGHT CONVERSIONS FROM IMPERIAL.
8. AWWA FLANGE: 30" CLASS B, SLIP-ON (STANDARD)
   AWWA FLANGE: 30" CLASS D, SLIP-ON (OPTIONAL)
   DIN FLANGE: DN 800 EN1092-1, PN 6 (OPTIONAL)
   DIN FLANGE: DN 800 EN1092-1, PN 10 (OPTIONAL)

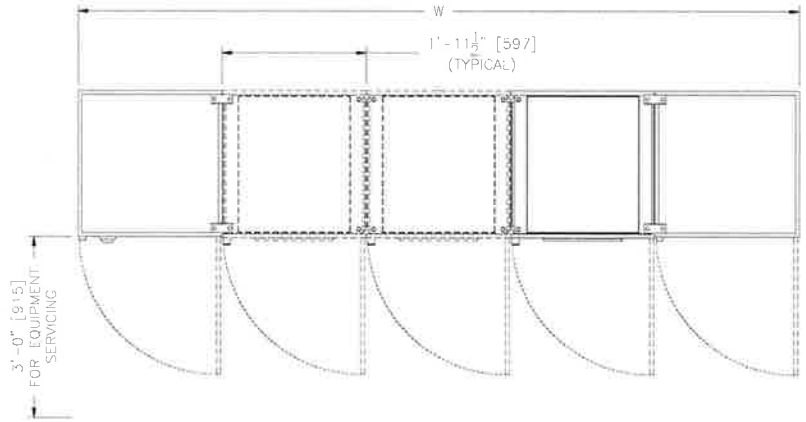
DIMENSION					
A	B	C	D	E	F
84" 2134mm	36" 915mm	62" 1575mm	52-3/4" 1340mm	49" 1245mm	88" 2235mm

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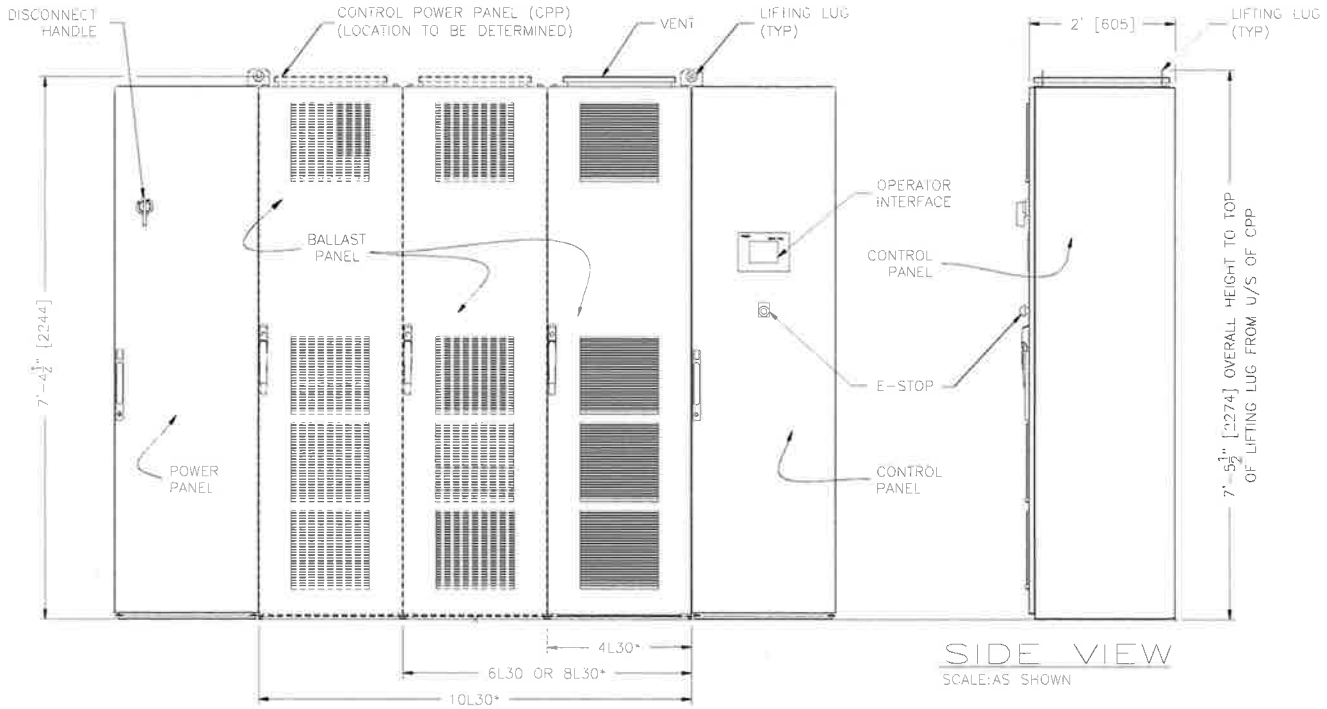
DESCRIPTION: STD, TROJANUVSWIFT 30 UV CHAMBER (HORIZONTAL)		STD. DRAWING NO.	SW0033
DRAWN BY : CAR/DAC/MVW	DATE : 14MY17	REFERENCE NO.	820543
CHECKED BY : RLM	DATE : 15MR11	DWG NO.	D01
APPROVED BY : MP	DATE : 15MR11	REV.	F
SCALE (8.5x11) : NOT TO SCALE	LOG NUMBER : N/A		

Exhibit RAW/C-19

UV CHAMBER SIZE	DIMENSION W
4L30	70.5" [1791]
6L30	94" [2388]
8L30	94" [2388]
10L30	117.5" [2985]



TOP VIEW
SCALE:AS SHOWN



SIDE VIEW
SCALE:AS SHOWN

FRONT VIEW
SCALE:AS SHOWN

*ADDITIONAL BALLAST PANEL REQUIRED FOR ADDITIONAL LAMPS.
EG: 6L30 & 8L30 = 1 ADDITIONAL PANEL
10L30 = 2 ADDITIONAL PANELS
**SEE SIZE CHART FOR OVERALL DIMENSIONS

CONTROL POWER PANEL (CPP) NOTES:

1. CONTROL POWER PANEL TO BE E-COAT POWDER COATED RAL 7035 LIGHT GREY. MATERIAL TO BE MILD STEEL, NEMA 12, VENTILATED; FLOOR MOUNTED.
2. METAL FLEX OR RIGID METAL CONDUIT TO BE SUPPLIED BY OTHERS.
3. CONTROL POWER PANEL TO UV CHAMBER WIRING SHALL BE NO LONGER THAN 72 FT. (22m).
4. PANEL WEIGHT:
   4L30 = 1353lbs (618kg)
   6L30 = 1850lbs (844kg)
   8L30 = 1986lbs (906kg)
   10L30 = 2482lbs (1132kg)
5. METRIC DIMENSIONS SHOWN ARE STRAIGHT CONVERSIONS FROM IMPERIAL.
6. [ ] INDICATES DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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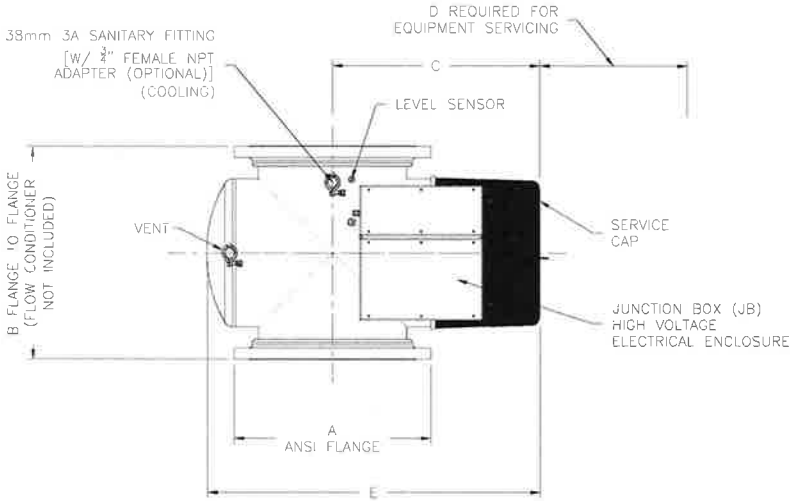
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DESCRIPTION: STD, TROJANUVSWIFT 30 CONTROL POWER PANEL (NEMA 12)		STANDARD DRAWING NO.: SW0067
DRAWN BY : MAN/SPM	DATE : 13MY21	REFERENCE NO.: 8289520
CHECKED BY : SAH	DATE : 13MY30	
APPROVED BY : RLM	DATE : 13MY30	DWG NO.: D01 REV.: B
SCALE (8½x11) : NOT TO SCALE	LOG NUMBER : N/A	

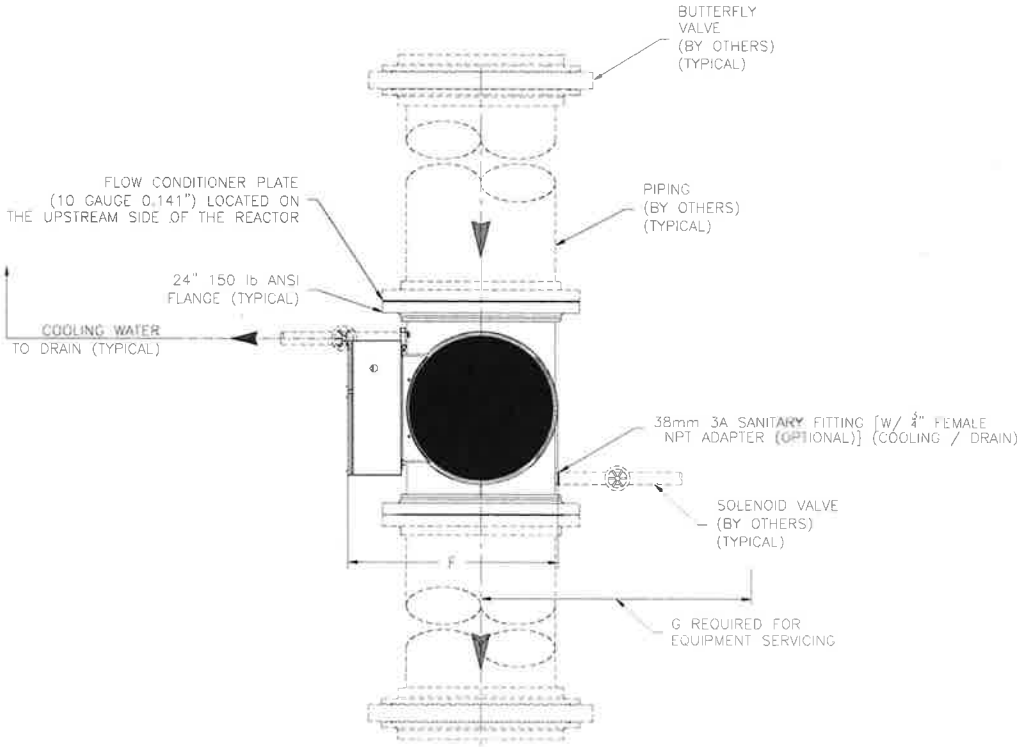
Exhibit RAW/C-10

REACTOR NOTES:

1. CHAMBER MATERIAL TO BE TYPE 316L STAINLESS STEEL.
2. MAXIMUM OPERATING PRESSURE TO BE 150 PSI.
3. TROJAN RECOMMENDS THAT VALVES ARE USED TO ISOLATE THE REACTOR FROM PLANT FLOW FOR SERVICING. (NOTE: LAMP CHANGE OUT CAN BE DONE ON-LINE) ALL VALVES ARE TO BE SUPPLIED BY OTHERS.
4. CONDUIT TO BE SUPPLIED BY OTHERS. ALL CONDUIT TO BE RIGID, METAL FLEX CONDUIT, OR EQUIVALENT ACCORDING TO LOCAL CODE.
5. XL24 REACTOR WEIGHT: DRY 1500lbs [680Kg] / WET 2200lbs [1000kg].
6. METRIC DIMENSIONS ARE STRAIGHT CONVERSIONS FROM IMPERIAL.
7. REFER TO DRAWING SW0058D01 OR SW0059D01 FOR CORRESPONDING CPP DRAWING.
8. COOLING FLOW LOOP REQUIREMENTS ARE SITE SPECIFIC DETAILS TO BE DETERMINED BY CONSULTANTS (CONTACT TROJAN FOR RECOMMENDED COOLING FLOW RATES).
9. FLOW CONDITIONER MUST BE IN PLACE BEFORE INSTALLING REACTOR INTO PIPE. SEE O&M FOR CORRECT ORIENTATION.



SIDE VIEW
SCALE: NOT TO SCALE



FRONT VIEW
SCALE: NOT TO SCALE

DIMENSION						
A	B	C	D	E	F	G
32" 813mm	34-3/4" 883mm	37" 940mm	24" 610mm	54" 1372mm	38" 996mm	88" 2235mm

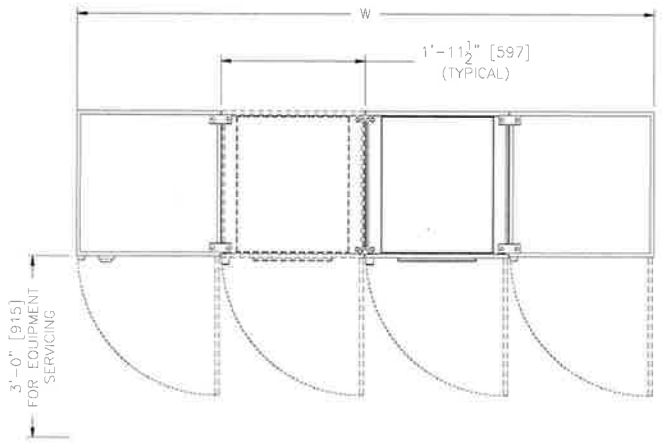
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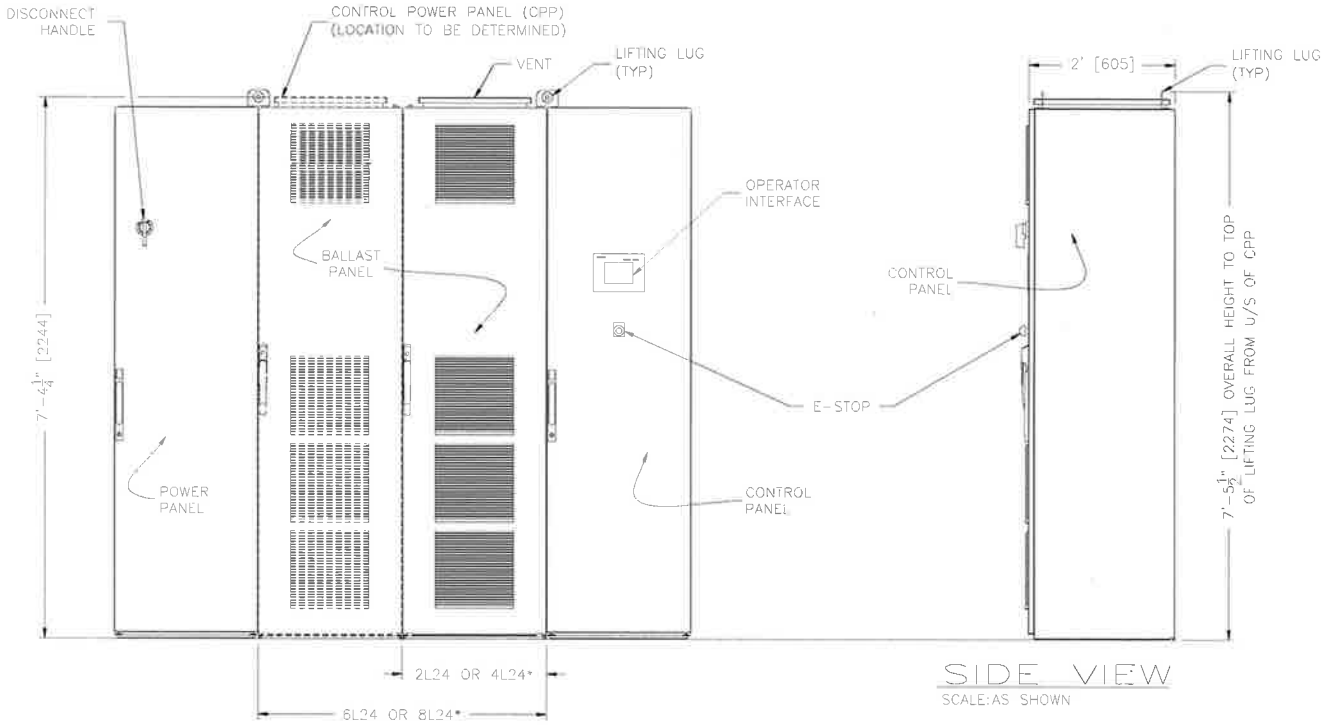
DESCRIPTION: STD. UVSWIFT 24 REACTOR (VERTICAL)		STANDARD DRAWING NO. SW0014
DRAWN BY : DAC/JV	DATE : 07MY02	REFERENCE NO N/A
CHECKED BY : SAH	DATE : 07MY02	
APPROVED BY : MP	DATE : 07MY15	DWG NO. D01 REV. C
SCALE (8½x11) : NOT TO SCALE	LOG NUMBER : N/A	

Exhibit RAW/C-30

UV CHAMBER SIZE	DIMENSION
	W
2L24	70.5" [1791]
4L24	70.5" [1791]
6L24	94" [2388]
8L24	94" [2388]



TOP VIEW
SCALE: AS SHOWN



FRONT VIEW
SCALE: AS SHOWN

SIDE VIEW
SCALE: AS SHOWN

*ADDITIONAL BALLAST PANEL REQUIRED FOR ADDITIONAL LAMPS.
EG: 6L24 & 8L24 = 1 ADDITIONAL PANEL
SEE SIZE CHART FOR OVERALL DIMENSIONS

CONTROL POWER PANEL (CPP) NOTES:

1. CONTROL POWER PANEL TO BE E-COAT POWDER COATED RAL 7035 LIGHT GREY. MATERIAL TO BE MILD STEEL, NEMA 12, VENTILATED; FLOOR MOUNTED.
2. METAL FLEX, RIGID METAL CONDUIT OR EQUIVALENT ACCORDING TO LOCAL CODE (TO BE SUPPLIED BY OTHERS).
3. MAXIMUM CONTROL POWER PANEL TO UV CHAMBER SEPARATION IS 72 FT. (22m).
4. PANEL WEIGHT:
   2L24 = 1217lbs (553kg) 6L24 = 1850lbs (844kg)
   4L24 = 1353lbs (618kg) 8L24 = 1986lbs (906kg)*
5. METRIC DIMENSIONS SHOWN ARE STRAIGHT CONVERSIONS FROM IMPERIAL.
6. [ ] INDICATES DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

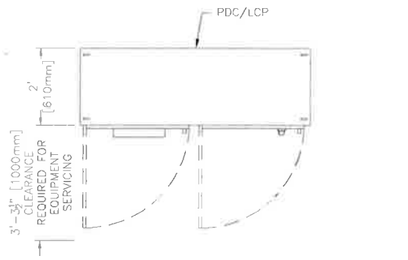
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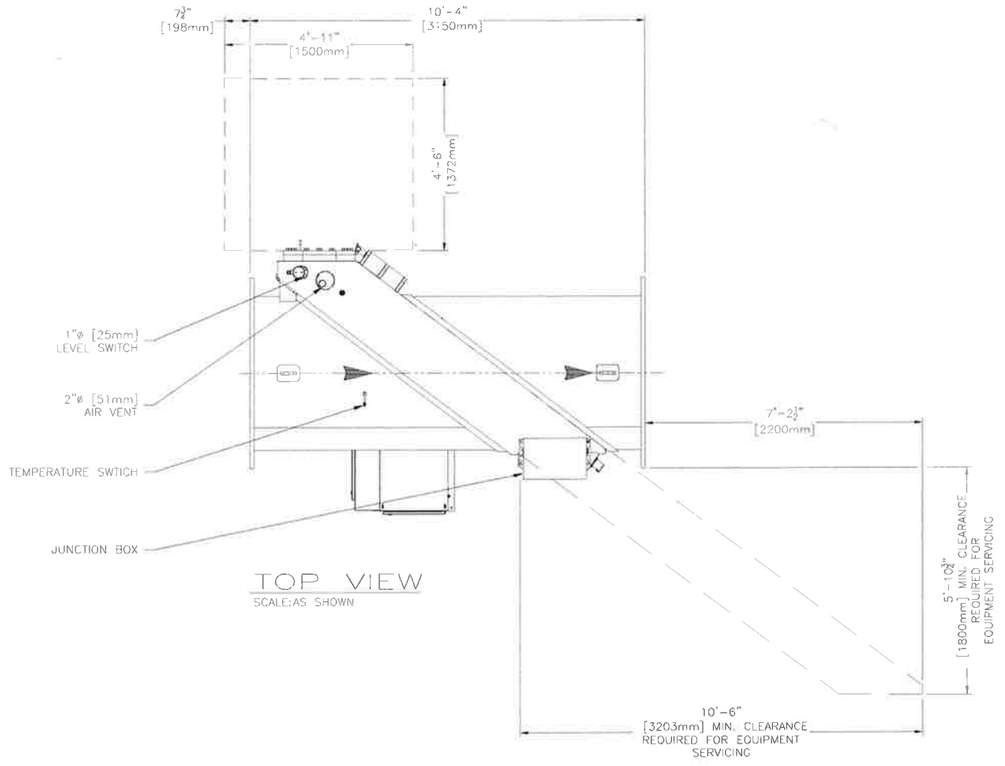
DESCRIPTION: STD. TROJANUVSWIFT 24 CONTROL POWER PANEL (NEMA 12)		STANDARD DRAWING NO. SW0066
DRAWN BY : MAN/SPM	DATE : 13MY21	REFERENCE NO. 828952C
CHECKED BY : SAH	DATE : 13MY30	DWG NO. D01 / REV. B
APPROVED BY : RLM	DATE : 13MY30	
SCALE (8½x11) : NOT TO SCALE	LOC NUMBER : N/A	

Exhibit RAW/C-30

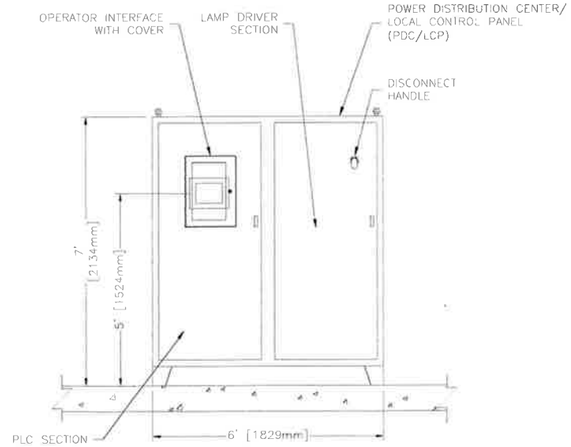
Exhibit RAW/C-30



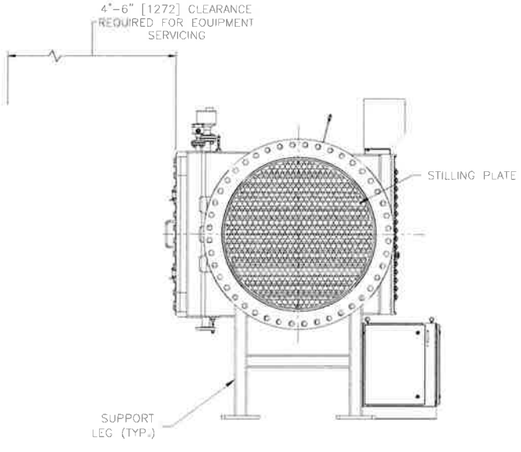
TOP VIEW OF LCP
SCALE: AS SHOWN



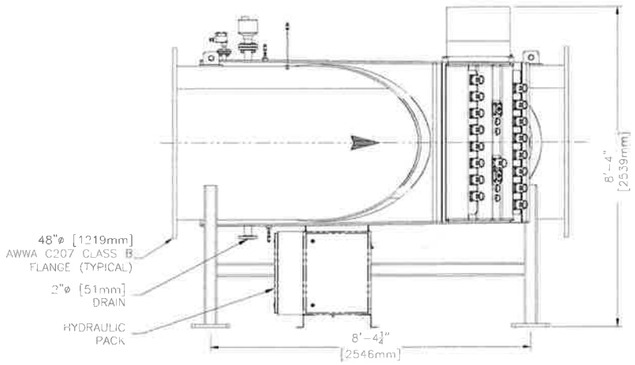
TOP VIEW
SCALE: AS SHOWN



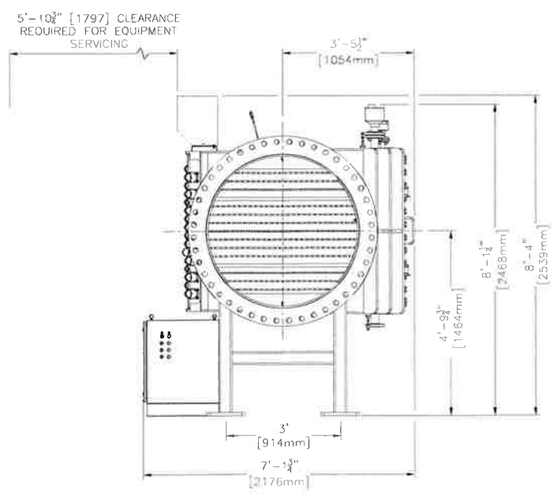
FRONT VIEW OF PDC/LCP
SCALE: AS SHOWN



LEFT SIDE VIEW
SCALE: AS SHOWN



FRONT VIEW
SCALE: AS SHOWN



RIGHT SIDE VIEW
SCALE: AS SHOWN

REACTOR NOTES:

1. REACTOR MATERIAL TO BE TYPE 316L STAINLESS STEEL, OR 2304 DUPLEX STAINLESS STEEL.
2. MAXIMUM OPERATING PRESSURE TO BE 50 PSI.
3. TROJAN RECOMMENDS THAT VALVES ARE USED ON BOTH INLET AND OUTLET SIDES TO ISOLATE THE REACTOR FROM PLANT FLOW FOR SERVICING. ALL VALVES ARE TO BE SUPPLIED BY OTHERS.

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DESCRIPTION: STD, UVTORRENT 16SL48 HORIZONTAL REACTOR		STANDARD DRAWING NO. TT0003
DRAWN BY : SPM	DATE : 11DE09	REFERENCE NO. N/A
CHECKED BY : KRB	DATE : 11DE12	
APPROVED BY : SAH	DATE : 11DE12	DWG NO D01 / REV. B
SCALE (11x17) : 1/4" = 1'-0"	LOG NUMBER : N/A	

Exhibit RAW/C-30

EMERSON
Process Management

ROSEMOUNT

Please submit your purchase order to:

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317-9687

Quote # 4480451

Date:	**08-Feb-16**	**Time:**	**07:35 AM**
To:	**Margie Gray**	**Phone:**	**973-912-3483**
	HATCH MOTT MACDONALD INC	**Fax:**	
	111 WOOD AVE S ISELIN, NJ 08830-2700		
Prepared By:	**BREYETTE, ADAM**	**Phone:**	800-406-5252
	Inside Sales Representative	**Email:**	Adam.Breyette@Emerson.com
Salesperson:	**PRO-TECH SOLUTIONS LLC - COMM - MUNI**	**Phone:**	
	Field Sales Representative	**Email:**	DFoti@pro-techsolutionsltd.com
Reference:	**Hatch Mott MacDonald**	**Fax:**	952-906-8813
	Quote #4480451		

Quote Summary Information

Project Name:		**Quote Date:**	02-Feb-16
Payment Terms:	NET30	**Quote Firm For:**	60 Days
Trade Terms:	INCO2010 FCA	**Ship Date:**	TBD
Frght & Hdlg:	PREPAID AND ADD	**Ultimate Dest:**	

Margie,

We are pleased to submit the attached quotation for your review. Should you have any questions, please do not hesitate to contact us at the above number.

Thank you for your consideration of Rosemount. We look forward to satisfying your instrumentation needs.

Best Regards,

Adam Breyette
Inside Sales Representative
Rosemount Customer Central

Number of Pages Including This Cover Sheet: 5

Quotation Number: 4480451

Price Summary

CUST LINE	ITEM	QTY	ITEM DESCRIPTION			UNIT $	TOTAL US $
	1.1	4	**8750WDEW1A1FPSE480FADM4** For an Drinking Water Certificate, please add DW to the model and $49.11 to the unit selling price.			**$12,544.43**	**$50,177.72**
	2.1	1	**MISC-PRES-0003** FedEx Freight Economy			**$5,558.13**	**$5,558.13**
						Quote Total	**$55,735.85**

Item Specification

CUST LINE	ITEM	QTY	ITEM DESCRIPTION			UNIT $	TOTAL US $
	1.1	4	**8750WDEW1A1FPSE480FADM4**			**$12,544.43**	**$50,177.72**
			8750W		Magnetic Flowmeter System (Water/Wastewater/Utility)		
			D	Revision	Revision "D"		
			E	Transmitter Class	E-Series| Revision 3 Electronics		
			W	Transmitter Mount	Transmitter| Wall Mount		
			1	Transmitter Power	Transmitter Power Supply| AC		
			A	Transmitter Outputs	4-20 mA Digital Electronics (HART Protocol)		
			1	Conduit Entry	1/2-14 NPT		
			F	Sensor Style	Sensor Style| Flanged		
			P	Lining Material	Polyurethane		
			S	Electrode Material	316L SST		
			E	Electode Type	3 Electrodes| Standard		
			480	Line Size	48.0"(1200mm)		
			F	Flange Material	Carbon Steel|Flat-Face| Slip-On		
			AD	Flange Rating	AWWA C207(Line Size 30" and above)| Class D		
			M4	Transmitter Display	Local Operator Interface Display		
			For an Drinking Water Certificate, please add DW to the model and $49.11 to the unit selling price.				
			Qty/Cfg	*Primary Tag*	*Secondary Tag*	*Calibration*	
			4			0 to 30 FPS 480	
	2.1	**1**	**MISC-PRES-0003**			**$5,558.13**	**$5,558.13**
					FREIGHT AND HANDLING - PRESSURE		
			FedEx Freight Economy				
						Quote Total	**$55,735.85**

**THANK YOU FOR YOUR INQUIRY! TO HELP US SERVE YOU BETTER, PLEASE REFERENCE QUOTE # 4480451 WHEN CALLING FOR INFORMATION OR PLACING YOUR ORDER.

Exhibit RAW-30

Please submit Purchase order to:

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317-9687
Phone: 800-406-5252
Fax: 952-906-8813

"No statement or condition contained in any order submitted by buyer which modifies, adds to, is different from or inconsistent with any term or condition of this Quotation shall be binding on the Seller unless the Seller shall have expressly consented in writing to such statement or condition. This quotation is subject to the warranties and disclaimers set forth in the attached Emerson Process Management Terms and Conditions of Sale and no others, unless Seller and Buyer have entered into a separate written agreement."

Prepared by: BREYETTE, ADAM **Inside Sales Representative**

View order status, tracking information, and retrieve documentation online at
http://partner.emersonprocess.com/API/cclogon.aspx?Division=RoseMount&AppId=OS

Please email comments regarding the quality of Rosemount products, services or processes to:
Chan.RMD-Customerfeedback@EmersonProcess.com

Emerson Process Management is committed to customer service excellence.
Please click HERE to take a five question customer satisfaction survey on your quotation experience.

TERMS AND CONDITIONS OF SALE

Exhibit RAW/C-30

These terms and conditions, the attendant quotation or acknowledgment, and all documents incorporated by reference therein, binds seller (i.e. Fisher Controls International LLC, Rosemount Inc., Fisher-Rosemount Systems Inc., or other Emerson Process Management Group Company) hereinafter the Seller, and the buyer, hereinafter Buyer, and constitutes the entire agreement (Agreement) between Buyer and Seller for the provision of services (Services) and/or the sale of goods (Goods) including (except as provided in Section 10) firmware incorporated therein.

1. PRICES: Unless otherwise specified by Seller, Seller's price for the Goods and/or Services shall remain in effect for thirty (30) days after the date of Seller's quotation or acceptance of the order for the Goods/Services, whichever is delivered first, provided an unconditional, complete authorization for the immediate manufacture and shipment of the Goods and/or provision of Services pursuant to Seller's standard order processing procedures is received and accepted by Seller within such time period. If such authorization is not received by Seller within such thirty (30) day period, Seller shall have the right to change the price for the Goods/Services to Seller's price in effect for the Goods/Services at the time the order is released to final manufacture. Prices for Goods do not cover storing, installing, starting up or maintaining Goods unless expressly stated in Seller's quotation. Notwithstanding the foregoing, the price for Goods/Services sold by Seller, but manufactured by others, shall be Seller's price in effect at the time of shipment to Buyer.

2. DELIVERY, ORDER ACCEPTANCE AND DOCUMENTATION: All shipping dates are approximate and are based upon Seller's prompt receipt of all necessary information from Buyer to properly process the order. Notwithstanding any provisions to the contrary in this or other documents related to this transaction, and regardless of how price was quoted, whether FOB, FAS, CIF or otherwise, legal title to the Goods and risk of loss thereto shall transfer to Buyer as follows: for sales in which the end destination of the Goods is within the United States, upon delivery to the freight carrier at the shipping point; for sales in which the end destination of the Goods is outside of the United States, immediately after the Goods have passed beyond the territorial limits of the United States. Seller shall provide Buyer with that data/documentation which is specifically identified in the quotation. If additional copies of data/documentation or non-standard data/documentation are to be provided by Seller, they shall be provided to Buyer at Seller's price then in effect. Data/documentation marked as confidential or proprietary may not be reproduced or used for any purpose other than the purpose for which it was provided and may not be disclosed to third parties without the prior written permission of Seller.

3. EXCUSE OF PERFORMANCE: Seller shall not be liable for delays in performance or for non-performance due to failure or interruption of computer or telecommunication systems, acts of God, war, riot, fire, terrorism, labor trouble, unavailability of materials or components, explosion, accident, compliance with governmental requests, laws, regulations, orders or actions, or other unforeseen circumstances or causes beyond Seller's reasonable control. In the event of such delay, the time for performance or delivery shall be extended by a period of time reasonably necessary to overcome the effect of the delay.

4. TERMINATION AND SUSPENSION BY BUYER: Buyer may terminate or suspend its order for any or all of the Goods/Services covered by the Agreement only upon Seller's written consent or pursuant to Seller's applicable policy or practices covering such termination or suspension.

5. LIMITED WARRANTY: Subject to the limitations contained in Section 6 herein, Seller warrants that the licensed firmware embodied in the Goods will execute the programming instructions provided by Seller, and that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and care and Services will be performed by trained personnel using proper equipment and instrumentation for the particular Service provided. The foregoing warranties will apply until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, correct any errors that are found by Seller in the firmware or Services or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources or environmental conditions, accident, misuse, improper installation, modification, repair, use of unauthorized replacement parts, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Seller. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel and representatives for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Goods repaired and parts replaced by Seller during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by Seller. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

6. LIMITATION OF REMEDY AND LIABILITY: SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE REMEDIES OF BUYER SET FORTH IN THIS AGREEMENT ARE EXCLUSIVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED OR SERVICES PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, REVENUE OR USE AND COSTS INCURRED INCLUDING WITHOUT LIMITATION FOR CAPITAL, FUEL AND POWER, AND CLAIMS OF BUYER'S CUSTOMERS.

7. PATENTS: Subject to the limitations contained in Section 6, Seller shall defend any suits brought against Buyer based on a claim that use of the Goods manufactured by Seller constitutes an infringement of a valid patent of the United States, and shall pay any damages awarded therein against Buyer, provided that Buyer: promptly notifies Seller in writing of the filing of such suit or the threat thereof; permits Seller to control completely the defense or compromise of such claim of infringement; and provides all reasonable assistance and cooperation requested by Seller for the defense of such suit. In the event that only the Goods manufactured by Seller are held to be infringing in such suit and their use is enjoined, Seller shall, at its sole option and expense, provide a commercially reasonable alternative, including, but not limited to, procuring for Buyer the right to continue using the Goods, replacing them with a non-infringing product or modifying them so they become non-infringing. Buyer agrees that Seller shall not be liable for infringement, and that Buyer shall fully indemnify Seller therefore, if infringement is based upon the use of Goods in connection with goods not manufactured by Seller or in a manner for which the Goods were not designed by the Seller or if the Goods were not designed by the Seller or if the Goods were designed by the Buyer or were modified by or for the Buyer in a manner to cause them to become infringing.

8. TAXES: Any tax or governmental charge payable by the Seller because of the manufacture, sale or delivery of the Goods, or provision of Services, may at Seller's option be added to the price herein specified. The foregoing shall not apply to taxes based upon Seller's net income.

9. TERMS OF PAYMENT: Unless otherwise agreed by Seller, and subject to the approval of Seller's Credit Department, terms are F.O.B. shipping point, net 30 days from date of Seller's invoice in U.S. currency, except for applicable milestone payments or export shipments for which Seller may require other arrangements. Freight charges may include shipping and handling charges, and Buyer shall pay all such charges. If any payment owed to Seller hereunder is not paid when due, it shall bear interest, at a rate to be determined by Seller which shall not exceed the maximum rate permitted by law, from the date on which it is due until it is received. Seller shall have the right, among other remedies, either to terminate the Agreement or to suspend further deliveries under this and/or other agreements with Buyer in the event Buyer fails to make any payment hereunder when due. Buyer shall be liable for all expenses attendant to collection of past due amounts, including attorneys' fees.

10. SOFTWARE AND FIRMWARE: Notwithstanding any other provision herein to the contrary, Seller or applicable third party owner shall retain all rights of ownership and title in its respective firmware and software, including all copyrights relating to such firmware and software and all copies of such firmware and software. Except as otherwise provided herein, Buyer is hereby granted a nonexclusive, royalty free license to use firmware and software, and copies of firmware and software, incorporated into the Goods only in conjunction with such Goods and only at the Buyer's plant site where the Goods are first used. Buyer's use of certain firmware (as specified by Seller) and all other software shall be governed exclusively by Seller's and/or third party owner's applicable license terms.

11. BUYER SUPPLIED DATA: To the extent that Seller has relied upon any data or information supplied by Buyer to Seller ("Data") in the selection or design of the Goods and/or provision of the Services and the preparation of Seller's quotation, and the Data is inadequate or inaccurate, any warranties or other provisions contained herein which are affected by such conditions shall be null and void.

12. EXPORT/IMPORT: Buyer agrees to comply with all applicable import and export control laws, regulations, orders and requirements, including without limitation those of the United States and the European Union, and the jurisdictions in which the Seller and Buyer are established or from which items may be supplied.

13. GENERAL PROVISIONS: (a) Buyer shall not assign its rights or obligations under the Agreement without Seller's prior written consent. (b) There are no understandings, agreements or representations, express or implied, not specified in the Agreement. (c) No action, regardless of form, arising out of transactions under the Agreement, may be brought by either party more than two [2] years after the cause of action has accrued. (d) Any modification of these terms and conditions must be set forth in a written instrument signed by a duly authorized representative of Seller. (e) The Agreement is formed and shall be construed, performed and enforced under the laws of the State of Missouri. However, Buyer and Seller agree that the proper venue for all actions arising under the Agreement shall be only in the USA and in the State where the Goods involved in such actions were manufactured. (f) UNLESS OTHERWISE SPECIFICALLY PROVIDED IN SELLER'S QUOTATION, GOODS AND SERVICES HEREUNDER ARE NOT INTENDED FOR USE IN ANY NUCLEAR OR NUCLEAR RELATED APPLICATIONS. Buyer (i) accepts Goods and Services in accordance with the restriction set forth in the immediately preceding sentence, (ii) agrees to communicate such restriction in writing to any and all subsequent purchasers or users and (iii) agrees to defend, indemnify and hold harmless Seller from any and all claims, losses, liabilities, suits, judgments and damages, including incidental and consequential damages, arising from use of Goods and Services in any nuclear or nuclear related applications, whether the cause of action be based in tort, contract or otherwise, including allegations that the Seller's liability is based on negligence or strict liability. (g) The 1980 United Nations Convention on Contracts for the International Sale of Goods does not apply to this Agreement. (h) If any provision of the Agreement is invalid under any statute or rule of law, such provision, to that extent only, shall be deemed to be omitted without affecting the validity of the remainder of the Agreement (i) Seller specifically objects to the application of any Federal Acquisition Regulation ("FAR") provision or clause to the Agreement.

C. Executive Summary of Aspinwall – Lanpher Rising Main Report

1 Introduction

The Lanpher Rising Main is a 60-inch diameter 20,000-foot long riveted steel pipeline that was constructed in the 1920's. The Lanpher Rising Main is owned and operated by the Pittsburgh Water and Sewer Authority (PWSA) and functions as the sole conduit for conveying treated potable water from the PWSA Drinking Water Plant in Aspinwall Borough through Aspinwall, Sharpsburg, and Etna Boroughs and Shaler Township to the Lanpher Reservoir. Water is pumped through the rising main by the Aspinwall Pump Station which is located at the PWSA Drinking Water Plant in Aspinwall Borough. In consideration of the rising main's age and the lack of a redundant water source for the service area and reservoir, PWSA desires to investigate the feasibility of constructing a redundant rising main.

1.1 Objective

The primary objective in the construction of a new rising main is to provide redundancy to the existing rising main system.

The redundant rising main would provide the same level of service as the existing rising main by providing treated drinking water to the Lanpher Reservoir and to the existing service connections. The redundant main could be operated by PWSA in parallel with the existing rising main, or it could be placed in service as the main conduit with the existing rising main utilized as a backup system. Existing service connections would be connected to the new rising main. Potential new service connections could be installed at strategic locations on the new rising main to serve additional customers.

A secondary objective in the construction of a new rising main will be to serve as part of a future rehabilitation effort of the potable water clearwell at the PWSA Drinking Water Plant in Aspinwall. This clearwell rehabilitation effort may require a temporary location where chlorine contact time (CT) is achieved while the clearwell is out of service. One approach to achieving this is to utilize the Lanpher Reservoir for this purpose. Under this scenario, the new rising main would convey water to Lanpher. Following the required CT in the reservoir, disinfected potable water would exit Lanpher Reservoir and return through the existing rising main to each of the service connections and Fox Chapel Pumping Station.

PWSA has contracted with Mott MacDonald to perform an evaluation of alternative methods to achieve these objectives.

1.2 Purpose

The purpose of this Feasibility Study is to determine the feasibility of constructing a new rising main system to meet the primary objective of providing redundancy to the existing Lanpher Rising Main System. The feasibility of meeting the primary objective will be determined by evaluating a number of factors that are itemized in Section 3 of this report. The primary drivers in the evaluation are:

- Constructability
- Redundancy and hydraulics
- Construction cost

- Complexity and risk of trenchless crossings
- Impacts to residents and business

2 Existing Lanpher Rising Main System

2.1 Physical description

The existing Lanpher Rising Main extends through the boroughs of Aspinwall, Sharpsburg, and Etna, and Shaler Township as shown on Figure 1. The existing route traverses railroad systems, PennDOT highways, water bodies, and utilities and is primarily routed within existing public right-of-ways and beneath paved roadways and alleys. However, there are several locations where the route traverses through business parking areas, private property, creeks, and wooded areas.

Figure 2 shows the ground surface profile of the existing Lanpher Rising Main. The profile initiates at an invert elevation of 748 feet at the Aspinwall Pump Station and terminates at an elevation of 934 feet at the Lanpher Reservoir inlet structure. The profile has a slight negative slope for its initial 16,500 feet before intersecting Butler Street in Etna Borough and then ascends along Parker Street to the Lanpher Reservoir. The lowest elevation along the route is at Pine Creek, located near the intersection of PennDOT 8 and 28, at an elevation of about 720 feet.

The rising main receives pumped potable water from the Aspinwall Pump Station which is located at the PWSA Drinking Water Plant in Aspinwall Borough. The pump station consists of four (4) pumps. Table 1 provides pump information for the Aspinwall Pump Station.

Table 1: Aspinwall pump station pumps

Pump No.	Aspinwall Pumps			
	1	2	3	4
Capacity (MGD)	12	15	22	28
TDH (feet)	265	265	265	265
Motor (HP)	1,000	1,000	1,500	1,500

The four (4) pumps share two (2) common pump discharge pipes with Pumps 1 and 3 and Pumps 2 and 4 pumping through common 36-inch diameter discharge outlets to a common 60-inch diameter manifold. The 60-inch diameter manifold extends from the plant site to the west as the Lanpher Rising Main. The 60-inch diameter manifold also extends to the east through an isolation valve and a reducer to a 24-inch diameter pipe. The 24-inch diameter pipe serves the drinking water plant filter building as an emergency filter backwash supply main.

The Lanpher Rising Main is connected to the Lanpher Reservoir at the reservoir's inlet gate house at an elevation of 934 feet. The reservoir operates at a low elevation of 958 feet and a high water level of 972 feet. The rising main extends to the reservoir inlet gate house through a network of pipes and isolation valves designed to allow the reservoir to route potable water from the reservoir to the service areas on the City of Pittsburgh's north side.

Exhibit RAW/C-30

Lanpher Reservoir

Shaler Township

Etna Borough

Sharpsburg Borough

Lanpher Rising Main

Pittsburgh

O Hara Township

Sharpsburg Borough

Lanpher Rising Main

O Hara Township

Pittsburgh

O Hara Township

Fox Chapel Borough

O Hara Township

Aspinwall Borough

Pittsburgh

Aspinwall Pump Station

Legend

- Service Connections
- Existing Supply Main
- Existing Rising Main

0 500 1,000 Feet

N W E S

Map Document: (C:\GIS\PWSA\MXDs\Copy_of_Pittsburgh (new split layout) figure 1.mxd)
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PGH2O

MOTT MACDONALD

1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY

PITTSBURGH, PA

LANPHER RISING MAIN

FIGURE 1 - EXISTING RISING MAIN

	Designed	Drawn	Checked	Approved	Date
		DWW			10/12/2016

Figure 2
Lanpher Rising Main
Existing Ground Surface Profile

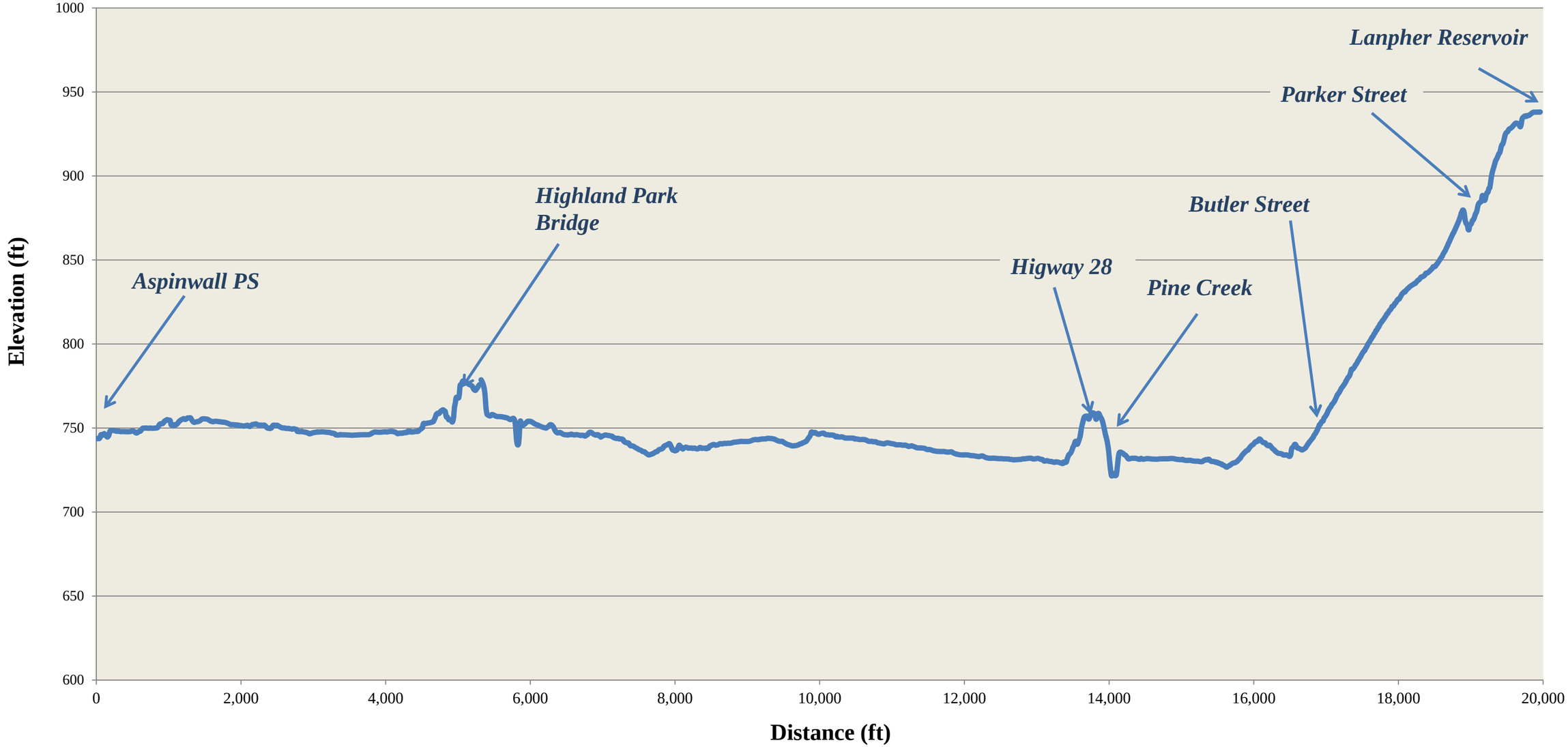


Table 2
Lanpher Rising Main Service Connections

Station	Location	Tap Size (in)	Service Area	Average Daily Demand (gal)	Average Flow Rate (gpm)	Min Monthly (gal)	Avg Monthly (gal)	Max Monthly (gal)
---	Freeport Rd	30	Waterworks Mall/ Blawnox	54,600	38	1,195,161	1,639,102	2,102,913
144+57	Delafield Rd	24	Hospital	98,800	69	664,028	2,964,208	5,669,601
161+43	Eastern Ave	16	Aspinwall	182,700	127	3,102,273	5,480,781	9,277,500
167+13	Center Ave	8	Aspinwall	2,900	2	7,000	85,760	320,690
217+50	18th St	16	Sharpsburg	22,100	15	0	663,157	6,990,000
232+01	15th St	6	Sharpsburg	Emergency Connection				
244+94	11th St	6	Sharpsburg	Emergency Connection				
274+62	Bridge St	16	Etna	Capped				
---	Lanpher Reservoir	8	Shaler	17,400	12	349,071	522,614	1,050,805
---	Aspinwall Pump Station	16	Fox Chapel	1,888,700	1312	38,862,750	56,660,193	146,922,000
			TOTALS:	**2,267,200**	**1,574**	**44,180,284**	**68,015,816**	**172,333,508**

As shown on the previously presented Figure 1, eight (8) service connections intersect the rising main along its route. Metered water demand data at each of the service connections is provided in Table 2. Two (2) of the service connections are utilized as emergency connections and a third is capped. The remaining five (5) service connections provide potable water to Aspinwall Borough, Sharpsburg Borough, and St. Margret's Hospital.

2.2 Repair history and condition of existing Lanpher Rising Main System

The Lanpher Rising Main has been in operation for nearly 100 years. During this time it has served to convey drinking water to the Lanpher Reservoir and the service areas along its route. However, in order to maintain this functionality, PWSA has performed repairs that were intended to lengthen the lifetime of the rising main system. See Appendix A for historic information related to the repair work.

In 1930 PWSA had a portion of the Lanpher Rising Main encased in concrete. The work was performed under two (2) contracts.

- Contract No. 1 was performed at the Guyastuta Run Crossing in O'Hara Township.
- Contract No. 2 was performed at South Canal Street near the intersection of 18th Street in Sharpsburg Borough.

In the late 1960's through the mid 1970's, PWSA initiated a cleaning and cement mortar lining effort to the interior of much of the existing Rising Main route and to repair and replace isolation and blow off valves along the route.

- In 1967, PWSA performed the cleaning and cement lining effort from Eastern Avenue in Aspinwall Borough for a length of approximately 8,000 feet to the west culminating at the intersection of North Canal Street and 15th Street in Sharpsburg Borough. During this work, two (2) isolation gate valves were installed.
- In 1968, PWSA performed the cleaning and cement lining effort from Pine Creek in Etna Borough to the Lanpher Reservoir.
- In 1974, PWSA performed the cleaning and cement lining effort from the Aspinwall Pump Station to Eastern Avenue in Aspinwall Borough. During this work a new valve structure with isolation valves was installed at the intersection of Delafield and Second Ave in Aspinwall.

In 2015, PWSA had a portion of the Lanpher Rising Main improved by installing a carbon fiber liner to the interior of port of the rising main. The segment that was improved was in the vicinity of the Pine Creek Crossing beneath the PennDOT Highway 28 and 8 interchange between Sharpsburg and Etna Boroughs. The work required extensive cleaning and conditioning of the existing rising main walls. The cleaning and conditioning work involved removal of a low strength cement past from the pipe wall, moisture testing, and high strength grout injection to prevent infiltration at 21 locations along the segment.

3 New rising main system evaluation

As previously stated, the primary objective in considering the new rising main is to provide a redundant system to the existing Lanpher Rising Main System. The purpose of this evaluation is to determine the feasibility of constructing a new rising main system. The evaluation will focus on three (3) alternative routes for a new Rising Main. The three alternative routes were established at the Lanpher Rising Main Project Workshop Number 1 (Workshop No. 1). The three alternative routes will be evaluated using factors that were developed at Workshop No.1.

3.1 Evaluation criteria

As part of Workshop No. 1, PWSA and Mott MacDonald developed list of evaluation criteria were created to generate primary factors for evaluating the overall feasibility of new Rising Main alternative routes.

The list of evaluation criteria that was discussed at the Workshop No. 1 is as follows:

- Impact to public and business
- Traffic impact
- Adequate access for construction and maintenance
- Redundancy and hydraulics
- Feasible construction methods
- Permitting
- Complexity and risk of trenchless crossings
- Limited wetlands mitigation
- Construction cost
- Selecting alignment for potential future customers
- Potential for utility conflicts and required relocations
- Pipe material and potential for material corrosion
- Accessibility to pipe in future for maintenance
- Impacts to business and residents
- Regulatory review schedule
- Constructability
- Overall project schedule
- Number of easements
- Long-term reliability

Based upon the discussion at the Workshop, PWSA input and Mott MacDonald's previous experience on similar projects, the following issues have been identified as the primary factors for comparing alternate routes:

- Constructability
- Redundancy and hydraulics

- Construction cost
- Complexity and risk of trenchless crossings
- Impacts to business and residents

3.1.1 Constructability

The evaluation of constructability includes an assessment of the most feasible method of constructing the water main. Open cut and trenchless methods will be considered for the water main route. This will include the most feasible option for crossing locations where property owners will not permit open-cut construction or where permitting requirements make open-cut installation not feasible or practical (i.e. water body crossings or highway crossings). Pipe material will be evaluated to determine the suitability of certain materials for the proposed installation and system conditions.

3.1.2 Redundancy and hydraulics

PWSA's ability to provide drinking water service to the existing and potential service areas is a primary factor in constructing the redundant rising main system. The new rising main is to provide PWSA with operational flexibility, should be located in close proximity to the existing rising main, and is to provide a level of service that would allow PWSA to serve additional customers in the future if needed.

3.1.3 Construction cost

The estimated cost to construct the new rising main will be considered for the alternate routes in order to provide a quantitative evaluation of the routes.

3.1.4 Complexity and risk of trenchless crossings

The number of trenchless crossings and the complexity in achieving the crossings will be a critical component in comparing the alternative routes. As such, special consideration will be given to minimizing the number, complexity, and risk in crossing highways, water bodies, railroad property, and other locations where open-cut construction is not possible.

3.1.5 Impacts to residents/business

Much of the existing and proposed rising main routes extend through residential neighborhoods and through areas where small businesses exist. The impact to these neighborhoods during construction is a major consideration in PWSA's decision-making process. The necessity of limiting impacts in these areas will be considered for each of the alternative routes in order to provide a qualitative analysis.

3.2 Alternative routes

An important aspect of Workshop No. 1 was to identify three alternative routes for a new rising main. The three alternative routes that were selected at the kickoff meeting are presented in Figure 3. Each alternative route commences at the Aspinwall Pump Station at the PWSA Drinking Water Plant in Aspinwall Borough and terminates at the inlet structure at the Lanpher Reservoir in Shaler Township.

Exhibit RAW/C-30

Lanpher Reservoir
Alfatimiah of Pittsburgh
Pine Creek
CSX RR
28
8
St Mary's
Sharpsburg Family Worship Center
St Juan Catholic Church
Kennedy Park
18th St
First English Lutheran Church
Norfolk Southern RR
Trenchless Crossing 3

Heinz Memorial Field
Main St
RR Spur
Industrial Park
Trenchless Crossing 2
Aspinwall Community Park
Aspinwall Presbyterian Church
St Scholastica Catholic Church
Christ the Divine Catholic Academy
Med Express Urgent Care
Highland Park Bridge
Norfolk Southern RR
Crossing 48" Brick Sewer
Freeport Rd
Clearwell
UPMC St Margaret's Hospital
Trenchless Crossing 1

Legend

- Service Connections
- Alt_Route_2rev1
- Alternative Alignment 2
- Alignment 1 (Existing Rising Main)
- Crossover Connection Alt 2
- Crossover Connection Alt 3

0 500 1,000 Feet

N W E S

Map Document: (P:\359110 PWSA Aspinwall to Lanpher Rising Main\Background Information\Files from Derek 10-5-16\Copy_of_Pittsburgh (new split layout).mxd)
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PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
LANPHER RISING MAIN
FIGURE 3 - ALTERNATIVE NEW RISING MAIN ROUTES

	Designed	Drawn	Checked	Approved	Date
		DWW			10/11/2016

3.2.1 Alternative Route No. 1

Alternative Route No. 1 follows the existing rising main route and initiates at the Aspinwall Pump Station in Aspinwall Borough and extends along Freeport Road, Delafield Street, 2nd Street, 2nd Street Alley, and into the Aspinwall Community Park. From the park, the route extends under the on-ramp to PennDOT Highland Park Bridge and into Sharpsburg Borough.

In Sharpsburg Borough, the route extends in a westerly direction from the PennDOT Highway crossing through an industrial park and along an unnamed gravel roadway to Chapman Street, through an industrial complex to South Canal Street, along North Canal Street and Clay Street, and under the PennDOT Highway 28 and 8 interchange to Etna Borough.

In Etna Borough and Shaler Township the route follows the existing rising main alignment along Sycamore Street, Cherry Street, through an industrial complex to the intersection of Butler Street and Parker Street, along Parker Street to Sherman Street, and into the Lanpher Reservoir property.

The total length of the proposed rising main shown as Alternative Route No. 1 is 19,772 feet. Alternative Route No. 1 would require three (3) trenchless crossings of property where open cut construction will not be achievable.

3.2.2 Alternative Route No. 2

Alternative Route No. 2 commences at the Aspinwall Pump Station in Aspinwall Borough and extends in a westerly direction along Freeport Road to the Highland Park Bridge. The route extends under the bridge and into Sharpsburg Borough to Main Street.

In Sharpsburg Borough the route extends in a westerly direction from the Highland Park Bridge along Main Street and South Main Street to PennDOT Highway 8 (William Flynn Highway). The route extends under Highway 8 and into Etna Borough.

In Etna Borough and Shaler Township, the route extends in a west-northwest direction from the Highway 8 crossing into an industrial park and to Poplar Street. From Poplar Street the route extends to the north crossing Pine Creek and PennDOT Highway 28 to a ballfield. From the ballfield, the route extends along VFW Way, Butler Street, and Parker Street to Koehler Street and into the Lanpher Reservoir property.

The total length of the proposed rising main shown as Alternative Route No. 2 is 19,651 feet. An additional length of 3,386 feet of pipe would be required to connect the proposed rising main with the existing system at each of the active service connections.

3.2.3 Alternative Route No. 3

Alternative Route No. 3 commences at the Aspinwall Pump Station in Aspinwall Borough and extends along Freeport Road, Delafield Street, 4th Street, Field Street, and into the Aspinwall Community Park. From the park, the route extends under the PennDOT Highland Park Bridge on-ramp and into Sharpsburg Borough.

In Sharpsburg Borough, the route extends in a westerly direction from the PennDOT Highway crossing through an industrial park and along 23rd Street, Noble Street, Front Street, 18th Street, Middle Street, 13th Street, School Street, Penn Street, and Garnier Street to Main Street. From Main Street, the route extends under the PennDOT Highway 28 and 8 interchange as well as Pine Creek and into Etna Borough.

In Etna Borough and Shaler Township the route extends in a westerly direction from the PennDot Highway 28 and 8 interchange along Finney Street, Cherry Street, Clark Street, and Butler Street to Parker Street. At Parker Street the route extends in a north westerly direction along Parker Street, Washington Street, Nauman Street, through a wooded right-of-way, and into the Lanpher Reservoir property.

The total length of the proposed rising main shown as Alternative Route No. 3 is 21,072 feet. An additional length of 1,281 feet of pipe would be required to connect the proposed rising main with the existing system at each of the active service connections.

3.3 Hydraulic analysis

3.3.1 Model objective

Mott MacDonald performed a hydraulic analysis of potential rising main diameters using Bentley WaterGEMS software. The model was developed for the purpose of determining a rising main diameter that would allow PWSA to meet the primary and secondary objective of this report as detailed in Section 1.0. The existing rising main is a 60-inch diameter riveted steel pipeline.

To meet the primary objective of this report, the new rising main would provide redundancy to the existing rising main by providing the same level of service as the existing rising main; by providing treated drinking water to the Lanpher Reservoir and to the existing service connections. The redundant rising main could be operated by PWSA in parallel with the existing rising main or it could be placed in service as the main conduit with the existing rising main utilized as a backup system. Existing service connections would be connected to the new rising main. Potential new service connections could be installed at strategic locations on the new rising main to serve additional customers in the future.

To meet the secondary objective of this report, chlorinated water would be pumped through the new rising main directly to the Lanpher Reservoir. Following the required CT in the reservoir, disinfected potable water would exit Lanpher Reservoir and return through the existing rising main to each of the service connections and Fox Chapel Pumping Station.

3.3.2 Model construction

The model was developed in ArcGIS using the existing rising main, the proposed rising main, existing and proposed rising main interconnects, and 5-foot contour shapefiles. Performance curve data points for the existing Aspinwall Pump Station pumps were extracted from PWSA's existing InfoWater model and input into the WaterGEMS model. Table 3 provides pump information for the Aspinwall Pump Station. So as to represent current pumping operations, Aspinwall Pumps 1 and 2 were set with an initial status as being in operation, and Aspinwall Pumps 3 and 4 were set with an initial status as being offline in the hydraulic analysis.

Table 3: Aspinwall pump station pumps

Pump No.	Aspinwall Pumps			
	1	2	3	4
Capacity (MGD)	12	15	22	28
TDH (feet)	265	265	265	265
Motor (HP)	1,000	1,000	1,500	1,500

Existing pump and reservoir elevations from PWSA's "Pittsburgh Water System Schematic" were input into the model; node/junction elevations were assigned using the software's Terrain Extractor ("TRex") tool and the existing 5-foot contour shapefile. Five feet was then subtracted

from each node elevation to simulate the pipe's actual installed elevation. To account for minor losses throughout the system and the varying age of existing infrastructure, Mott MacDonald globally applied a Hazen Williams C-factor of 120 to each existing pipe. The existing rising main was modeled with a 60-inch inside diameter.

Meter data from 2012 to 2015 was used to determine monthly minimum, maximum, and average demands off of the existing rising main. Monthly average and monthly maximum demands were then input into the model. These demands were modelled in a steady-state mode with no diurnal fluctuations, as shown in Table 4.

Table 4: Modelled service area demand

Node Label	Average Daily Demand (gal/day)	Demand (gal/day) (Based on max. monthly)
Aspinwall 1	92,500	160,000
Aspinwall 2	92,500	160,000
Shaler	17,400	35,000
Sharpsburg	22,100	233,000
St. Margaret's Hospital	98,800	189,000
Water Works Mall	54,600	70,000
Fox Chapel	1,889,000	4,890,000
Total	**2.27 MGD**	**5.74 MGD**

The new rising main was modelled parallel to the existing rising main between the Aspinwall Pump Station and Lanpher Reservoir with a Hazen Williams C-factor of 130 at the diameters described in the scenarios below.

3.3.3 Scenarios

The following scenarios were analyzed to hydraulically model the existing and proposed new rising main system.

- Aspinwall Pumps 1 and 2 discharging through the existing 60-inch diameter Rising Main to Lanpher Reservoir with existing average day demands at the service connections.
- Aspinwall Pumps 1 and 2 discharging through the existing 60-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through a new 48-inch diameter rising main to the existing service connections with average daily demands.
- Aspinwall Pumps 1 and 2 discharging through the existing 60-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through a new 48-inch diameter rising main to the existing service connections with maximum monthly demands.
- Aspinwall Pumps 1 and 2 discharging through a new 48-inch diameter rising main directly to Lanpher Reservoir. Lanpher Reservoir draining back through the existing 60-inch diameter Rising Main to the existing service connections with average daily demands.
- Aspinwall Pumps 1 and 2 discharging through a new 48-inch diameter rising main directly to Lanpher Reservoir. Lanpher Reservoir draining back through the existing 60-inch diameter Rising Main to the existing service connections with maximum monthly demands.
- Aspinwall Pumps 1 and 2 discharging through the existing 60-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through a new 36-inch diameter rising main to the existing service connections with average daily demands.

- Aspinwall Pumps 1 and 2 discharging through the existing 60-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through a new 36-inch diameter rising main to the existing service connections with maximum monthly demands.
- Aspinwall Pumps 1 and 2 discharging through a new 36-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through the existing 60-inch diameter rising main to the existing service connections with average daily demands.
- Aspinwall Pumps 1 and 2 discharging through a new 36-inch diameter Rising Main directly to Lanpher Reservoir. Lanpher Reservoir draining back through the existing 60-inch diameter rising main to the existing service connections with maximum monthly demands.

As detailed above, it is anticipated that there will be three (3) trenchless crossing locations along each of the alternative routes that will be analyzed.

- 180 linear feet near the Aspinwall Pump Station
- 200 linear feet crossing the PA-18/Highland Park Bridge interchange
- 400 linear feet crossing the PA-28/PA-8 interchange

These three (3) sections of the new rising main will be modelled under the nine (9) scenarios to determine the most feasible crossing diameter.

3.3.4 Hydraulic criteria

The criteria for selecting the diameter of the new rising main is to maintain the ability to deliver the required flow to the Lanpher Reservoir while maintaining a velocity of between 2 and 8 feet per second through the pipe system.

3.3.5 Results

See Table 5 on the following page for a summary of the nine (9) scenarios. Based on the results, Mott MacDonald considers the most hydraulically practical new rising main to be 48 inches in diameter with reductions to 36-inch diameter at each of trenchless crossings. The scenarios that depict this configuration are Scenarios 2, 3, 4 and 5.

Under these scenarios, the Aspinwall Pump Station would deliver approximately 26.4 MGD through the 48-inch diameter new rising main at a velocity of approximately 3.2 feet/second and approximately 5.8 feet/second through the 36-inch diameter sections.

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MOTT MACDONALD

Table 5
Hydraulic Model Results

	Scenario Description	Aspinwall PS Pump Flow (MGD)			Demand Total (MGD)	Inflow to Lanpher Reservoir (MGD)	Outflow from Lanpher Reservoir (MGD)	Demand-Aspinwall1	Demand-Aspinwall2	Demand-Fox Chapel	Demand-PA-8 / 28	Demand-Shaler	Demand-Sharpsburg	Demand-St. Margret's Hospital	Demand-Waterworks Mall
		Pump 1	Pump 2	Pump 3/4				Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)	Flow (GPD) / Pressure (psi)
1	Existing 60" rising main - Aspinwall PS to Lanpher Reservoir	12.86	15.40	OFF	2.36	25.90	0.00	92,500 / 100	92,500 / 100	1,888,700 / 75.5	92,500 / 104	17,400 / 15.8	22,100 / 102	98,800 / 96.4	55,600 / 101
2	Exist. 60" RM to Lanpher Reservoir (no demands); new 48" RM from Lanpher Reservoir to Aspinwall PS (with ADF demands)	12.78	15.33	OFF	2.36	28.11	2.36	92,500 / 95.3	92,500 / 94.7	1,888,700 / 73.3	92,500 / 104	17,400 / 15.8	22,100 / 101	98,800 / 93.8	55,600 / 98.3
3	Exist. 60" RM to Lanpher Reservoir (no demands); new 48" RM from Lanpher Reservoir to Aspinwall PS (with Max Mo. demands)	12.78	15.33	OFF	5.9	28.11	5.9	231,250 / 95.1	231,250 / 94.4	4,721,750 / 49.9	231,250 / 104	43,500 / 15.8	55,250 / 101	247,000 / 93.5	139,000 / 98.0
4	New 48" RM from Aspinwall PS to Lanpher Reservoir (no demands); exist. 60" RM from Lanpher Reservoir to Aspinwall PS (with ADF demands)	11.85	14.59	OFF	2.36	26.43	2.36	92,500 / 98.5	92,500 / 98.4	1,888,700 / 73.3	92,500 / 104	17,400 / 15.6	22,100 / 101	98,800 / 94.4	55,600 / 99.1
5	New 48" RM from Aspinwall PS to Lanpher Reservoir (no demands); exist. 60" RM from Lanpher Reservoir to Aspinwall PS (with Max Mo. demands)	11.85	14.59	OFF	5.9	26.43	5.9	231,250 / 98.5	231,250 / 98.3	4,721,750 / 50.5	231,250 / 104	43,500 / 15.6	55,250 / 101	247,000 / 94.3	139,000 / 99.0
6	Exist. 60" RM to Lanpher Reservoir (no demands); new 36" RM from Lanpher Reservoir to Aspinwall PS (with ADF demands)	12.78	15.33	OFF	2.36	28.11	2.36	92,500 / 95.2	92,500 / 94.6	1,888,700 / 73.1	92,500 / 104	17,400 / 15.8	22,100 / 101	98,800 / 93.7	55,600 / 99.1
7	Exist. 60" RM to Lanpher Reservoir (no demands); new 36" RM from Lanpher Reservoir to Aspinwall PS (with Max Mo. demands)	12.78	15.33	OFF	5.9	28.11	5.9	92,500 / 94.3	92,500 / 93.6	1,888,700 / 49.0	92,500 / 104	17,400 / 15.8	22,100 / 100	98,800 / 92.6	55,600 / 97.0
8	New 36" RM from Aspinwall PS to Lanpher Reservoir (no demands); exist. 60" RM from Lanpher Reservoir to Aspinwall PS (with ADF demands)	9.32	12.63	OFF	2.36	21.95	2.36	92,500 / 98.5	92,500 / 98.4	1,888,700 / 73.4	92,500 / 104	17,400 / 15.6	22,100 / 101	98,800 / 94.4	55,600 / 99.1
9	New 36" RM from Aspinwall PS to Lanpher Reservoir (no demands); exist. 60" RM from Lanpher Reservoir to Aspinwall PS (with Max Mo. demands)	9.32	12.63	OFF	5.9	21.95	5.9	231,250 / 98.5	231,250 / 98.3	4,721,750 / 50.5	231,250 / 104	43,500 / 15/6	55,250 / 101	247,000 / 94.3	139,000 / 99.0

3.4 Existing utilities

Mott MacDonald performed a One-Call request through the Pennsylvania One-Call System, Inc. for the purpose of understanding the locations and sizes of the existing underground utilities. In addition, Mott MacDonald performed a visual on-site review of above ground utilities that exist along the potential alignments. All One-Call information received is located in Appendix B. Figure 4 shows the location of above ground and below ground utilities that may potentially be impacted or disrupted during construction of the new rising main.

One-Call utility information was requested and received from the following utility owners:

- Aspinwall Borough
- Alleghany County Sanitary Authority (ALCOSAN)
- People's Gas
- Pittsburgh Water and Sewer Authority (PWSA)
- Girty's Run Joint Sewer Authority
- Hampton Township
- Shaler Township
- Duquesne Light

The following utility owners did not respond to the One-Call request or responded on a limited basis:

- Sharpsburg Borough
- Etna Borough (partial)

Aboveground utilities and water bodies were visually identified and researched. Above ground utilities and water bodies include the following:

- Railroad
- PennDOT Highways and surface roads
- Pine Creek

3.4.1 Potential buried utility conflicts

Utilities identified in the One-Call request include potable water, sanitary sewer, combined sewer, and gas. Potable water and sanitary sewer pipe networks exist along most of the east-west streets and north-south avenues in Aspinwall Borough and are assumed to exist in Sharpsburg and Etna Boroughs and Shaler Township. Major buried utilities that may affect the alternative routes include the following:

- A PWSA 96-inch diameter filtered water pipe traverses parallel to the existing discharge manifold. In addition, an abandoned PWSA 96-inch filtered water pipe crosses Freeport Road as it extends north from the Clearwell Gate House.
- An ALCOSAN 24-inch diameter combined sewer pipe exists along Freeport Street in Aspinwall Borough
- A People's Gas 20-inch diameter high pressure gas main exists along Freeport Street in Aspinwall Borough and Etna Borough.
- A People's Gas 20-inch diameter high pressure gas main exists at the intersection of Butler and Parker Street in Shaler Township.

Exhibit RAW/C-30

20" and 12" Shaler Water Mains on Kriss Dr. and Koehler St.

72" Sewer on Parker St

Crossing 36" Sewer, 20" Gas Pine Creek, and CSX RR

Crossing 36" Sewer, 20" Gas Pine Creek, and CSX RR

20" Gas on Main St.

RR Spur Crossing

Crossing 24" Sewer

Crossing 48" Brick Sewer

Crossing 36" Brick Sewer

20" Gas on Freeport

Crossing Abandoned 96" Filtered Water Conduit

Crossing 72" Sewer, 24" Sewer, 20" Gas, and 30" Water

Crossing 96" Filtered Water Conduit and NS RR

Crossing 48" Brick Sewer

Legend

- Service Connections
- Alt_Route_2rev1
- Alternative Alignment 2
- Alignment 1 (Existing Rising Main)
- Crossover Connection Alt 2
- Crossover Connection Alt 3

0 500 1,000 Feet

N W E S

Map Document: (C:\GIS\PWSA\MXDs\Copy_of_Pittsburgh (new split layout) ex utilities.mxd)
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MOTT MACDONALD

1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA

LANPHER RISING MAIN

FIGURE 4 - EXISTING UTILITIES

	Designed	Drawn	Checked	Approved	Date
		DWW			10/11/2016

- An Aspinwall Borough 48-inch diameter brick combined sewer extends from Delafield Avenue to 4th Street and Brilliant Avenue in Aspinwall.
- A Shaler Township 72-inch diameter gravity sewer exists on Parker Street near the intersection of Butler Street in Shaler Township.
- An Etna Borough 36-inch diameter gravity sewer exists adjacent to Pine Creek in Etna Township.
- A Shaler Township parallel 20-inch and 12-inch diameter water main exists on Kriss Drive and Koehler Street in Shaler Township

3.4.2 Potential major aboveground utility conflicts

Visual on-site observations of aboveground utilities that may affect the alternative routes include the following:

- A Class I Norfolk Southern railroad line extends adjacent to Freeport Street and Main Street, adjacent to the Alleghany River and adjacent to the PWSA Drinking Water Plant in Aspinwall.
- A spur off of the Norfolk Southern railroad line extends into the PWSA Drinking Water Plant and is utilized for the delivery of water treatment chemicals and equipment.
- Freeport Road located just outside of the PWSA Drinking Water Plant, is owned by PennDOT.
- The Highland Park Bridge at the border of Aspinwall and Etna is owned by PennDOT.
- PennDOT Highway 28 runs along the northern border of Aspinwall and Sharpsburg and intersects with Highway 8 in Etna.
- PennDOT Highway 8 intersects with Highway 28 in Etna.
- Pine Creek extends beneath and adjacent to the Highway 28 and Highway 8 interchange in Etna.
- A Class I CSX railroad line extends adjacent to Pine Creek at the Highway 28 and 8 interchange.
- Overhead electrical lines exist throughout each of the boroughs and in Shaler Township.

3.5 Construction methods and evaluation

The new rising main will be constructed primarily through residential and light commercial locations in Aspinwall, Sharpsburg, and Etna Boroughs and Shaler Township. However, there are locations where the new rising main will need to extend across highways, railroad tracks, and water bodies as well as locations where existing utilities exist. At these locations, trenchless methods of construction will be considered.

Several factors should be considered when evaluating construction methods of a water main.

- Pipe diameter and pipe material
- Desired pipeline depth
- Soil material and characteristics
- Depth to rock along potential pipe alignment
- Groundwater elevation
- Final pipe alignment
- Regulatory requirements
- Adequate access and size of construction area

- Impacts to residents/business and traffic
- Construction cost

This section will describe open cut and trenchless construction methods and their feasibility at the potential new rising main alignments based on the factors listed above.

3.5.1 Methods of construction

3.5.1.1 Horizontal directional drilled (HDD)

This method has been used for major and minor crossings of bodies of water and highways and has been previously utilized successfully by a number of projects throughout the country. Using this technology, the pipeline can be installed on both a horizontal and vertical curve. The most significant aspect of this method as it relates to this specific project is the required laydown area for the casing and/or carrier pipe, which would generally be at least as long as the proposed installation length and the necessary staging area of the entry point side (drilling rig side). Typical space requirements for these size crossing will be approximately 100 feet wide by 100 feet long to allow for the staging of drilling equipment (i.e. drilling rig, drilling pipe, slurry mixing tank, cuttings separation equipment, pumps, etc.) and for maneuvering of construction equipment. However, it is noted that the width of the staging area can be reduced to the width of the drilling rig with the ancillary drilling equipment arranged linearly. If a linear arrangement of drilling equipment were to be utilized, the staging area could potentially be reduced to a width of approximately 25 feet.

3.5.1.2 Auger boring

Auger bores push or drive casing pipe into the ground and use continuous augers to remove material. If the casing is pushed, the auger will typically advance ahead of the casing. If the casing is pneumatically driven into place (pipe ramming), the auger will typically trail the casing. A plug of soil can be utilized to maintain face stability; however, the soil is not conditioned and may not be effective. Obstructions can be difficult to pass. The machine is advanced from an excavation by jacking casing pipe in behind the machine. Auger bores can only accommodate straight drives.

3.5.1.3 Micro-tunneling

Micro-tunneling is one of the many existing trenchless construction methods used to install underground pipelines. The method utilizes a pressurized Slurry Shield Boring Machine combined with the pipe jacking technique. It is a remotely controlled process operating from a control panel, guided to meet the required tolerance for line and grade, and continuously applying pressure to the face of the excavation to balance groundwater and earth pressures. Micro-tunneling is a steerable jacking method that requires less lay down area than horizontal directional drilling. Since the cutting head of the micro-tunneling machine is pressurized, it can operate in a wide variety of ground conditions, including wet sands and silts. Typical jacking pipes are either steel or concrete, although fiberglass and ductile iron pipe can also be utilized.

The advantage of installing the pipeline utilizing the micro tunneling method is that it is not necessary to string out the pipeline. Temporary jacking and reception shafts are constructed to jack the casing and/or carrier pipes in place.

3.5.1.4 Open-faced pipe jacking

Open-face pipe jacking is more commonly used in pipe diameters larger than 48 inches because it requires man entry. Open-face pipe jacking is typically performed above the water table or in conjunction with dewatering to control the mining face. Obstructions are more readily removed with open-face pipe jacking because laborers can split and remove larger obstructions.

3.5.1.5 Conventional tunnel boring machine (TBM)

Under this method, an available conventional TBM would be utilized to excavate a rock tunnel that is supported using steel ribs and lagging with a secondary carrier pipe installed to complete the lining. Unlike micro-tunneling, conventional tunneling can easily traverse more than a mile without the need for an intermediate shaft, and curves in the alignment can be incorporated in the tunnel.

3.5.1.6 Open cut

Open cut construction utilizes excavation equipment to dig a pipe trench to a depth below the desired invert of the pipe system. If deemed suitable, excavated earth is removed and stored on-site to be utilized as fill material to bed and secure the new pipe system. To allow for proper installation, the pipe trench is typically excavated to a width of approximately 1.8 times the diameter of the new pipe. A trench box can be used to secure a shallow pipe trench allowing for the trench to be excavated with 1:1 walls. A deeper pipe trench will require 1.5 or 2:1 walls which widens the width of the pipe trench and increases the volume of excavated earth.

3.5.2 Evaluation

Based on the findings of Section 3.3, the proposed new rising main is recommended to be a 48-inch diameter pipeline with 36-inch diameter segments utilized at the trenchless crossings. Ideally, the new rising main will be installed at a minimum depth of 5 feet so that the PWSA can easily access, operate, and maintain the system. Based on the alternative routes summarized in Section 3.3, the alignment of the new rising main will require frequent fittings to change the direction of the rising main in order to traverse through the existing right-of-ways. Whenever a fitting is placed on the pipeline to change the direction of the alignment, a thrust force is created which must be restrained in order to prevent separation of the pipe joints.

Due to these factors, Mott MacDonald believes that the most feasible method of installing the new rising main in locations where trenchless installation is not required is with open cut construction. Open cut construction will allow for the PWSA to install the rising main at minimal depths and to maintain the location of the new rising main within public right-of-way.

At locations where open-cut installations are not practical or feasible, trenchless crossings will be required. The trenchless crossing locations are evaluated below in order to determine the most feasible methods of installation.

3.6 Trenchless crossings

Locations where trenchless construction methods will likely be required are shown on Figure 3. As shown, the alternative routes include three (3) crossings at PennDOT highways, railroad tracks, major surface roadways, and water bodies. An initial discussion with owner agencies for each location indicates that open cut construction across these locations will more than likely not be allowed.

3.6.1 Description

Trenchless Crossing 1 is located at Freeport Street near the Pittsburgh Drinking Water Plant. The crossing will extend along a straight alignment beneath Freeport Street and railroad tracks owned by the Norfolk Southern Railroad as well as beneath a 96-inch diameter filtered water pipe at the PWSA Drinking Water Plant, an ALCOSAN 24-inch diameter sewer along Freeport Street, and a 20-inch diameter gas main on Freeport Street. Trenchless Crossing 1 will extend approximately 180 feet from the Pittsburgh Drinking Water Plant to a parking lot across Freeport Street.

Trenchless Crossing 2 is located at the PennDOT Highland Park Bridge at the border of Aspinwall and Sharpsburg. There are no known buried utilities or surface utilities at this crossing. Trenchless Crossing 2 will extend approximately 200 feet from the Aspinwall Borough playground and baseball field in Aspinwall to an industrial park complex in Sharpsburg Borough. The crossing will run beneath the Pennsylvania State Highway 28 Exit 6 entry and exit ramps.

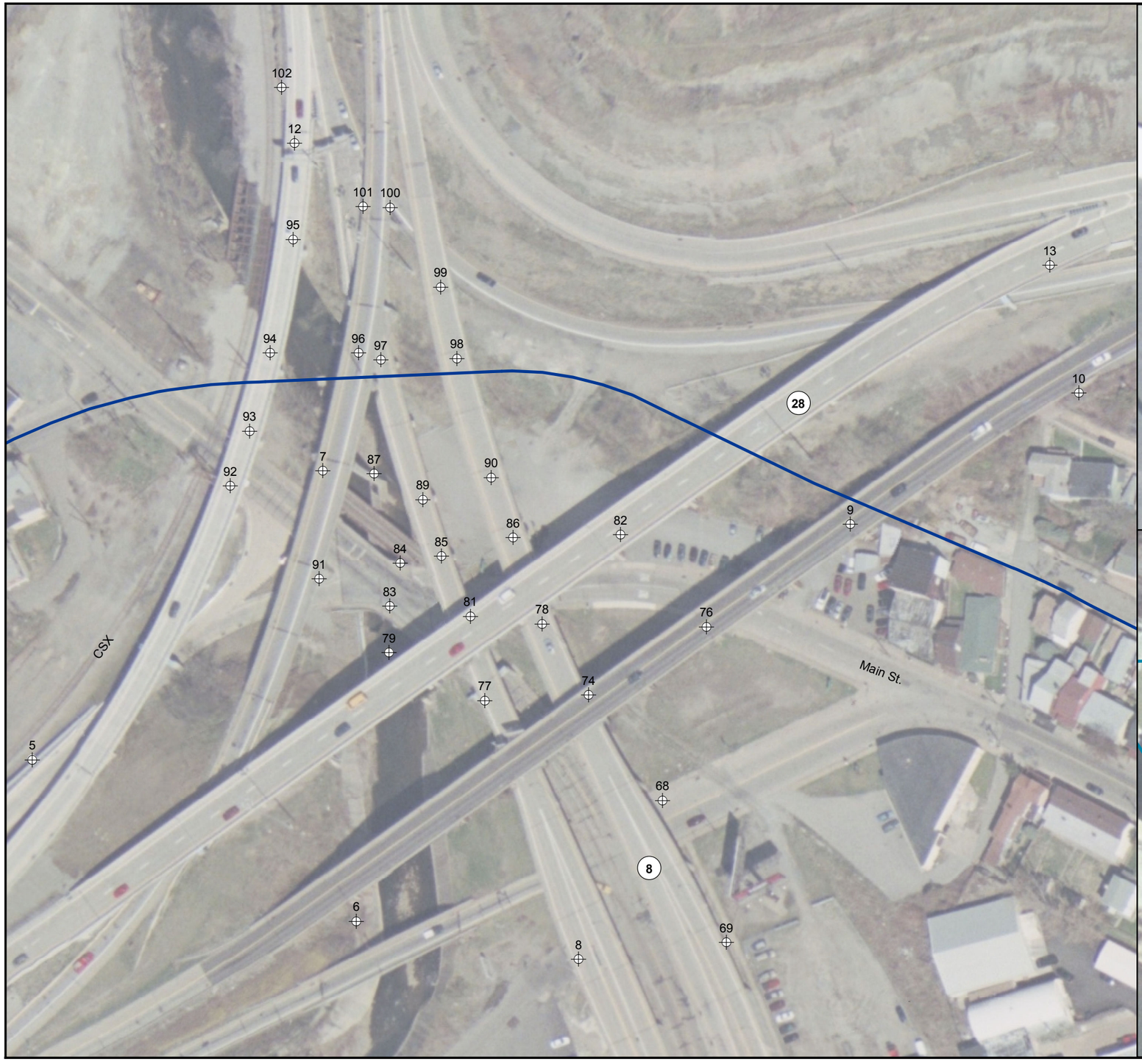
Trenchless Crossing 3 is required to cross the Pennsylvania State Highway 8 and Pennsylvania State Highway 28 interchange and Pine Creek. The proposed crossing will begin north of North Main Street at the intersection of Bridge Street and continue west under Pine Creek to a location north of Bridge Street. Buried utilities in the area include a 12-inch diameter water main, a high-pressure gas transmission main owned by People's Gas, and a 36-inch diameter sanitary sewer owned by Etna Borough. Surface utilities at this crossing include a CSX Rail Line and Pine Creek. Pine Creek runs north-south through the PennDOT interchange. The creek bed is about 20 feet below grade at this location. Trenchless Crossing 3 is proposed to extend a length of about 365 feet from a parking lot off of North Main Street to a parking lot off Bridge Street, adjacent to the rail line.

3.6.2 Geotechnical conditions

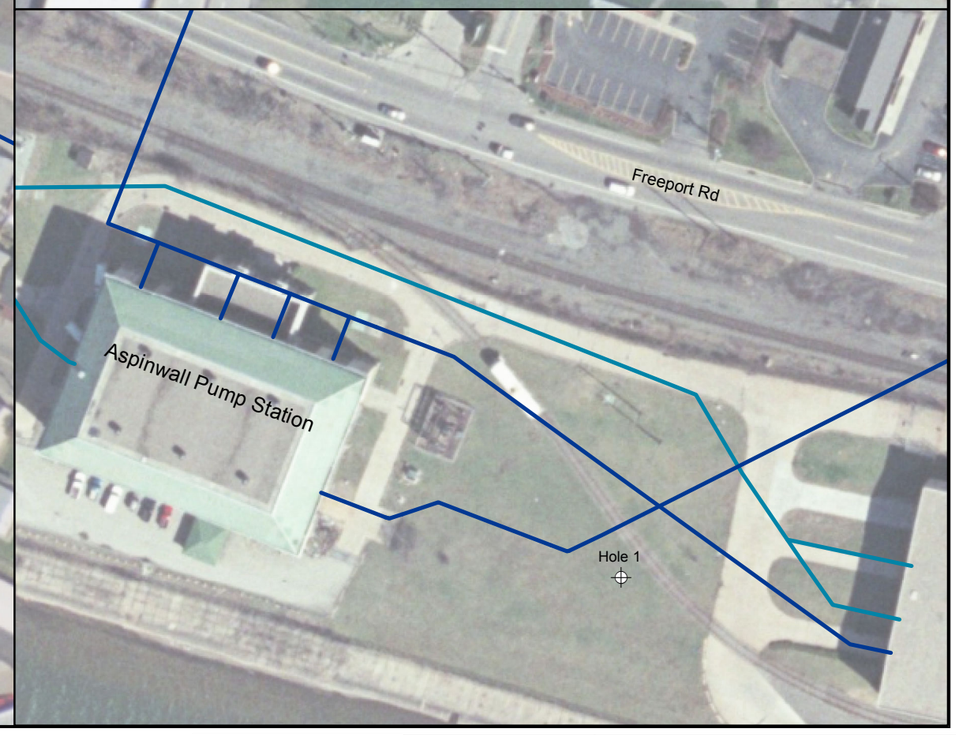
Mott MacDonald performed a desktop evaluation of existing geotechnical borings at the three (3) trenchless crossings as shown on Figure 5. In addition, one (1) subsurface geotechnical boring was performed at Trenchless Crossing 2. All of the geotechnical information that was obtained is located in Appendix C of this report.

Trenchless Crossing 1 is located about 400 feet north of the Allegheny River with a surface elevation of about 745 feet. The general soil conditions are expected to be 5 to 10 feet of the Urban Land soil composed of heterogeneous fill and by 50 feet of glacio-fluvial sediment. Directly underlying the fill is a stratum of saturated sand and silt with very low strength. The historical borings at the location of the Drinking Water Plant indicate 5 feet to 25 feet of fill underlain by about 10 feet of soft silt and sand followed by medium dense to dense sand and gravel. Bedrock consisting of shale was encountered at approximately Elevation 670. The bedrock is in the lower portion of the Glenshaw Formation of the Conemaugh Group of Pennsylvanian age. This portion of the stratigraphic section includes sandstone, siltstone, and shale with minor limestone and coal. Groundwater has been recorded from the historical borings between Elevation 735 feet and 725 feet and as low as Elevation 707 feet. No mining is reported in the vicinity.

Exhibit RAW/C-30







Legend

- Test Borings
- RisingMain

0 100 200 Feet

N W E S

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MOTT MACDONALD

1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY

PITTSBURGH, PA

LANPHER RISING MAIN

FIGURE 5 - GEOTECHNICAL INVESTIGATION (BORING LOCATIONS)

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		DWW			3/9/2016

Trenchless Crossing 2 is located near the north side of the Allegheny River valley at the Exit 6 ramps for State Road 28, at an elevation of about 770 feet. It is underlain by the Urban Land Rainsboro complex soil, which is composed mainly of heterogeneous fill and anticipated to be 5 to 15 feet thick. The fill is underlain by glacio-fluvial sediments, which are up to 50 feet thick in the central part of the Allegheny Valley. One (1) geotechnical boring was completed in the vicinity of the crossing. A 49-foot thick stratum of alluvial clay underlain by 29 feet of silt was encountered at the boring. Possible sandstone was encountered 49 feet below ground surface elevation at approximately Elevation 720 feet. This bedrock is in the middle of the Glenshaw Formation of the Conemaugh Group of Pennsylvanian age and is expected to consist of sandstone, siltstone, and shale with minor limestone and coal. No mining is reported in the vicinity.

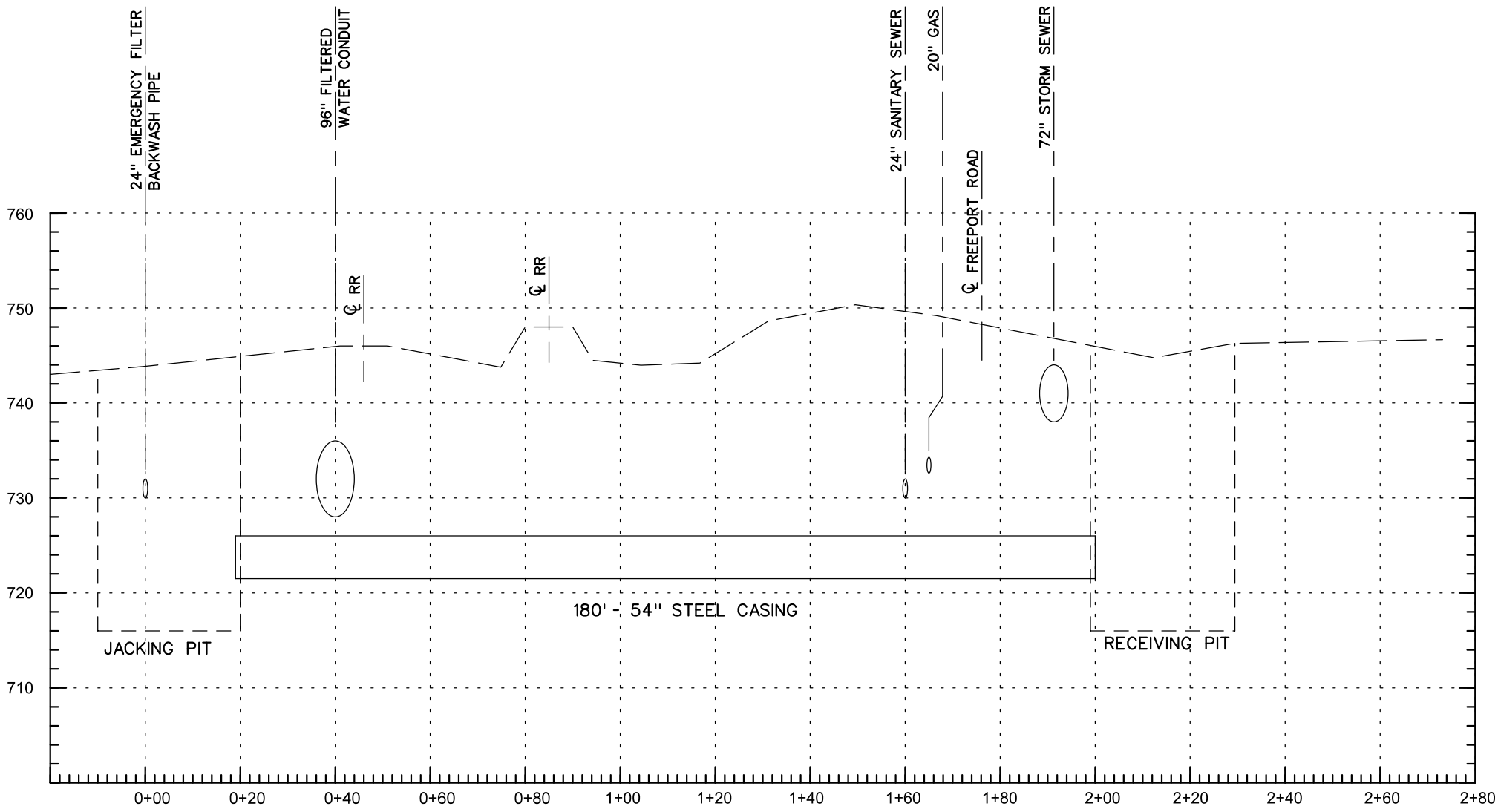
Trenchless Crossing 3 is located at the Pennsylvania State Road 28 and State Road 8 intersection in Etna. This area has a ground surface elevation of about 730 feet. Much of this area contains the Urban Land Rainsboro complex soil, which is composed mainly of heterogeneous fill. The fill is underlain by glacio-fluvial sediments, which are found to be up to 50 feet thick in the central part of the Allegheny Valley. The historical borings closest to this site indicate little fill underlain by glacio-fluvial sediments, typically consisting of clay to sandy clay. Bedrock was typically encountered 20 to 30 feet below existing ground surface and 5 to 8 feet below Pine Creek. The bedrock consists of sandstone overlain by fractured shale that seams out to the east. The elevation of competent bedrock was approximately Elevation 710 feet. This bedrock is in the lower portion of the Glenshaw Formation of the Conemaugh Group of Pennsylvanian age and is expected to consist of sandstone, siltstone, and shale with minor limestone and coal. No mining is reported in the vicinity.

3.6.3 Trenchless evaluation

Mott MacDonald evaluated each trenchless crossing by analyzing the potential design and construction risks for each alignment. Specifically, different types of tunneling methodologies were contrasted with project conditions and assessed for feasibility. These risks were contrasted against each other to identify the tunneling method that is perceived to have the least risk.

3.6.3.1 Trenchless Crossing 1

As described previously, there are several utilities located along the alignment of Crossing 1. The deepest of these is a 96-inch filtered water pipe with invert elevation at approximately 728 feet. Maintaining a minimum clearance equal to one diameter of the bore, the invert of the crossing will be at approximately Elevation 722 feet. A 54-inch casing pipe is proposed to accommodate a 36-inch product pipe. The trenchless crossing may encounter fill as well as silt and sand deposits. Obstructions included within the fill deposits may be within the tunnel alignment. The borings indicate that silt and sand layers are of low strength with N-values between 0 and 2. The tunnel alignment is also expected to be below the groundwater table.



Pittsburgh Water and Sewer Authority
Lanpher Rising Main
Figure 6
Trenchless Crossing No. 1

> Crossing method

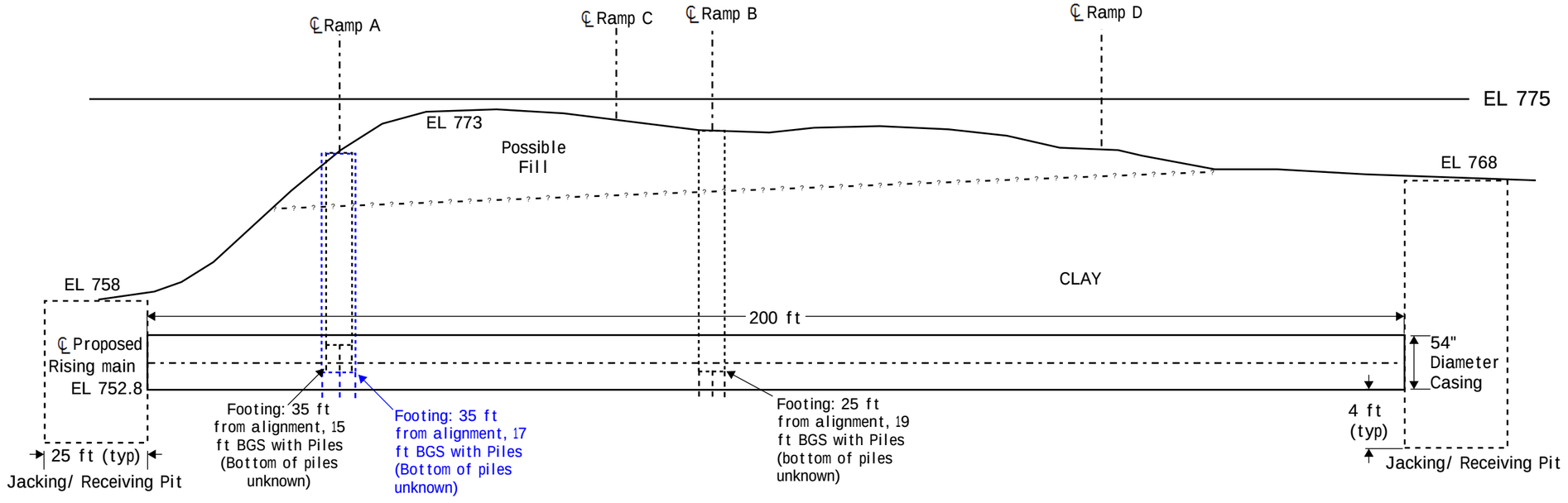
A profile of Trenchless Crossing No. 1 is shown in Figure 6. Potential trenchless construction methods were evaluated based on cost and construction risk. Auger boring in conjunction with pipe ramming is the method that appears to be the best value while also managing the potential construction risks. The crossing will be within soft ground and will be relatively short in length. Several risks exist that may require mitigation during design and construction. The site is likely to contain natural and manmade obstructions from fill operations, which can impede or halt the advance of a jacked pipe if located within the path of the casing pipe. Similarly, obstructions greater than a third of the diameter can be difficult to remove with the continuous augers used for excavation during pipe jacking, even if the obstructions are located within the center of the jacked pipe. Groundwater control can be difficult with an auger bore because no positive pressure is applied to the tunnel face. Dewatering may be able to be utilized to locally lower the groundwater table and create a more stable face condition. Alternatively, pipe ramming or pneumatically ramming the casing pipe into place can provide additional face stability and increase the ability to drive through obstructions. The space between the casing and the carrier pipe can be backfilled with grout or left open. The shafts can also be backfilled or built out with permanent liners.

3.6.3.2 Trenchless Crossing 2

Crossing 2 will extend under the SR 28 Exit 6 ramps connecting to Highland Park Bridge. The ramps are located on an embankment as well as elevated on overpasses supported by bridge piers. The bridge piers are typically constructed on pile caps supported by piles of unknown length. The crossing is proposed to be beneath the embankments and will traverse between two (2) bridge pier foundations supporting the SR 28 eastbound exit ramp. The pier to the north supports the single lane exit ramp while two (2) piers to the south support the pile cap under the two-lane merge between eastbound exit ramp and the westbound exit ramp. To the north of the merge on the westbound exit, the ramp is constructed on an embankment and supported by a shallow abutment. It is anticipated this option will require the pipe to be installed approximately 25 to 35 feet from the bridge piers to the north and south to reduce the risks of construction impacts on the ramps.

The industrial park complex in Sharpsburg Borough was likely constructed on a large cut area, resulting in a ground surface elevation 10 feet below the natural elevation of the baseball field on the west side of the SR 28 Exit 6 ramps. In order to provide adequate cover at this location, the centerline of the crossing will be installed at an approximate elevation of 752.8 feet, providing approximately 3 feet of cover between the ground surface of the parking lot and the top of the casing. A 54-inch diameter casing is proposed at this crossing to accommodate the 36-inch pipe. Based on the subsurface conditions encountered at the boring done in the baseball field, the crossing will likely be within stiff to hard clay.

Groundwater was encountered 45 feet below ground surface, at approximate Elevation 724 feet. As such, groundwater is not expected to be encountered during the construction of the crossing. The rising main will enter or exit through a vertical shaft in the baseball field which will require 90 degree bends. The pipe will cross the PennDOT right-of-way from the baseball field to the industrial park complex parking lot where a shallow pit will be required to retrieve or jack the pipe.



TRENCHLESS CROSSING 2
HORIZONTAL SCALE 1" = 20'
VERTICAL SCALE 1" = 10'
(Looking North)

MOTT MACDONALD

PGH2O

Pittsburgh Water and Sewer Authority
Lanpher Risign Main
Figure 7
Trenchless Crossign No. 2

> Crossing method

A profile of Trenchless Crossing No. 2 is shown in Figure 7. Potential trenchless construction methods were evaluated based on cost and construction risk. Auger boring is the method that appears to be the best value while also managing the potential construction risks. The crossing will be within stiff clay and will be a relatively short crossing. An auger can be used to advance the pipe casing, and the cuttings are transferred out by the blades of the continuous flight helical auger. There are several risks that may require mitigation during design and construction. The typical subsurface profile for the crossing was determined based on a single geotechnical boring and may not be representative of the entire crossing. The embankments for the highway ramps are likely large areas of fill which may extend into the area of the auger bore. Obstructions from fill operations can impede or halt the advance of a jacked pipe if located in the path of the casing and may be difficult to remove with the continuous augers used to excavation during pipe jacking. Groundwater is not expected to be encountered during construction, but localized dewatering in the jacking and receiving pits may be required to maintain a dry excavation. The space between the casing and the product pipe can be filled with grout or left open. The shafts can also be backfilled or built out with permanent liners.

3.6.3.3 Trenchless Crossing 3

The proposed location of Crossing 3 is near many existing highway overpasses. SR 8 is located on an elevated structure directly over the proposed alignment as is the entrance ramp from SR 28 eastbound and exit ramp to SR 28 westbound. These structures are supported on several bridge piers which are typically supported on shallow foundations. Bridge Street and North Main Street are located directly south of the proposed crossing, and the existing rising main is located to the north. An abandoned rail bridge parallels Bridge Street to the north over Pine Creek. Pine Creek is a channelized flow in this area approximately 16 feet below the average ground surface elevation. An active rail line parallels the exit ramp to SR 28 westbound. The distance between weathered bedrock and the channelized cut for Pine Creek appears to be between 5 and 8 feet. This will provide insufficient cover between the creek and the crown of a proposed crossing. Additionally, the walls to the channelized flow are embedded below the creek bottom. Most trenchless methods are ineffective or inefficient in highly fractured rock, which requires moving the crossing down into the competent bedrock. A minimum amount of cover from the top of rock would be required to allow the tunnel to be completely driven in competent rock. Additionally, tunneling in soft ground below or adjacent to the bridge piers should be avoided as construction could induce settlement on the existing bridges. Locating the crossing in rock will significantly lower the risk of settlement to adjacent structures. The shafts are proposed to be located approximately 365 feet apart to allow each shaft to be constructed without overhead clearance restrictions.

Groundwater is assumed to be at or slightly above the level of Pine Creek which is approximately 25 feet higher than the proposed tunnel invert. If the bedrock is massive with few fractures, the tunnel may not experience a significant amount of hydrostatic pressure. Both the launch and receiving pits will require watertight excavations or localized dewatering to maintain a dry excavation. The proposed rising main will enter and exit the crossing through vertical shafts which will require 90-degree bends.

> Crossing method

A profile of Trenchless Crossing No. 3 is shown in Figure 8. Potential trenchless construction methods were evaluated based on cost and construction risk. Closed-face micro-tunneling is the method that appears to be the best value while also managing the potential construction risks. Micro-tunneling can be utilized to bore through sandstone below the water table. The

cutter head can be equipped with tooling such as disk cutters and rippers that are able to bore through the bedrock and cuttings are piped out in a slurry suspension. The machine is advanced with a typical pipe jacking procedure, adding additional lengths of casing from the jacking pit. The jacking pipe is typically oversized, and the product pipe will be inserted into the bore at completion. A 54-inch casing is proposed at this crossing to accommodate the 36-inch pipe. The annulus around the product pipe can then be filled with grout or left open. The shafts can also be backfilled or built out with permanent liners.

3.7 Evaluation of pipe materials

The pipe materials included in this evaluation are ductile iron pipe (DIP), pre-stressed concrete cylinder pipe (PCCP), steel pipe, polyvinyl chloride pipe (PVC), high-density polyethylene pipe (HDPE), and fiberglass reinforced pipe (FRP).

Based on the probable profile of the new rising main and existing PWSA Aspinwall Pump Station pump data, it is anticipated that the normal working pressure of the new rising main at the lowest elevation will be approximately 110 PSI, and the test pressure will be 200 PSI.

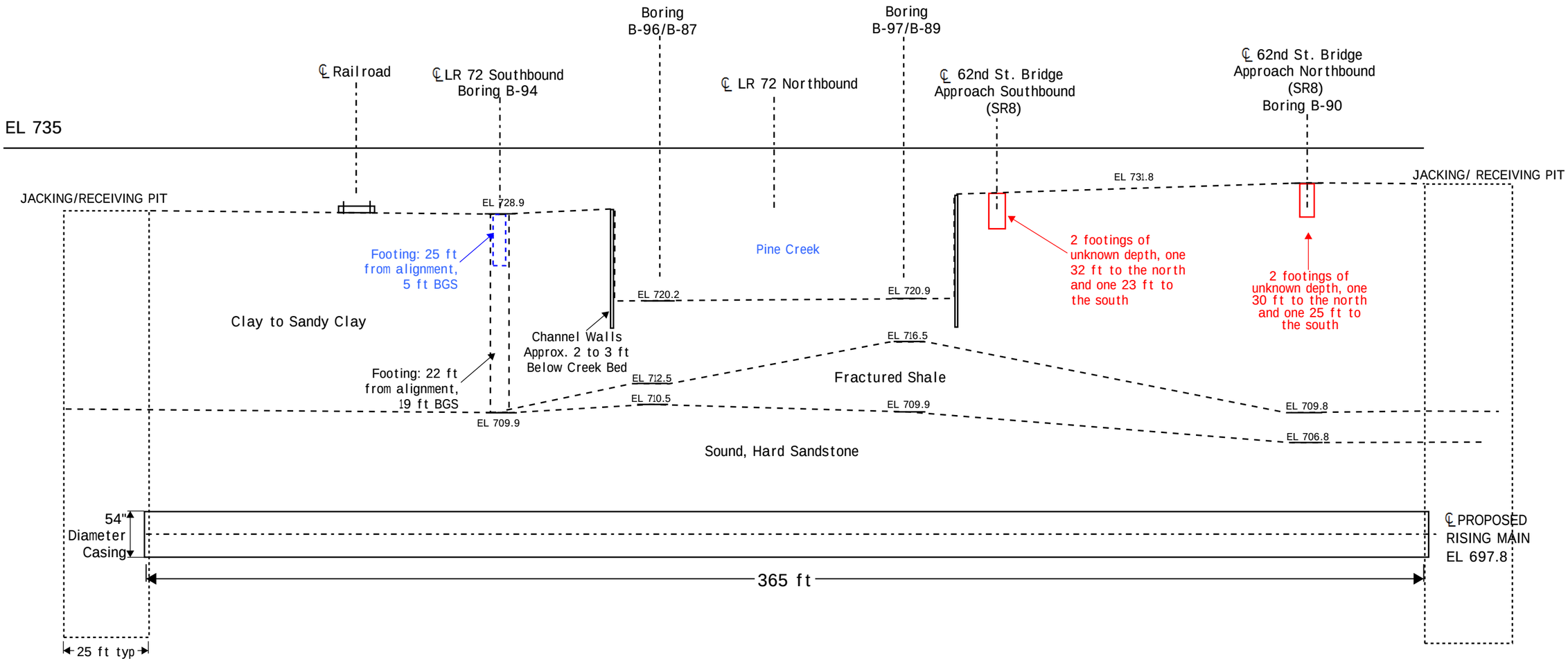
Pipe materials will be evaluated based upon their ability to meet the design pressure conditions, ease of installation, joint restraint types, bedding and backfill requirements, availability of fittings for field adjustment, relative corrosion resistance, tapping considerations, longevity, and cost.

3.7.1 Design loading conditions

The proposed rising main must be designed to meet internal loads (i.e. the water pressure) and external loads (the soils surrounding and above the pipe plus any dead or live loads on the ground surface above the pipe). Given the variations in the nature of the potential alternative pipe materials, a direct comparison of alternatives can be a challenge. A particular issue that can skew the comparison, especially with regard to cost, is the factors of safety that is either inherent in the applicable industry standards or written into the project specifications. Therefore, this analysis attempts to provide a fair comparison with comparable factors of safety in the design parameters for each alternative.

Several factors are relevant to the design pressure rating of a pipeline. Industry practice for accommodating the design pressure criteria may vary among alternate materials. Working pressure is the normal operating pressure. Field test pressure is the pressure applied to the completed pipeline, in the field, to test for leaks. Typically field test pressures are specified as 1.25 to 1.5 times the working pressure. The pipe material and the pipeline restraint systems must be selected and designed to accommodate the field test pressure. A surge pressure allowance is inherent in the design of certain pipe materials, whereas it must be specified in others. Ductile iron pipe has a 100 PSI surge allowance above and beyond the rated working pressure. However, if the pipeline restraint system is not designed for this additional pressure, then the ability of the pipeline to withstand surge pressures will be limited to the design field test pressure. Absent a surge analysis, it is usually assumed that a field test pressure of 1.5 times working pressure will provide sufficient capacity for the pipeline to withstand surges.

For purposes of this comparison, it is assumed that surge pressure will not exceed 200 PSI, and therefore, all alternative pipeline materials would need to be selected and designed for 200 PSI field test pressure.



EL 685

TRENCHLESS CROSSING 3

HORIZONTAL SCALE 1"=30'
VERTICAL SCALE 1"=10'
(Looking North)

MOTT MACDONALD

PGH2O

Pittsburgh Water and Sewer Authority
Lanpher Rising Main
Figure 8
Trenchless Crossign No. 3

3.7.2 Corrosivity

A site-specific corrosivity study required for this project has not been conducted at the time of this analysis. This study should be conducted during the design phase after the final pipeline alignment has been determined.

Preliminary indications are that at least some type of minimal corrosion protection will be required for the new rising main. However, a general discussion of typical corrosion protection measures for each alternative is provided.

Absent any unusually corrosive conditions, it is not expected that resistance to corrosion would be a deciding factor in selection of pipe material for this project. However, it is recommended that this matter be revisited through a corrosivity field investigation. An evaluation of the corrosion potential of soils along the final pipeline alignment will be made by examining soil chemistry parameters (resistivity, redox potential, pH, sulfides, and moisture) against the Ductile Iron Pipe Research Association's (DIPRA) guidelines. In general, soils along the route that are found to be corrosive to ductile iron pipe will also be corrosive to bare steel pipe. If steel pipe is determined to be an acceptable pipe material, it is anticipated that the pipe will be furnished with an exterior tape coating, bonded or welded joints, and test stations. The bonded joints and exterior tape coating will permit a cathodic protection system to be installed in the future if necessary. Pre-stressed concrete cylinder pipe is affected by three (3) soil chemistry parameters that are not typically measured for ductile iron pipe evaluations, namely total acidity, sulfates, and chlorides. If PCCP is determined to be an acceptable pipe material, these parameters should also be determined.

An evaluation for the potential for stray current corrosion from potential adjacent utilities (cathodically protected petroleum and gas pipelines) should also be considered during the corrosivity field investigation.

3.7.3 Rising main pipe materials

3.7.3.1 Ductile iron pipe

For 48-inch, diameter Pressure Class 200, ductile iron pipe has a wall thickness of 0.52 inches which would have a working pressure rating of at least 200 PSI.

Ductile iron pipe also has an inherent surge pressure allowance of 100 PSI above the rated maximum working pressure. The presumption of this analysis is that the pipeline restraint systems will be designed for 200 PSI field test pressure.

Regarding ease of installation, ductile iron pipe, depending upon thickness, may be considered a flexible or semi-rigid pipe, which means its resistance to external loads is partially dependent upon the soil envelope surrounding the pipe. Therefore, reasonable care must be taken to provide proper bedding and backfilling. Jointing is relatively simple, especially for non-restrained joints, and no special treatment of the external coating or internal lining is required after jointing.

Regarding longevity, ductile iron pipe, and its cast iron predecessor, has a long history of installations around the country that have been in service for many decades and in older cities for over 100 years.

3.7.3.2 Pre-stressed concrete cylinder pipe

Pre-stressed Concrete Cylinder Pipe (PCCP) is manufactured based upon the specified internal and external loading conditions in accordance with AWWA Standard C301. PCCP can be designed to handle the 200 PSI field test pressure. For purposes of cost comparisons to ductile iron pipe with a comparable factor of safety, material prices were requested from PCCP manufacturers with a 200 PSI maximum pressure rating.

PCCP is commonly used in large transmission mains of similar size and pressure requirements to this project. PCCP joints are typically of the bell and spigot type with rubber gasket. Exposed metal at the joints are protected by a plastic or cloth diaper filled with flowable grout. Fittings for PCCP are custom fabricated for the specific angle required. Therefore, there is little room for field adjustment of the alignment when PCCP is used. Typically, several small spare harnessed deflection joints can be provided on a construction site to make minor horizontal or vertical adjustments.

Regarding ease of installation, PCCP is considered to be a rigid pipe, and therefore, is less dependent upon the soil envelope for its strength and more forgiving to inadequate bedding or backfill. All field joints, whether restrained or not, require field mortaring, which adds to installation labor cost. A unique characteristic of PCCP is that the manufacturer will design several different pipe sections for the same project with variations in steel cylinder thickness, wire diameter, and wire spacing. The variations are generally driven by depth of bury and by longitudinal stress associated with thrust from changes in pipeline direction. Extra care must be taken during construction to ensure that the correct pieces of pipe are used as the installation progresses.

In terms of longevity, PCCP has a shorter history than ductile iron. However, there are many PCCP water transmission mains that have now been in service for 40 to 50 years without significant problems.

PCCP pipe is manufactured in standard 20-foot lengths. Special short lengths can be fabricated and are used to meet critical points such as valves, bends, or connections.

3.7.3.3 Steel pipe

Welded steel pipe is manufactured in accordance with AWWA C200. The welded steel pipe wall thickness is based upon the specified internal and external loading conditions. Based upon a 200 PSI field test pressure, and assuming Type 2 bedding and haunching, a Class 200 pipe is recommended.

Steel pipe joints can be either bell-and-spigot gasketed or continuous fillet welded lap joints. Restrained sections are normally constructed using field-welded lap joints. Steel fittings are fabricated from cut and mitered steel pipe and are custom fabricated to the angle required. The ability to cut and weld the steel pipe allows for some alignment adjustment in the field.

Regarding ease of installation, steel pipe, unless thicknesses are very conservative, is a flexible pipe, which means it's resistance to external loads is partially dependent upon the soil envelope surrounding the pipe. Therefore, reasonable care must be taken to provide proper bedding and backfilling. Jointing of non-restrained joints is straight-forward. Restrained joints require the additional labor of welding followed by field coating and lining of the joints. This can increase installation costs in pipelines with many fittings and restrained joints. Conversely, on pipelines with long straight runs in open areas, steel pipe could be furnished in lengths up to 40 or 50 feet, reducing the number of joints and reducing installation costs.

In terms of longevity, steel pipe for large diameter transmission mains was commonly used in the late 1800's and early 1900's in several East Coast urban areas, and many of those mains remain in service today.

3.7.3.4 PVC pipe

PVC pipe in 48-inch diameter is manufactured in accordance with AWWA C905. PVC pipe classes are defined by the dimension ratio (DR), which is the ratio of the outside diameter to the wall thickness of the pipe. The smaller the DR, the thicker the pipe. The smallest DR commonly specified for 48-inch diameter PVC is DR21 (maximum pressure rating of 200 PSI). The maximum pressure rating is the maximum pressure that can be applied assuming a surge pressure of zero. In order to provide the same pressure ratings and safety factor as the other types of pipe, the dimension ratio would have to be DR14.

PVC pipe must be protected from external damage during installation and backfilling. Backfill must be free of materials that may impose point loads on the pipe.

While there is a good history of the use of PVC for water distribution mains in certain areas of the country, the use of PVC for large diameter transmission mains in the pressure ranges anticipated for PWSA's rising main have not been proven and, therefore, longevity for this project is difficult to evaluate.

3.7.3.5 HDPE pipe

HDPE pipe that is 48 inches in diameter is manufactured in accordance with AWWA C906. HDPE pipe classes are also defined based upon their DR. Considering 48-inch DR 13.5 HDPE pipe, the wall thickness would be 3.763 inches (DIPS pipe size). Since HDPE pipe is typically extruded in standard ductile iron pipe size outside diameters, this would mean that the pipe would have an inside diameter that is smaller than the nominal inside diameter for ductile iron, steel, or PCCP. This pipe would also have a working pressure rating of 160 PSI, which is inadequate for this project. The allowable maximum surge pressure above the working pressure rating for DR13.5 pipe for occasional surge events is 160 PSI. As detailed in AWWA C906, occasional surge events are caused by emergency operations and usually the result of a fire flow or a malfunction, such as a power failure or system component failure, which includes a pump seize-up, valve stem failure and pressure relief valve failure.

HDPE pipe manufacturers have recently developed a new formula for HDPE pipe, which is known as PE 4710. This formula has a higher strength than the current AWWA PE 3408 approved pipe. PE 4710 pipe is not covered by an AWWA standard as of the date of this evaluation

HDPE pipe is more susceptible to external damage during installation than DIP, steel, or PCCP. Special precautions are necessary during backfill and installation in order not to gouge the pipe exterior.

3.7.3.6 Fiberglass reinforced pipe

Centrifugally cast, fiberglass reinforced, polymer mortar pipe (CCFRPM) is a fairly recent entry into the potable water transmission main market. The pipe is a composite that contains glass fibers reinforcing mortar. CCFRPM pipe is available in sizes from 1 through 156-inch diameter. The manufacturing process for fiberglass pipe is described in AWWA C950.

CCFRPM pipe is available in pressure classes up to 450 PSI. For pressure pipe installations, CCFRPM pipe is usually jointed with FW Coupling (FWC) joints. The FWC joint consists of a structural filament wound sleeve over-wrapped and mechanically locked to an internal gasket.

The seal includes both lip and compression elements to achieve a watertight seal for maximum sustained operating pressures up to 450 psi. Special molded fittings are available for CCFRPM pipe. The pipe can also be manufactured to be compatible with standard ductile iron fittings.

Thrust blocks are the most practical method of restraining fiberglass pipe. A tied restraint joint system utilizing either flanged joints or laminated joints that are fabricated in the field can also be used for thrust restraint. However, pipe manufacturers do not recommend flanged joints and laminated joints as they are time-consuming, expensive, and it is difficult to control the quality in the field. The order of preference for thrust restraint alternatives by the pipe manufacturers are thrust blocks, axial reinforced concrete encasement, piles in shear, flanged joints, and laminated (tied) joints. Due to the size of the pipe and the test pressure, the required concrete thrust blocks for a 48-inch diameter pipe at 200 psi test pressure would be large. Fittings may also require full encasement in reinforced concrete to prevent deformation.

The use of fiberglass pipe for water transmission mains is relatively uncommon and therefore, there is not a wealth of experience from which to judge longevity.

3.7.3.7 Acceptable Pipe Materials

DIP, PCCP, and steel pipe all have a proven history of successful installations for similar sized projects throughout the United States. These three (3) pipe materials have been in service for many decades providing potable water supply to customers, and each material can be engineered and manufactured to meet the project design requirements. DIP, PCCP, and steel pipe are considered to be acceptable pipe materials for use on this project.

However, on the basis of their inability to meet the pressure requirements of the project, the need to provide thrust restraint through the use of concrete blocking, and due to a lack of experience in large diameter water transmission mains, it is not recommended that PVC, HDPE, or FRP be considered for this project. For purposes of this evaluation, PVC, HDPE, and FRP will no longer be considered.

3.7.4 Thickness design

All pipe installed by open cut will be bedded on a minimum 6 inches of quarry-processed stone or 6 inches of compacted select excavated material. This design will provide for a Type IV trench. However, the thickness design will be based on the contractor achieving only a Type II trench. A Type II trench situates the pipe on a flat bottom trench with lightly consolidated backfill to the centerline of the pipe.

This design criteria lessens dependency on the contractor's ability to compact the bedding and backfill materials, accounts for unforeseen instances where adequate compaction cannot be achieved, and accounts for situations where poor foundation soils require the pipe to function as a beam. The contract drawings will require the pipeline to be installed with a minimum earth cover of 5 feet.

3.7.5 Thrust restraint

Whenever a fitting is placed on the pipeline to change the direction of the alignment, a thrust force is created which must be restrained in order to prevent separation of the pipe joints. The two (2) thrust restraint methods available are concrete thrust blocks and restrained joint pipe. Due to the size of the pipe and anticipated test pressure for this project, the required thrust blocks would be quite large and cost prohibitive. In addition, the bearing capacity of certain types of soil may be such that thrust blocks are not feasible, such as in swampy lands or soils with high moisture content. For this project, restrained joint pipe is the most practical thrust

restraint method. The required length of restrained joint pipe on each side of fittings will be calculated for each size and type of fitting based on the required test pressure during the design phase of the project.

3.7.5.1 Ductile iron pipe

Ductile iron pipe joints for underground installation are typically bell and spigot push-on joints with a rubber gasket. Where joint restraint is required, manufacturers typically provide a boltless restrained joint system that mechanically locks the pipe together. Each manufacturer has a particular type of restrained joint design. For small adjustments of alignment in the field, 48-inch ductile iron pipe joints can be deflected up to 5 degrees for push-on joint sections and up to 1.5 degrees for restrained joint sections. Restrained joint ductile iron fittings are manufactured in standard sizes of 11.25-, 22.5-, 45-, and 90-degree bends.

3.7.5.2 Pre-stressed concrete cylinder pipe

Harnessed joints, which mechanically tie the joints together, are typically provided by the manufacturers for restrained joint sections. The type of harnessed joint varies according to the individual manufacturer's design. Similar to the bell and spigot type joints, PCCP restrained joint sections require field mortaring at the exposed metal joints.

3.7.5.3 Steel pipe

Restrained sections are normally constructed using field-welded lap joints, which require the additional labor of welding followed by field coating and lining of the joints.

In most field-welded lap joint installations, the joint is assembled bell over spigot. Lap-welded joints are configured for the application of a single fillet weld either on the outside or inside of the pipe. It is suggested that a non-destructive test of the field welds be completed using magnetic particle testing procedures and acceptance criteria as set forth in ANSI/AWS D.1.1, Section 6.14.5 Table 6.1.

3.7.6 Tapping connections

A criteria utilized in the evaluation of the alternate routes is the degree to which an alignment provides an opportunity for connections for potential future customers. It is not recommended that tees for future use be installed on the proposed rising main since there is a chance that they will not be used. Rather, future connections should be made by wet tapping. As such, the ease of making taps on the potential pipe materials is reviewed below.

3.7.6.1 Ductile iron pipe

Taps for flanged outlets on ductile iron pipe are completed using a tapping sleeve to which a tapping gate valve is bolted. A tapping machine is used to cut a disc from the pipe wall of the pipe while under pressure. The tapping saddle is installed on the ductile iron pipe utilizing mechanical joints.

Tapping ductile iron pipe can be completed by PWSA personnel depending on experience. Tapping machines may be purchased or rented with or without an operator.

3.7.6.2 Pre-stressed concrete cylinder pipe

Pressure taps for flanged outlets 3 inches and larger for PCCP are detailed in AWWA Manual M9. Flanged pressure taps are limited to the next smaller pipe diameter that is being tapped. A 48-inch diameter PCCP, the largest flanged pressure tap that can be installed would therefore be 30-inch diameter.

The general procedure used to install pressure taps for flanged outlets on PCCP is to first chip away the mortar coating where the tap is to be installed. A saddle is then positioned at the location of the chipped mortar coating and straps tightened around the pipe. The PCCP reinforcing wires are cut to provide clearance for the gland to seal against the steel pipe cylinder. A tapping valve or gate valve is attached to the gland flange and pressure-tested to confirm a watertight flange seal. A tapping machine is used to cut the steel cylinder of the pipe. The space between the saddle and gland is filled with grout, and a protective coating of cement-mortar is applied over the entire tapping assembly.

Tapping PCCP is a relatively routine procedure; however, a contractor specializing in PCCP tapping services is recommended for the diameter of the new rising main that is proposed.

3.7.6.3 Steel pipe

Taps for flanged outlets on steel pipe consist of installing a welded-on flanged outlet or a welded-on sleeve with flanged outlet. Upon installing the flanged outlet, a tapping valve or gate valve is installed and a tapping machine attached to drill the hole into the steel water main.

Similar to PCCP, tapping steel pipe is a relatively routine procedure; however, a contractor specializing in steel tapping services is recommended for the diameter of the rising main that is proposed. In addition, all welding should be done by qualified welders as required by AWWA C-200.

3.7.7 Appurtenances

3.7.7.1 Isolation valves

Isolating butterfly valves could be provided at key locations along the rising main to permit relatively small sections to be isolated and drained if necessary for repairs. The location and spacing of isolation valves should be considered during the design phase of the rising main. Two-inch corporations will be installed on both sides of the main line valves to permit chlorine to be added to the rising main and air to be expelled from the main during pressure testing. These corporations will be closed upon the completion of bacteriological testing.

3.7.7.2 Air release

Automatic air release, vacuum valve, and piping will be installed at high points along the rising main. A transient analysis of the pumps and rising main is recommended in sizing and locating combination air vacuum valves at strategic points along the alignment to protect the water rising main from vacuum conditions and cavitation.

3.7.7.3 Blow-offs

Manual blow-off lines will be provided at low points along the rising main. No fire hydrants will be connected to the rising main.

3.7.7.4 Access manways

Access manways will be provided along the rising main so as to provide for future access to the interior of the pipeline.

3.7.7.5 Leak detection devices

For sections of the rising main alignment where it will be difficult to determine if there is an active leak (i.e. water crossing), there is leak detection equipment available that may be considered for this project. Multi-channel data loggers can be utilized to record and communicate variables such as flow, leakage assessment, pressure, and pressure surges. A telemetry link can be provided either by landline telephone using an internal modem or by using cellular communications. Communication options also include direct cable to PDAs and laptop computers. The potential use of leak detection devices will be conducted during the design phase after the final pipeline alignment has been determined.

3.7.8 Corrosion control

A site-specific corrosivity study should be conducted when the final pipeline alignment is determined. However, preliminary indications are that at least some type of corrosion protection will be required for the rising main at certain locations.

3.7.8.1 Ductile iron pipe

Ductile iron pipe is subject to external corrosion. In the past, ductile iron pipe could be obtained with an external epoxy coating to protect the pipe from contact with corrosive soils. However, it is currently the practice of the ductile iron pipe manufacturers not to provide this coating. The corrosion protection recommended by the Ductile Iron Pipe Research Association (DIPRA) is encasement in polyethylene wrapping. As with most external coatings, this wrap is subject to damage during installation, which can be readily repaired. The application of field-installed wrap is more likely to suffer from quality control problems than coatings applied under controlled factory conditions. In unusually corrosive conditions, passive or active cathodic protection can be used on ductile iron pipelines. Bonding of the pipe joints to create a continuous path for current is also used as a corrosion protection measure.

3.7.8.2 Pre-stressed concrete cylinder pipe

In normal soil conditions, PCCP is protected from aggressive soils by the mortar coating that surrounds the pre-stressing wires and steel cylinder of the pipe. In special conditions where corrosion potential is great, PCCP can be provided with a factory-applied coal tar epoxy exterior coating or a cathodic protection system. A polyethylene wrap similar to ductile iron pipe can also be used and PCCP joints can also be bonded. There are also passive monitoring systems available for the use with PCCP, which “listen” for a snapped pre-stressed wire. The intent of these systems is to identify the location of a potential failure and allow the owner to make a repair to the pipe before a leak occurs.

3.7.8.3 Steel pipe

Corrosion protection for large steel mains is usually achieved through a factory-applied polyethylene tape coating or a factory-applied polyurethane external coating system. Tape coating systems are applied in accordance with AWWA C214. Polyurethane exterior coating systems are applied in accordance with AWWA C222. There is the potential for damaging either system during handling and installation, but damaged tape and coatings can be repaired in the field. Tape coatings are generally easier to detect damage and repair in the field than the

polyurethane coatings. Additional protection can be provided by buried sacrificial anodes or active current cathodic protection systems.

3.7.9 Trench restoration

After the rising main has been installed in the trench, the excavation must be backfilled with approved material. Proper bedding and backfilling is critical to distribute surface loads above the rising main. In addition, proper bedding and backfilling provides lateral support for the rising main to limit its movement due to thrust forces and surges (water hammer).

Depending on the soil conditions, the rising main will be bedded on either compacted select excavated material or quarry process stone. Trench backfill will be select excavated material, bank run sand and gravel or quarry process stone, depending on the applicable governing body requirements.

Where groundwater is encountered, clay stops will be constructed in the pipe trench at a spacing of 500 feet.

3.7.9.1 Ductile iron pipe

Laying conditions for ductile iron pipe must comply with ANSI/AWWA C150/A21.50. Five (5) standard laying conditions for ductile iron pipe (Type 1 through 5) provide flexibility for selecting the most appropriate pipe wall thickness.

A Type 1 trench, which consists of a flat bottom trench (undisturbed earth) with loose backfill, is not recommended for 36-inch through 48-inch pipe.

It is anticipated that if ductile iron pipe is used for this project, a detail specifying a Type 4 trench will be used. A Type 4 trench situates the pipe bedded in a 4-inch minimum layer of quarry-processed stone, with backfill compacted 80 percent to the top of pipe.

However, the thickness design will be based on the contractor achieving only a Type 2 trench. A Type 2 trench situates the pipe on a flat bottom trench with lightly consolidated backfill to the centerline of the pipe. This design criteria lessens dependency on the contractor's ability to compact the bedding and backfill materials, accounts for unforeseen instances where adequate compaction cannot be achieved, and accounts for situations where poor foundation soils require the pipe to function as a beam.

3.7.9.2 Pre-stressed concrete cylinder pipe

PCCP is considered to be a rigid pipe, and therefore, is less dependent upon the soil envelope for its strength and more forgiving to inadequate bedding or backfill. Pipe bedding and backfill for PCCP is detailed in ANSI/AWWA C304 and AWWA Manual M9. For PCCP diameters less than 72 inches, a Type R1 or R2 bedding condition is commonly used. Type R1 and R2 bedding conditions use a 30-dgree bedding angle and 45-degree bedding angle, respectively.

For Type R1 and R2 bedding conditions, the trench bottom should be over-excavated and bedding material extended to a depth of 4 inches below the bottom of the pipe if the trench bottom is rock or other unyielding material.

3.7.9.3 Steel pipe

AWWA Manual M11 states that the trench bottom should be excavated to a depth of a minimum of 2 inches below the grade line of the outside bottom of the pipe. The excess excavation should be filled with loose bedding material. The loose bedding material should be graded uniformly to the established grade line of the pipe.

Where the trench bottom includes solid or hard objects that can potentially penetrate or gouge the protective coating of the pipe, a bedding of crushed rock or sand 3 to 6-inches thick should be placed under the barrel of the pipe.

Pipe zone backfill height over the top of the pipe should be a minimum of 12 inches for diameters larger than 24 inches.

3.8 Comparison of alternative routes

The evaluation of Alternative Routes 1, 2, and 3 has been made based on the evaluation criteria and factors of importance described in Section 3.0 and with the design determinations made in Sections 3.3 through 3.7.

The primary factors for comparing alternatives are as follows:

- Constructability
- Redundancy and hydraulics
- Construction cost
- Complexity and risk of trenchless crossings
- Impacts to residents and business

As determined in the preceding sections of this report, the comparison of routes will be based on the following aspects of design:

- Construction Method: Open cut construction except at trenchless crossings.
- Trenchless Crossings:
  - Auger Boring at Trenchless Crossing No. 1
  - Auger Boring at Trenchless Crossing No. 2
  - Closed Faced Micro-Tunneling at Trenchless Crossings No. 3
- Depth of Pipe: 5-foot cover.
- Pipe Material: CL52 ductile iron pipe/welded steel pipe/pre-stressed concrete cylinder pipe
- Pipe Diameter: 48-inch diameter (open cut), 36-inch diameter (trenchless crossings), and 12-inch diameter connections to existing service connections (open cut).

3.8.1 Constructability of open cut segments

3.8.1.1 Alternative Route No. 1

Constructing Alternative Route No. 1 along the same alignment as the existing rising main will present many challenges. It is imperative that the existing rising main remain in service throughout the duration of construction. The primary constructability challenge related to Alternative Route No. 1 is the lack of available space adjacent to the existing rising main which would be required to install the new rising main. A secondary but related challenge is the inherent risk in excavating a new trench in close proximity to the existing main. It is the opinion of Mott MacDonald that Alternative Route No. 1 should be eliminated from consideration due to the limited available space needed for construction and the inherent risk of construction excavation adjacent to the existing rising main.

It is recommended that PWSA avoid having the proposed rising main installed within the same roads since having multiple mains in one road will not add a significant degree of reliability and redundancy.

3.8.1.2 Alternative Route No. 2

Constructing Alterative Route No. 2 along Freeport Road and Main Street will present many challenges related to traffic control, utility conflicts, ownership, and restoration. Freeport Road and Main Street are major thoroughfares in Aspinwall and Sharpsburg Boroughs. Open cut excavation in the right-of-ways is possible but would potentially require the closure of two (2) lanes of traffic and could necessitate major traffic control plans. In addition, Freeport Road is a PennDOT-owned roadway which could restrict PWSA's ownership and access for maintenance and could put PWSA at risk of having to relocate the water main in the future.

In consideration of these aspects of construction, Mott MacDonald considers Alternative Route No. 2 to be a constructible route and should remain in consideration as a viable new rising main alignment.

3.8.1.3 Alternative Route No. 3

Constructing Alterative Route No. 3 along local roadways within the boroughs will present many challenges related to construction access, utility conflicts, ownership, restoration, and impacts to residents. The primary challenge will be the impact that construction will have on homeowners and small businesses along the route coupled with the limited construction area within the right-of-ways. The roadways along Alternative Route No. 3 are narrow and are not in a grid pattern within Sharpsburg and Etna Boroughs. This will necessitate the use of shorter lengths of pipe with frequent changes in direction.

Moderate traffic control and construction notifications would be required along the local roadways. A moderate number of utility conflicts exist along Alternative Route No. 3.

In consideration of these aspects of construction, Mott MacDonald considers Alternative Route No. 3 to be a constructible route and should remain in consideration as a viable new rising main alignment.

3.8.2 Redundancy

Alternative Routes 2 and 3 both meet the primary objective in providing redundancy to the existing rising main system. Alternative Route 3 is situated further from the existing rising main system which will require additional piping in order to tie the new rising main into the existing system at the existing service connections. Alternative Route No. 2 is closer to the existing service connections which will require less piping to make connections.

3.8.3 Complexity and cost of trenchless crossings

As discussed in Section 3.5, both Alternative Route No. 2 and Alternative Route No. 3 include complex trenchless crossings at Trenchless Crossing No. 3 and, to a lesser extent, at Trenchless Crossing No. 2. Trenchless Crossing No. 1 is identical for Alternative Routes 2 and 3.

3.8.3.1 Alternative Route No. 2

Trenchless Crossing No. 2 – Alternative Route No. 2 would cross Trenchless Crossing No. 2 near the intersection of Freeport Road and the on/off ramps to the Highland Park Bridge in Aspinwall, with a total crossing length of approximately 500 feet. The total crossing may require two (2) separate trenchless installations to cross the entire width of PennDOT property and into Etna Borough. The Alternative 2 crossing of Trenchless Crossing No. 2 would require significant traffic routing and road closures possibly effecting the on and off ramps from Freeport Road to the bridge.

Trenchless Crossing No. 3 – Alternative Route No. 2 will require a minimum of two (2) and possibly three (3) trenchless crossing installations to cross Trenchless Crossing No. 3, with a total crossing length of approximately 815 feet. The first crossing would extend across PennDOT Highway 8. The second crossing would extend across Pine Creek, a CSX Rail line and PennDOT Highway 28. The second crossing may require two (2) separate crossing installations. Each of the trenchless crossings would require complex design evaluations due to the existence of shallow bedrock, soft soils, Pine Creek, and the highway piers.

3.8.3.2 Alternative Route No. 3

Trenchless Crossing No. 2 – Alternative Route No. 3 would cross Trenchless Crossing No. 2 near PennDOT 28 Exit 6 on ramp to the Highland Park Bridge, with a total crossing length of approximately 200 feet. The crossing will extend from the Aspinwall Community Park to an industrial park located on the western side of the Highland Park Bridge approach. Coordination with the borough would be required due to the need for construction activities in the park. An easement through the industrial park complex would be required.

Trenchless Crossing No. 3 – Alternative Route No. 3 can be accomplished with one (1) trenchless crossing extending across Trenchless Crossing No. 3, with a total crossing length of approximately 365 feet. The single crossing will extend across the Highway 8 and 28 interchange, Pine Creek, and a CSX Rail Line. The single crossing will require complex design evaluations due to the existence of shallow bedrock, soft soils, Pine Creek, and the highway piers.

Mott MacDonald believes the Alternative Route No. 3 trenchless crossings to be the most feasible options to cross property where open cut construction will not be permitted. The Alternative Route No. 3 trenchless crossings are less complex, would have less of a negative impact to the area, and are shorter in length in comparison to the Alternative Route No. 2 crossings.

3.8.4 Impacts during construction

The impacts to the residents and businesses in Aspinwall, Sharpsburg, Etna Boroughs, Shaler Township, as well as the surrounding communities, must be carefully weighed as this matter is an important aspect of the construction project. Design considerations including traffic control, construction notification, noise abatement, dust control, parking, and access to businesses and institutions will each need careful consideration.

Alternative Route No. 2 – The main impacts that would result from the construction of Alternative Route No. 2 is the control of traffic and the impacts to businesses along the route. Construction within the right-of-ways along Freeport Road and Main Street will have a major impact on traffic throughout the area and would require the use of alternative traffic routes along the local roads. Access to businesses, particularly in Sharpsburg and Etna Boroughs, would be considerably impacted.

Alternative Route No. 3 – The main impacts that would result from the construction of Alternative Route No. 3 is parking and access to local streets and homes along the route. Construction within borough right-of-ways will have local impacts requiring a greater amount of communication with residents, restricted working hours in residential areas, traffic and parking plans, and small borough-owned utility conflicts.

Alternative Route No. 2 will likely have a larger impact to the communities when compared to Alternative No. 3.

3.8.5 Cost estimates

Cost estimates have been prepared for the proposed rising main alignments in order to provide a quantitative analysis of the alternate routes. Detailed cost estimates are provided in Appendix E. The proposed rising main costs were calculated based on unit prices for material as quoted by pipe manufacturers within the last 60 days and from estimated labor costs for pipeline construction.

In order to perform a comparable evaluation of the cost of Alternative Routes 2 and 3 Mott MacDonald will utilize the per foot cost of ductile iron pipe in the costing estimate comparison. As previously stated Mott MacDonald recommends that the new rising main design considers the use of welded steel and pre-stressed concrete cylinder pipe, as well as ductile iron pipe, as appropriate pipe materials for the new rising main. As part of this report, unit price quotations were secured from local pipe representatives for ductile iron, steel, and PCCP pipe, as follows:

- Ductile iron pipe was quoted at $272/foot for 20-foot section of 48-inch, CL52, cement-lined, asphalt coated, non-restrained joint pipe and $370/foot for restrained joint pipe (including fittings and occasional blocking).
- Pre-stressed concrete cylinder pipe (PCCP) was quoted at $241 per linear foot for 48-inch diameter lined cylinder pipe with a 16-mil exterior coal tar epoxy. The unit price would need to be adjusted in consideration of restrained joined pipe, which would require harness clamp or snap-ring joints, which cost an average of $400 per joint or approximately $20 per foot of pipe.
- Welded steel pipe was quoted at $235 per linear foot for 20-foot sections of 48-inch diameter, class 200, cement lined, epoxy coated, welded steel pipe. While steel may have the lowest material cost, Mott MacDonald's experience in Western Pennsylvania has been that installation costs for steel pipe are less predictable than ductile iron or PCCP due to the added expense of welding for restrained joints and a smaller pool of contractors with familiarity in steel pipe installations.

In preparing estimates for pipeline installation, the following assumptions were made:

- Costs for the proposed rising main alignments were developed using ductile iron pipe as the pipe material. It has been assumed that 20 percent of the route would require restrained joint pipe.
- Pipe installation rates have been assumed to vary between 100 feet per day in more congested or difficult areas and 200 feet per day in less difficult areas. An average installation rate of 125 feet per day was utilized in the cost estimates.
- Backfill and bedding estimates assume 5 feet of cover throughout and to a depth of 0.5 feet below the invert of the new water main. This results in an excavation depth of approximately 10 feet.
- The proposed rising main would be provided with isolation valves, air valves, and blow-off assemblies at 2,500-foot spacing.
- Pipe installation within local roadways would require trench restoration with stabilized base followed by edge-to-edge paving.
- The unit costs utilized for the three (3) trenchless crossings were calculated from historical bid prices for various sized mains, discussions with pipeline contractors, and coordination with Mott MacDonald's pipelines group.
- All estimates for pipe installation include a 10 percent mark-up for contractor overhead, a 10 percent mark-up for profit, and a 30 percent mark-up for contingencies.

A total project estimate has been developed for each alternate route by adding assumed costs for permitting, easement acquisition, engineering, and other miscellaneous costs to the construction estimates. Permitting fees will need to be further refined during design stages. Proposed easements have been assumed to be a uniform 20 feet wide along any alternate alignment and were estimated at $5 per square foot. Easement costs will need to be further developed based on actual land value and preliminary negotiations with property owners. Engineering and other miscellaneous costs have been assumed at 10 percent of the estimated construction cost.

A summary of estimated costs for each alternate alignment is Appendix E. Alternative Route 3 represents the least costly alternative at $26.7 million while Alternative Route 2 is the more expensive alignment at $ 31.1 million.

4 Recommended route and summary

4.1 Recommended rising main route

Alternative Routes No. 2 and No. 3 are potentially feasible from a construction standpoint, and each alternate route appears to be permittable from a regulatory standpoint with no special requirements that would prevent or prohibit the selection. Section 3.0 of this report evaluates the potential alternate routes in terms of qualitative issues that were identified by Mott MacDonald and PWSA as being the primary factors for comparing the alternate alignments.

The estimated construction cost of Alternative Routes 2 and 3 are provided below.

- Alternate Route 2: $31,050,000
- Alternate Route 3: $26,662,000

Based on the factors evaluated in previous sections, MacDonald recommends that the new rising main follow the Alternative Route No. 3 alignment. The recommended route is shown in Figure 9. A majority of the route will be constructed utilizing open cut installation methods. Mott MacDonald believes that much of the route can be installed at a minimum depth with 5-foot of cover above the pipe crown. The three (3) trenchless crossings will be constructed using the following methods of trenchless technology:

- Auger Boring at Trenchless Crossing No. 1
- Auger Boring at Trenchless Crossing No. 2
- Closed Faced Micro-Tunneling at Trenchless Crossings No. 3

The final design of the new main will further evaluate the three (3) pipe materials; ductile iron, welded steel, and pre-stressed concrete cylinder pipe (PCCP), to determine which should be included in the final design package. It is recommended that at least two (2) pipe materials be included in the final design.

Based on the hydraulic analysis, the final alignment will be constructed using 48-inch diameter pipe on the open cut segments and 36-inch diameter pipe (installed with a 54-inch diameter steel casing) at the three (3) trenchless crossings.

A majority of Alternative Route No. 3 will be constructed within existing right-of-way in Aspinwall, Sharpsburg, and Etna Boroughs and Shaler Township. As part of the project's design phase, discussions and workshops with the governing bodies of each borough and township will be necessary to coordinate the construction effort and to further understand their needs.

Each trenchless crossing will require geotechnical investigations, as further described in Section 4.1.2 to further define below grade soil characteristics, depth to bedrock, and water table elevations.

It is recommended that the connection at the Aspinwall Pump Station be made off the eastern edge of the main discharge manifold as shown in Figure 10. As shown, the installation will require replacement of an isolation valve and temporary interruption of the emergency filter backwash pipe that extends to the WTP Filter Building. Trenchless Crossing No. 1 would commence at this location, requiring a jacking pit to be installed adjacent to the isolation valve.

Exhibit RAW/C-30

Crossing 36" Sewer, 20" Gas
Pine Creek, and CSX RR

72" Sewer on Parker St

Trenchless Crossing 3

Trenchless Crossing 2

Crossing 24" Sewer

Crossing 48" Brick Sewer

Crossing Abandoned
96" Filtered Water Conduit

Crossing 72" Sewer, 24" Sewer,
20" Gas, and 30" Water

Trenchless Crossing 1

Crossing 96" Filtered
Water Conduit and NS RR

Legend

- Service Connections
- Alignment 2 (Proposed Rising Main)
- Alignment 2 Crossover Connection
- Alignment 1 (Existing Rising Main)

0 500 1,000 Feet

N W E S

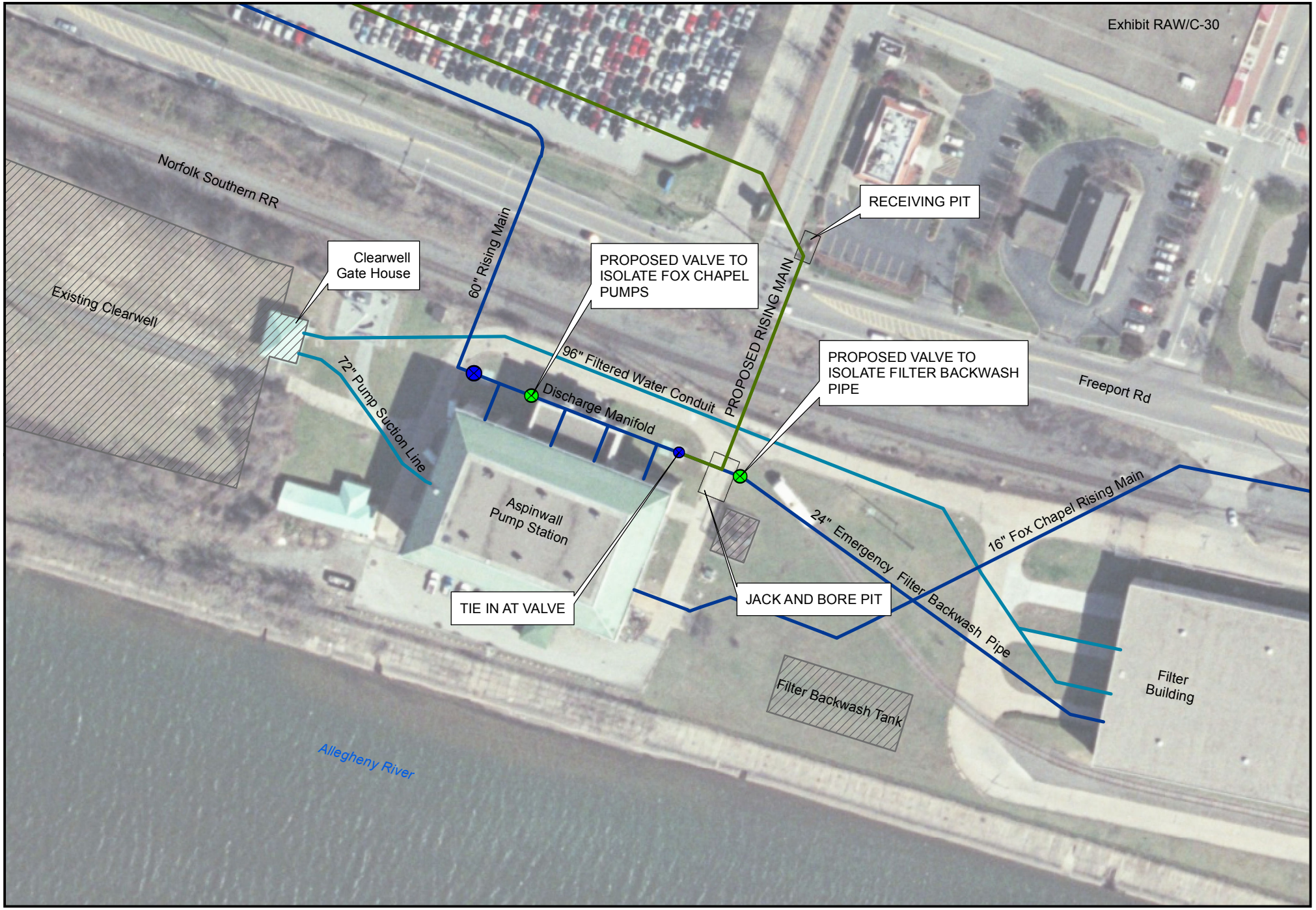
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MOTT MACDONALD
1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
LANPHER RISING MAIN
FIGURE 9 - RECOMMENDED RISING MAIN SYSTEM

	Designed	Drawn	Checked	Approved	Date
		DWW			10/12/2016



Legend

Mainline Valves

- Closed
- Open
- Proposed Valves (closed)

0 100 200 Feet

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N W E S

PGH2O

MOTT MACDONALD
1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
LANPHER RISING MAIN
FIGURE 9 - CONNECTION AT ASPINWALL PS

	Designed	Drawn	Checked	Approved	Date
		DWW			3/9/2016

It is recommended that the connection to the Lanpher Reservoir be made in the parking lot adjacent to the Lanpher Reservoir inlet house. As shown in Figure 11, the installation would require the operation of several isolation valves that exist on the existing rising main. If the new rising main will be utilized as part of the clear well construction as described in the secondary objective of this report, the isolation valves can be configured to allow rerouting of potable water back through the existing rising main to serve the existing service connections.

4.1.1 Inventory of required licenses, permits, approvals, and easements

Required licenses, permits, and approvals Alternate Route No. 3 are provided below:

Table 6: Licenses, permits, and approvals

Allegheny County	Erosion and Sediment Control Permit
CSX Rail	Occupancy
Local Jurisdiction	Road Opening Permit
Norfolk Southern Rail	Occupancy
PennDOT	Highway Occupancy Permit (M-945)
Pennsylvania DEP	GP5 Utility Line Stream Crossing
Pennsylvania DEP	Public Water Supply Permit
State of Pennsylvania	NPDES
US Army Corps of Engineers	Crossing of Pine Creek

4.1.2 Geotechnical program

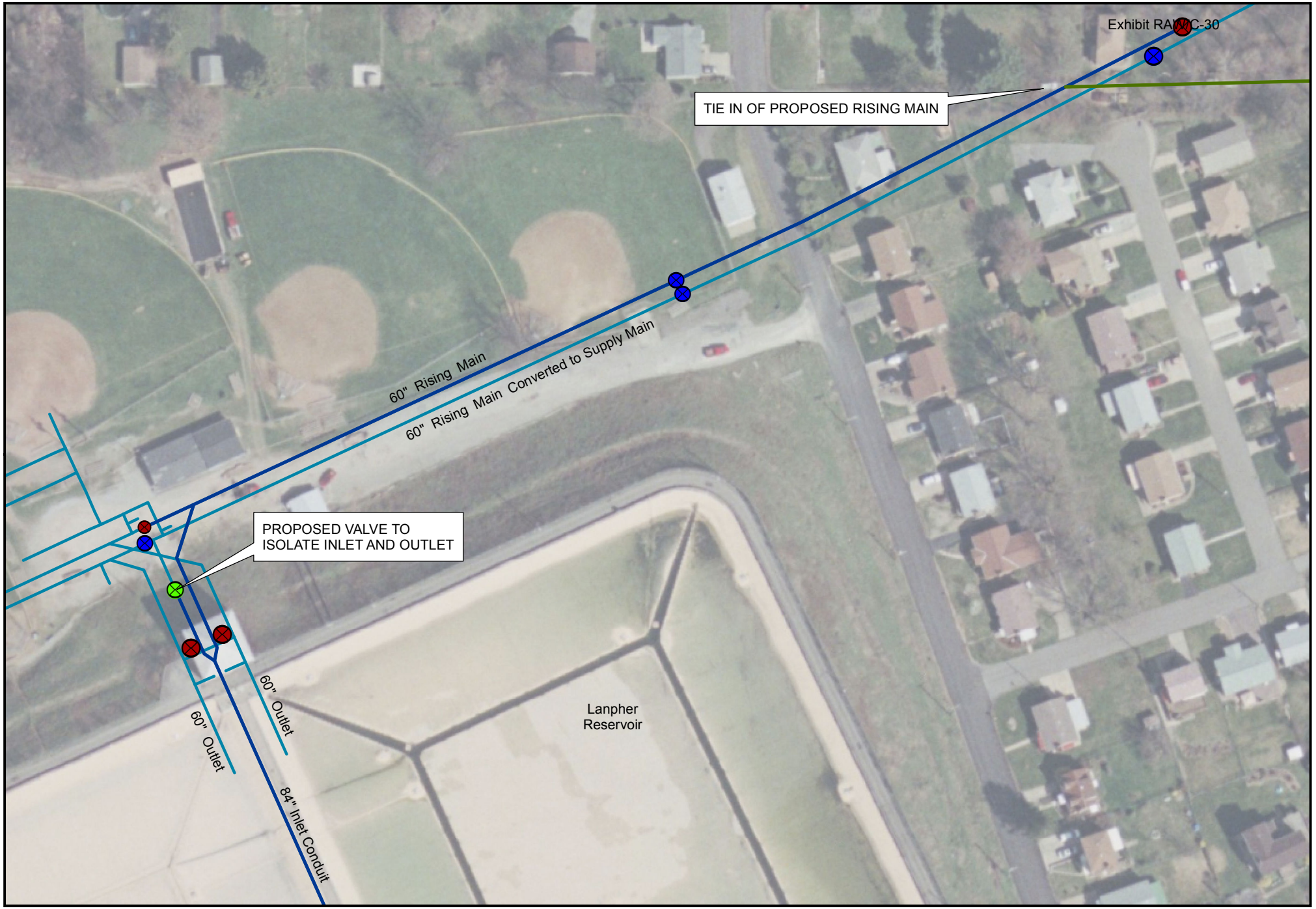
A geotechnical program will be an important part of the project as it progresses into the design and construction phases. Mott MacDonald anticipates that a minimum of three (3) borings will be completed at each of the trenchless crossings, with up to ten (10) required at Trenchless Crossing No. 3. The trenchless crossing borings will include rock core samples.

Borings along the open cut segment should be performed at a spacing of about 500 feet to provide a general understanding of the area subsurface. Boring logs should be prepared with the classification of the soils at each boring, blow counts, and depth to groundwater.

Laboratory testing will need to be performed on a sample collected every 10 feet at each boring location to obtain data on natural water content, Atterberg limits, particle size (sieve and hydrometer analysis), and unconfined compressive strength for cohesive soil. These analyses will be utilized to determine the optimum strata for the various crossings and assist in an evaluation of the trenchless crossings.

It is also recommended that laboratory testing include obtaining data using the 10-Point System as described in Appendix A of ANSI/AWWA C105/A21.5 to evaluate the likelihood of corrosive soils. This geotechnical investigation would be obtained through a series of soil borings uniformly spaced along the alignment advanced to a depth of 10 feet below the ground surface.

Soil boring logs available from the Pennsylvania Department of Transportation for work previously performed along at the trenchless crossings will provide supplemental information to the geotechnical program.



Legend

- Valve Closed
- Valve Open
- RisingMain
- SupplyMain

0 100 200 Feet

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PGH2O

MOTT MACDONALD
1600 W Carson St.
Pittsburgh, PA 15219

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
LANPHER RISING MAIN
FIGURE 10 - CONNECTION AT LANPHER

Designed	Drawn	Checked	Approved	Date
	DWW			3/9/2016

D. Alternatives evaluation detailed engineer's opinion of cost

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 1: CT in Sedimentation Basins
Mar-2017

Division	Cost
Division 0 - General Conditions	$1,370,000
Division 2 - Sitework	$16,320,000
Division 3 - Structural	$3,690,000
Division 4-10 - Architectural	$3,330,000
Division 11 - Equipment	$210,000
Division - 13 I&C	$30,000
Division 15 - HVAC, Plumbing and Fire	$360,000
Division 16 - Electrical	$3,470,000
Subtotal Division 0-16	$28,780,000
Contingencies @ 40%	$11,510,000
Engineering, CM, Legal, PM @ 25%	$10,070,000
Total Estimated Capital Cost	**$50,360,000**

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 1: CT Obtained in Sedimentation Basins

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
SWWP Erosion Control					
Silt Fence - Aspinwall	LIN FT	3000	$3	$9,000	
Construction Entrance - Aspinwall	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Aspinwall	LUMP	1	$1,500	$1,500	
Misc. SWPP Work - Aspinwall	LUMP	1	$2,500	$2,500	
Silt Fence - Breuken	LIN FT	1000	$3	$3,000	
Construction Entrance - Breuken	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Breuken	LUMP	1	$500	$500	
Misc. SWPP Work - Breuken	LUMP	1	$1,000	$1,000	
Site Demo-Removals					
Remove Existing Obstructions - Aspinwall	LUMP	1	$33,550	$33,550	
Remove Existing Obstructions - Breuken	LUMP	1	$33,550	$33,550	
Demo. Ex. Maint. Bldg - Breuken	SQ FT	6000	$12	$72,000	
Clearing for Clearwell Bypass (heavy) - Aspinwall; 1400 LF x	ACRE	0.78	$15,000	$11,700	
EXCAVATION & SHEETING					
Excavation Support					
1.1 MG Clearwell - Aspinwall	SQ FT	11880	$57	$678,942	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	SQ FT	12420	$57	$709,803	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Mass Excavation					
1.1 MG Clearwell - Aspinwall	CUB YD	14520	$37	$535,207	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	CUB YD	15600	$37	$575,016	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Mass Backfill					
1.1 MG Clearwell - Aspinwall	CUB YD	5280	$42	$222,130	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	CUB YD	5520	$42	$232,226	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Trench excavation for piping					
96" RCP - Aspinwall filtered water	LIN FT	300	$238	$71,484	Aspinwall filtered water
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$219	$372,640	Aspinwall clearwell bypass
72" Aspinwall Outfall	LF	100	$200	$20,049	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$219	$219,200	Breuken in/out/overflow
72" RCP - Breuken suction line	LIN FT	170	$200	$34,083	Breuken suction line
16" DIP - Fox Chapel force main	LIN FT	350	$25	$8,848	Fox Chapel force main
Pipe Trench Backfill					
96" RCP - Aspinwall filtered water	LIN FT	300	$324	$97,062	
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$324	$550,018	
72" Aspinwall Outfall	LF	100	$324	$32,354	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$324	$323,540	
72" RCP - Breuken suction line	LIN FT	170	$324	$55,002	
16" DIP - Fox Chapel force main	LIN FT	350	$81	$28,350	
PIPING					
Pipe Installation					
96 inch RCP filtered water conduit	LIN FT	300	$222	$66,741	
84 inch clearwell bypass	LIN FT	1700	$222	$378,199	
84" Bruecken Overflow	LIN FT	1000	$222	$222,470	
72 inch RCP pump suction line connection	LIN FT	170	$222	$37,820	
16" Fox Chappel WM	LIN FT	350	$56	$19,467	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 1: CT Obtained in Sedimentation Basins

Pipe Material					
96 inch RCP filtered water conduit	LIN FT	300	$623	$186,900	
84 inch clearwell bypass	LIN FT	1,700	$440	$748,000	
84" Bruecken Overflow	LIN FT	1,000	$440	$440,000	
72" Bruecken suction	LIN FT	170	$373	$63,410	
16" FC	LIN FT	350	$93	$32,375	
Dredging Sedimentation Basins	CY	300000	$30	$9,000,000	
Large diameter valves	EA	6	$25,000	$150,000	

Subtotal Division 2				**$16,318,436**

DIVISION 3 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
Reinforced Concrete for Aspinwall Wet Well	CY	1030	$1,000.00	$1,030,000	
Piles Aspinwall	SF	7500	$75.00	$562,500	
Piles Bruecken	SF	10000	$75.00	$750,000	
Reinforced Concrete for Bruecken Wet Well	CY	1350	$1,000.00	$1,350,000	
Subtotal Division 3				**$3,692,500**	

DIVISION 4 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
BUILDING CONSTRUCTION - ARCHITECTURAL					
Structural Improvements Aspinwall	LS	1	$300,000.00	$300,000	previous projects
Central Receiving Basin PPE Cover (Furnish and Install)	SF	140000	$2.55	$357,000	
East Sedimentation Basin PPE Cover (Furnish and Install)	SF	525000	$2.55	$1,338,750	
West Sedimenation Basin PPE Cover (Furnish and Install)	SF	525000	$2.55	$1,338,750	
Subtotal Division 4				**$3,334,500**	

DIVISION 11 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
Tracer Study	LS	1	$50,000	$50,000	RAM quotes
Sample Pumping System	LS	1	$30,000	$30,000	
pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	RAM quotes
Sodium Hypochlorite Feed Pumps	EA	2	$10,000	$20,000	
Estimated Labor @ 70% of Equipment Cost				$80,500	
Profit and Overhead on Equipment				$17,250	
Sub Total Division 11				**$212,750**	

DIVISION 16 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**NOTES**
Aspinwall Pump Station Upgrades	LS	1	$850,000	$850,000	Estimated based on previous projects with similar upgrades
Bruecken Pump Station Upgrades	LS	1	$2,600,000	$2,600,000	Estimated based on previous projects with similar upgrades
Sedimentation Basin Electrical for Analyzers and Sample Pum	LS	1	$20,000	$20,000	Estimated based on previous projects with similar upgrades
Subtotal Division 16				**$3,470,000**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 2: UV Disinfection of Filter Effluent
Mar-2017

Division	Cost
Division 0 - General Conditions	$1,050,000
Division 2 - Sitework	$8,250,000
Division 3 - Structural	$4,430,000
Division 4-10 - Architectural	$880,000
Division 11 - Equipment	$2,980,000
Division 13 I&C	$450,000
Div 15 HVAC, Plumbing and Fire	$410,000
Div 16 - Electrical	$3,550,000
Subtotal Div 0-16	$22,000,000
Contingencies @ 40%	$8,800,000
Engineering, CM, Legal, PM @ 25%	$7,700,000
Total Estimated Capital Cost	$38,500,000

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 2: CT Obtained with UV and additional Clearwell

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
ENVIRONMENTAL PROTECTION					
Silt fence/Erosion Control Aspinwall	LF	3000	$3	$9,000	JACEA Estimate
Stabilized Construction Entrance Aspinwall	SQY	400	$36	$14,400	JACEA Estimate
Inlet Filters Aspinwall	LS	1	$1,500	$1,500	JACEA Estimate
Mis SWPP Work Aspinwall	LS	1	$2,500	$2,500	JACEA Estimate
Silt fence Bruecken	LF	1000	$3	$3,000	JACEA Estimate
Stabilized Construction Entrance Bruecken	SQY	400	$36	$14,400	JACEA Estimate
Inlet Filters Bruecken	LS	1	$500	$500	JACEA Estimate
Mis SWPP Work Bruecken	LS	1	$1,000	$1,000	JACEA Estimate
Site Demo-Removals					
Remove Existing Obstructions Aspinwall	LS	1	$33,500	$33,500	JACEA Estimate
Remove Existing Obstructions Bruecken	LS	1	$33,500	$33,500	JACEA Estimate
Demo Maintenance Building bruecken	SQF	6000	$12	$72,000	JACEA Estimate
Clearing for Clearwell ByPass	ACRE	1	$15,000	$11,700	JACEA Estimate
EXCAVATION & SHEETING					
Excavation Support Effluent UV Facility	SQF	7560	$57	$432,054	JACEA Estimate
Excavation Support Effluent Clearwell Aspinwall	SQF	11880	$57	$678,942	JACEA Estimate
Excavation Support Effluent Clearwell Bruecken	SQF	12420	$57	$709,803	JACEA Estimate
Mass Excavation Effluent UV Facility	CY	5880	$37	$216,737	JACEA Estimate
Mass Excavation Clearwell Bruecken	CY	15600	$37	$575,016	JACEA Estimate
Mass Excavation Clearwell Aspinwall	CY	14520	$37	$535,207	JACEA Estimate
Mass Backfill Aspinwall UV Effluent	CY	3360	$42	$141,355	JACEA Estimate
Mass Backfill Clearwell Aspinwall	CY	5280	$42	$222,130	JACEA Estimate
Mass Backfill Clearwell Bruecken	CY	5520	$42	$232,226	JACEA Estimate
Pipe Trench Excavation					
96"RCP Aspinwall Filter Effluent	LF	250	$238	$59,570	JACEA Estimate
84" RCP Aspinwall Clearwell By-Pass	LF	1700	$219	$372,640	JACEA Estimate
84" RCP Bruecken In/Out Overflow	LF	1000	$219	$219,200	JACEA Estimate
72" RCP Aspinwall Outfall	LF	100	$200	$20,049	JACEA Estimate
72" RCP Bruecken Suction	LF	170	$200	$34,083	JACEA Estimate
16"DIP Fox Chappel	LF	350	$25	$8,848	JACEA Estimate
Valves 96 each at 25 ft.)	LF	150	$219	$32,880	JACEA Estimate
Pipe Trench Backfill					
96"RCP Aspinwall Filter Effluent	LF	250	$324	$80,885	JACEA Estimate
84" RCP Aspinwall Clearwell By-Pass	LF	1700	$324	$550,018	JACEA Estimate
84" RCP Bruecken In/Out Overflow	LF	1000	$324	$323,540	JACEA Estimate
72" RCP Aspinwall Outfall	LF	100	$324	$32,354	JACEA Estimate
72" RCP Bruecken Suction	LF	170	$324	$55,002	JACEA Estimate
16"DIP Fox Chappel	LF	350	$81	$28,312	JACEA Estimate
Valves 96 each at 25 ft.)	LF	150	$324	$48,531	JACEA Estimate
Pipe Installation					
96"RCP Aspinwall Filter Effluent	LF	250	$222	$55,618	
84" RCP Aspinwall Clearwell By-Pass	LF	1700	$222	$378,199	
84" RCP Bruecken In/Out Overflow	LF	1000	$222	$222,470	
72" RCP Aspinwall Outfall	LF	100	$222	$22,247	
72" RCP Bruecken Suction	LF	170	$222	$37,820	
16"DIP Fox Chappel	LF	350	$56	$19,467	
Valves 96 each at 25 ft.)	LF	150	$222	$33,371	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 2: CT Obtained with UV and additional Clearwell

Pipe Material					
96"RCP Aspinwall Filter Effluent	LF	250	$623	$155,750	
84" RCP Aspinwall Clearwell By-Pass	LF	1700	$440	$748,000	
84" RCP Bruecken In/Out Overflow	LF	1000	$440	$440,000	
72" RCP Aspinwall Outfall	LF	100	$373	$37,300	
72" RCP Bruecken Suction	LF	170	$373	$63,410	
16"DIP Fox Chappel	LF	350	$93	$32,638	
Valves 96 each at 25 ft.)	LF	150	$440	$66,000	
Utility Relocation Aspinwall/Bruecken	LS	1	$125,000	$125,000	
Subtotal Division 2				**$8,253,670**	

DIVISION 3		**ESTIMATEI**	**UNIT**	**EXTENDED**	
ITEM DESCRIPTION	**UNIT**	**QUANTITY**	**PRICE**	**PRICE**	**NOTES**
Reinforced Concrete for UV Structure	SF	2500	$239	$598,550	Summary From JACEA Estimate
Reinforced Concrete for Aspinwall Wet Well	SF	8100	$132	$1,067,337	Summary From JACEA Estimate
Reinforced Concrete for Bruecken Wet Well	CY	8800	$130	$1,140,832	Summary From JACEA Estimate
UV piling	SF	4200	$75	$315,000	Estimated based on previous projects requiring piles
piling Aspinwall	SF	7500	$75	$562,500	Estimated based on previous projects requiring piles
piling bruecken	SF	10000	$75	$750,000	Estimated based on previous projects requiring piles
Subtotal Division 3				**$4,434,219**	

DIVISION 4-10		**ESTIMATEI**	**UNIT**	**EXTENDED**	
ITEM DESCRIPTION	**UNIT**	**QUANTITY**	**PRICE**	**PRICE**	**NOTES**
BUILDING CONSTRUCTION - ARCHITECTURAL					
UV Building Superstructure	SF	2500	$100	$250,000	From Section 3.1.1.1 of Report
UV Building Additional features	LS	1	$195,750	$195,750	
Wetwell features	LS	1	$188,000	$188,000	
Structural improvements at aspinwall/bruecken	LS	1	$250,000	$250,000	estimated
Subtotal Division 4-10				**$883,750**	

DIVISION 11		**ESTIMATEI**	**UNIT**	**EXTENDED**	
ITEM DESCRIPTION	**UNIT**	**QUANTITY**	**PRICE**	**PRICE**	**NOTES**
48-inch Magnetic Flowmeter	EA	4	$13,000	$52,000	Rosemount quote.
UV Reactor	EA	4	$300,000	$1,200,000	Trojan UV quote.
UV Lamps	EA	64	$550	$35,200	Trojan UV quote.
48-inch Motor Operated Butterfly Isolation Valves	EA	4	$20,000	$80,000	Placeholder
48-inch Manually Operated Sluice Gates	EA	4	$25,000	$100,000	Placeholder
48-inch Pipe	LF	100	$250	$25,000	Forterra quote.
120-inch Sluice Gate	EA	2	$60,000	$120,000	Placeholder
Estimated Labor @ 70% of Equipment Cost				$1,128,540	
Profit and Overhead on Equipment Prepurchase				$241,830	
Subtotal Division 11				**$2,982,570**	

DIVISION 16		**ESTIMATEI**	**UNIT**	**EXTENDED**	
ITEM DESCRIPTION	**UNIT**	**QUANTITY**	**PRICE**	**PRICE**	**NOTES**
Aspinwall Pump Station Upgrades (UV Reactor Power)	LS	1	$100,000	$100,000	Estimated based on previous projects with similar upgra
Aspinwall Pump Station Upgrades	LS	1	$850,000	$850,000	Estimated based on previous projects with similar upgra
Bruecken Pump Station Upgrades	LS	1	$2,600,000	$2,600,000	Estimated based on previous projects with similar upgra
Subtotal Division 16				**$3,550,000**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 3: Permanent or Temporary Clearwell in West Sedir
Mar-2017

ITEM DESCRIPTION	EXTENDED PRICE
Division 0 - General Conditions	$1,960,000
Division 2 - Sitework	$21,060,000
Division 3 - Structural	$1,030,000
Division 4-10 - Architectural	$4,480,000
Division 11 - Equipment	$3,560,000
Division 13 I&C	$530,000
Div 15 HVAC, Plumbing and Fire	$450,000
Div 16 - Electrical	$8,080,000
Subtotal Div 0-16	$41,150,000
Contingencies @ 40%	$16,460,000
Engineering, CM, Legal, PM @ 25%	$14,400,000
Total Estimated Capital Cost	$72,010,000

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT Obtained in Highland 2 Reservoir

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
SWWP Erosion Control					
Silt Fence - Aspinwall	LIN FT	3000	$3	$9,000	
Construction Entrance - Aspinwall	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Aspinwall	LUMP	1	$1,500	$1,500	
Misc. SWPP Work - Aspinwall	LUMP	1	$2,500	$2,500	
Silt Fence - Breuken	LIN FT	1000	$3	$3,000	
Construction Entrance - Breuken	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Breuken	LUMP	1	$500	$500	
Misc. SWPP Work - Breuken	LUMP	1	$1,000	$1,000	
Silt Fence - Highland	LIN FT	600	$3	$1,800	
Construction Entrance - Highland	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Highland	LUMP	1	$500	$500	
Misc. SWPP Work - Highland	LUMP	1	$1,000	$1,000	
Silt Fence - Lanpher	LIN FT	600	$3	$1,800	
Construction Entrance - Lanpher	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Lanpher	LUMP	1	$500	$500	
Misc. SWPP Work - Lanpher	LUMP	1	$1,000	$1,000	
Site Demo-Removals					
Remove Existing Obstructions - Aspinwall	LUMP	1	$33,550	$33,550	
Remove Existing Obstructions - Breuken	LUMP	1	$33,550	$33,550	
Demo. Ex. Maint. Bldg - Breuken	SQ FT	6000	$12	$72,000	
Clearing for Clearwell Bypass (heavy) - Aspinwall; 1400 LF x	ACRE	0.78	$15,000	$11,700	
Misc. Site Demo - Highland	LUMP	1	$5,000	$5,000	
Misc. Site Demo - Lanpher	LUMP	1	$5,000	$5,000	
Clearing for Highland Main - Highland; 1400 LF x 24'	ACRE	0.78	$15,000	$11,700	
EXCAVATION & SHEETING					
Excavation Support					
1.5 MG Clearwell - Breuken	SQ FT	12240	$57	$699,516	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Lanpher Chemical Building	SQ FT	0	$57	$0	Lanpher - Revised to Slab on Grade
Highland Chemical Building	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Mass Excavation					
1.5 MG Clearwell - Breuken	CUB YD	15600	$37	$575,016	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	1120	$37	$41,283	Highland - Reduced for Slab on Grade
Lanpher Chemical Building	CUB YD	360	$37	$13,270	Lanpher - Reduced for Slab on Grade
Highland Chemical Building	CUB YD	164	$37	$6,045	Highland - Reduced for Slab on Grade
Mass Backfill					
1.5 MG Clearwell - Breuken	CUB YD	5520	$42	$232,226	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	507	$24	$12,168	Highland - unit cost reduced for easier scope
Lanpher Chemical Building	CUB YD	280	$24	$6,720	Lanpher - unit cost reduced for easier scope
Highland Chemical Building	CUB YD	134	$24	$3,216	Highland - unit cost reduced for easier scope
Highland Pump Station	CUB YD	667	$92	$61,277	Highland - 36" agg base under slab
Lanpher Chemical Building	CUB YD	134	$92	$12,311	Lanpher - 36" agg base under slab
Highland Chemical Building	CUB YD	84	$92	$7,717	Highland - 36" agg base under slab
Trench excavation for piping					
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$219	$372,640	Aspinwall clearwell bypass
84" RCP - Breuken in/out/overflow	LIN FT	1000	$219	$219,200	Breuken in/out/overflow
72" RCP - Breuken suction line	LIN FT	170	$200	$34,083	Breuken suction line
48" DIP - Highland Transfer Water Main	LIN FT	5570	$200	$1,116,729	Highland Transfer Water Main
16" DIP - Fox Chapel force main	LIN FT	350	$25	$8,848	Fox Chapel force main
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$219	$54,800	sized as 84" pipe
Pipe Trench Backfill					

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT Obtained in Highland 2 Reservoir

84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$324	$550,018	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$324	$323,540	
72" RCP - Breuken suction line	LIN FT	170	$324	$55,002	
48" DIP - Highland Transfer Water Main	LIN FT	5570	$324	$1,802,118	
16" DIP - Fox Chapel force main	LIN FT	350	$324	$113,239	
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$324	$80,885	
PIPING					
Pipe Installation					
84 inch clearwell bypass	LIN FT	1700	$222	$378,199	
84" Bruecken Overflow	LIN FT	1000	$222	$222,470	
72 inch RCP pump suction line connection	LIN FT	170	$222	$37,820	
Inspection and rehab of 2-48" Bruecken to H2 RM	LIN FT	12,000	$400	$4,800,000	
48" H2 transmission Main	LIN FT	5570	$222	$1,239,158	
Pipe Material					
84 inch clearwell bypass	LIN FT	1,700	$440	$748,000	
84" Bruecken Overflow	LIN FT	1,000	$440	$440,000	
72" Bruecken suction	LIN FT	170	$373	$63,410	
48" H2 transmission Main	LIN FT	5570	$370	$2,060,900	
48" river crossing	LIN FT	1500	$2,500	$3,750,000	
Utility Relocation	EA	1	$70,000	$70,000	
Large diameter valves	EA	10	$25,000	$250,000	
Subtotal Division 2				**$20,726,024**	

DIVISION 3 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Reinforced Concrete for Highland 2 PS	CY	550	$1,000.00	$550,000	
Piles Bruecken	SF	10000	$75.00	$750,000	
Reinforced Concrete for Bruecken Wet Well	CY	1350	$1,000.00	$1,350,000	
Reinforced Concrete for Lanpher Booster Station	CY	200	$1,000.00	$200,000	
Highland Chemical Building	CY	200	$1,000.00	$200,000	
Subtotal Division 3				**$3,050,000**	

DIVISION 4 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
BUILDING CONSTRUCTION - ARCHITECTURAL					
Highland Transfer Pump Station	SF	5000	$300.00	$1,500,000	previous projects
Chem Facility lanpher	SF	1000	$100.00	$100,000	
Chem Facility Highland	SF	650	$100.00	$65,000	
Structural Improvements PS	LS	1	$200,000.00	$200,000	
Subtotal Division 4				**$1,865,000**	

DIVISION 11 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Pumps at Bruecken Pump Station	Ea	3	$700,000	$2,100,000	RAM quotes
Bruecken valves appurtenances	Ea	1	$1,500,000	$1,500,000	
Highland 2 PS ancillary	LS	1	$300,000	$300,000	
Pumps at Highland Transfer Pump Station	Ea	3	$300,000	$900,000	
Highland 2 - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	2	$18,600	$37,200	
Highland 2 - Sodium Hypochlorite Day Tank, 540 gal	Ea	1	$3,630	$3,630	
Highland 2 - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Highland 2 - Sample Pumping System	LS	1	$15,000	$15,000	
Highland 2 - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Lanpher - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	1	$18,600	$18,600	
Lanpher - Sodium Hypochlorite Day Tank, 230 gal	Ea	1	$3,100	$3,100	
Lanpher - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Lanpher - Sample Pumping System	LS	1	$15,000	$15,000	
Lanpher - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Estimated Labor @ 70% of Equipment Cost				$3,501,771	
Profit and Overhead on Equipment				$750,380	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT Obtained in Highland 2 Reservoir

Sub Total Division 11				**$9,254,681**

DIVISION 16 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	NOTES
Bruecken Pump Station Motors	LS	1	$2,500,000	$2,500,000	Estimated based on previous projects with similar upgrades
Bruecken Electrical Upgrade	LS	1	$4,000,000	$4,000,000	
Highland Transfer Pump Station	LS	1	$2,000,000	$2,000,000	Estimated based on previous projects with similar upgrades
Lanpher Booster Chlorination Station	LS	1	$15,000	$15,000	
Highland Booster Chlkorination	LS	1	15000	15000	
Subtotal Division 16				**$8,530,000**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 4: CT in Lanpher and Highland 2 Reservoirs
Mar-2017

ITEM DESCRIPTION	EXTENDED PRICE
Division 0 - General Conditions	$4,160,000
Division 2 - Sitework	$54,980,000
Division 3 - Structural	$4,240,000
Division 4-10 - Architectural	$1,370,000
Division 11 - Equipment	$10,730,000
Division 13 I&C	$1,610,000
Div 15 HVAC, Plumbing and Fire	$820,000
Div 16 - Electrical	$9,360,000
Subtotal Div 0-16	$87,270,000
Contingencies @ 40%	$34,910,000
Engineering, CM, Legal, PM @ 25%	$30,550,000
Total Estimated Capital Cost	$152,730,000

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 4: CT in Lanpher and Highland 2 Reservoirs

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
SWWP Erosion Control					
Silt Fence - Aspinwall	LIN FT	3000	$3	$9,000	
Construction Entrance - Aspinwall	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Aspinwall	LUMP	1	$1,500	$1,500	
Misc. SWPP Work - Aspinwall	LUMP	1	$2,500	$2,500	
Silt Fence - Breuken	LIN FT	1000	$3	$3,000	
Construction Entrance - Breuken	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Breuken	LUMP	1	$500	$500	
Misc. SWPP Work - Breuken	LUMP	1	$1,000	$1,000	
Silt Fence - Highland	LIN FT	600	$3	$1,800	
Construction Entrance - Highland	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Highland	LUMP	1	$500	$500	
Misc. SWPP Work - Highland	LUMP	1	$1,000	$1,000	
Silt Fence - Lanpher	LIN FT	600	$3	$1,800	
Construction Entrance - Lanpher	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Lanpher	LUMP	1	$500	$500	
Misc. SWPP Work - Lanpher	LUMP	1	$1,000	$1,000	
Site Demo-Removals					
Remove Existing Obstructions - Aspinwall	LUMP	1	$33,550	$33,550	
Remove Existing Obstructions - Breuken	LUMP	1	$33,550	$33,550	
Demo. Ex. Maint. Bldg - Breuken	SQ FT	6000	$12	$72,000	
Clearing for Clearwell Bypass (heavy) - Aspinwall; 1400 LF x	ACRE	0.78	$15,000	$11,700	
Misc. Site Demo - Highland	LUMP	1	$5,000	$5,000	
Misc. Site Demo - Lanpher	LUMP	1	$5,000	$5,000	
Clearing for Highland Main - Highland; 1400 LF x 24'	ACRE	0.78	$15,000	$11,700	
EXCAVATION & SHEETING					
Excavation Support					
1.1 MG Clearwell - Aspinwall	SQ FT	11880	$57	$678,942	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	SQ FT	12240	$57	$699,516	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Lanpher Chemical Building	SQ FT	0	$57	$0	Lanpher - Revised to Slab on Grade
Highland Chemical Building	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Mass Excavation					
1.1 MG Clearwell - Aspinwall	CUB YD	14520	$37	$535,207	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	CUB YD	15600	$37	$575,016	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	1120	$37	$41,283	Highland - Reduced for Slab on Grade
Lanpher Chemical Building	CUB YD	360	$37	$13,270	Lanpher - Reduced for Slab on Grade
Highland Chemical Building	CUB YD	164	$37	$6,045	Highland - Reduced for Slab on Grade
Mass Backfill					
1.1 MG Clearwell - Aspinwall	CUB YD	5280	$42	$222,130	Aspinwall - 1.1 MG Clearwell - Aspinwall
1.5 MG Clearwell - Breuken	CUB YD	5520	$42	$232,226	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	507	$24	$12,168	Highland - unit cost reduced for easier scope
Lanpher Chemical Building	CUB YD	280	$24	$6,720	Lanpher - unit cost reduced for easier scope
Highland Chemical Building	CUB YD	134	$24	$3,216	Highland - unit cost reduced for easier scope
Highland Pump Station	CUB YD	667	$92	$61,277	Highland - 36" agg base under slab
Lanpher Chemical Building	CUB YD	134	$92	$12,311	Lanpher - 36" agg base under slab
Highland Chemical Building	CUB YD	84	$92	$7,717	Highland - 36" agg base under slab
Trench excavation for piping					
96" RCP - Aspinwall filtered water	LIN FT	300	$238	$71,484	Aspinwall filtered water
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$219	$372,640	Aspinwall clearwell bypass
84" RCP - Breuken in/out/overflow	LIN FT	1000	$219	$219,200	Breuken in/out/overflow
72" RCP - Breuken suction line	LIN FT	170	$200	$34,083	Breuken suction line
48" DIP - Highland Transfer Water Main	LIN FT	5570	$200	$1,116,729	Highland Transfer Water Main

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 4: CT in Lanpher and Highland 2 Reservoirs

16" DIP - Fox Chapel force main	LIN FT	350	$25	$8,848	Fox Chapel force main
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$219	$54,800	sized as 84" pipe
Pipe Trench Backfill					
96" RCP - Aspinwall filtered water	LIN FT	300	$324	$97,062	
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$324	$550,018	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$324	$323,540	
72" RCP - Breuken suction line	LIN FT	170	$324	$55,002	
48" DIP - Highland Transfer Water Main	LIN FT	5570	$324	$1,802,118	
16" DIP - Fox Chapel force main	LIN FT	350	$324	$113,239	
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$324	$80,885	
PIPING					
Pipe Installation					
96 inch RCP filtered water conduit	LIN FT	300	$222	$66,741	
84 inch clearwell bypass	LIN FT	1700	$222	$378,199	
84" Bruecken Overflow	LIN FT	1000	$222	$222,470	
72 inch RCP pump suction line connection	LIN FT	170	$222	$37,820	
48 inch PCCP Rising Main Total Price from the study	LIN FT	22000	$1,572	$34,588,180	
Inspection and rehab of 2-48" Bruecken to H2 RM	LIN FT	12,000	$400	$4,800,000	
48" H2 transmission Main	LIN FT	5570	$222	$1,239,158	
16" Fox Chappel WM	LIN FT	350	$56	$19,467	
Pipe Material					
96 inch RCP filtered water conduit	LIN FT	300	$623	$186,900	
84 inch clearwell bypass	LIN FT	1,700	$440	$748,000	
84" Bruecken Overflow	LIN FT	1,000	$440	$440,000	
72" Bruecken suction	LIN FT	170	$373	$63,410	
16" FC	LIN FT	350	$93	$32,375	
48" H2 transmission Main	LIN FT	5570	$370	$2,060,900	
Flowable pavement	LIN FT	4170	$196	$817,820	
MOT from Lanpher	LIN FT	4170	$119	$494,437	
Grind and pave 2"	SQ YD	11120	$16	$177,920	4170 LF x 24' wide
surface restoration non paved surface	SQ YD	9840	$9	$88,560	4920 LF x 18' wide
Large diameter valves	EA	10	$25,000	$250,000	
Subtotal Division 2				**$54,983,249**	

DIVISION 3 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Reinforced Concrete for Highland 2 PS	CY	550	$1,000.00	$550,000	
Reinforced Concrete for Aspinwall Wet Well	CY	1030	$1,000.00	$1,030,000	
Piles Aspinwall	SF	7500	$75.00	$562,500	
Piles Bruecken	SF	10000	$75.00	$750,000	
Reinforced Concrete for Bruecken Wet Well	CY	1350	$1,000.00	$1,350,000	
Reinforced Concrete for Lanpher Booster Station	CY	100	$1,000.00	$100,000	
Highland Chemical Building	SF	625	$53.42	$33,388	
Subtotal Division 3				**$4,242,500**	

DIVISION 4 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
BUILDING CONSTRUCTION - ARCHITECTURAL					
Highland Transfer Pump Station	SF	5000	$200.00	$1,000,000	previous projects
Chem Facility lanpher	SF	1000	$100.00	$100,000	
Chem Facility Highland	SF	650	$100.00	$65,000	
Structural Improvements PS	LS	1	$200,000.00	$200,000	
Subtotal Division 4				**$1,365,000**	

DIVISION 11 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Pumps at Bruecken Pump Station	Ea	3	$500,000	$1,500,000	RAM quotes
Bruecken valves appurtenances	Ea	1	$1,000,000	$1,000,000	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 4: CT in Lanpher and Highland 2 Reservoirs

Pumps at Aspinwall	Ea	4	$350,000	$1,400,000	RAM quotes
Aspinwall Appurtenances	LS	1	$500,000	$500,000	
Highland 2 PS ancillary	LS	1	$300,000	$300,000	
Pumps at Highland Transfer Pump Station	Ea	3	$300,000	$900,000	
Highland 2 - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	2	$18,600	$37,200	
Highland 2 - Sodium Hypochlorite Day Tank, 540 gal	Ea	1	$3,630	$3,630	
Highland 2 - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Highland 2 - Sample Pumping System	LS	1	$15,000	$15,000	
Highland 2 - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Lanpher - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	1	$18,600	$18,600	
Lanpher - Sodium Hypochlorite Day Tank, 230 gal	Ea	1	$3,100	$3,100	
Lanpher - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Lanpher - Sample Pumping System	LS	1	$15,000	$15,000	
Lanpher - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Estimated Labor @ 70% of Equipment Cost				$4,061,771	
Profit and Overhead on Equipment				$870,380	
Sub Total Division 11				**$10,734,681**	

DIVISION 16 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	NOTES
Aspinwall Pump Station Motors	each	4	$170,000	$680,000	Estimated based on previous projects with similar upgrades
Aspinwall PS VFD	each	4	$350,000	$1,400,000	
Bruecken Pump Station Motors	LS	1	$5,250,000	$5,250,000	Estimated based on previous projects with similar upgrades
Highland Transfer Pump Station	LS	1	$2,000,000	$2,000,000	Estimated based on previous projects with similar upgrades
Lanpher Booster Chlorination Station	LS	1	$15,000	$15,000	
Highland Booster Chlkorination	LS	1	15000	15000	
Subtotal Division 16				**$9,360,000**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 5: CT in Lanpher Reservoir
Mar-2017

ITEM DESCRIPTION	EXTENDED PRICE
Division 0 - General Conditions	$4,020,000
Division 2 - Sitework	$57,960,000
Division 3 - Structural	$2,140,000
Division 4-10 - Architectural	$2,170,000
Division 11 - Equipment	$7,210,000
Division 13 I&C	$1,080,000
Div 15 HVAC, Plumbing and Fire	$580,000
Div 16 - Electrical	$9,330,000
Subtotal Div 0-16	$84,490,000
Contingencies @ 40%	$33,800,000
Engineering, CM, Legal, PM @ 25%	$29,570,000
Total Estimated Capital Cost	$147,860,000

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 5 CT Obtained in Lanpher Reservoir

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
SWWP Erosion Control					
Silt Fence - Aspinwall	LIN FT	3000	$3	$9,000	
Construction Entrance - Aspinwall	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Aspinwall	LUMP	1	$1,500	$1,500	
Misc. SWPP Work - Aspinwall	LUMP	1	$2,500	$2,500	
Silt Fence - Highland	LIN FT	600	$3	$1,800	
Construction Entrance - Highland	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Highland	LUMP	1	$500	$500	
Misc. SWPP Work - Highland	LUMP	1	$1,000	$1,000	
Silt Fence - Lanpher	LIN FT	600	$3	$1,800	
Construction Entrance - Lanpher	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Lanpher	LUMP	1	$500	$500	
Misc. SWPP Work - Lanpher	LUMP	1	$1,000	$1,000	
Site Demo-Removals					
Remove Existing Obstructions - Aspinwall	LUMP	1	$33,550	$33,550	
Clearing for Clearwell Bypass (heavy) - Aspinwall; 1400 LF x	ACRE	0.78	$15,000	$11,700	
Misc. Site Demo - Highland	LUMP	1	$5,000	$5,000	
Misc. Site Demo - Lanpher	LUMP	1	$5,000	$5,000	
Clearing for Highland Main - Highland; 1400 LF x 24'	ACRE	0.78	$15,000	$11,700	
EXCAVATION & SHEETING **Excavation Support**					
1.1 MG Clearwell - Aspinwall	SQ FT	11880	$57	$678,942	
Highland Pump Station	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Lanpher Chemical Building	SQ FT	0	$57	$0	Lanpher - Revised to Slab on Grade
Highland Chemical Building	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Mass Excavation					
1.1 MG Clearwell - Aspinwall	CUB YD	14520	$37	$535,207	
Highland Pump Station	CUB YD	1120	$37	$41,283	
Lanpher Chemical Building	CUB YD	360	$37	$13,270	
Highland Chemical Building	CUB YD	164	$37	$6,045	
Mass Backfill					
1.1 MG Clearwell - Aspinwall	CUB YD	5280	$42	$222,130	Aspinwall - 1.1 MG Clearwell - Aspinwall
Highland Pump Station	CUB YD	507	$24	$12,168	Highland - unit cost reduced for easier scope
Lanpher Chemical Building	CUB YD	280	$24	$6,720	Lanpher - unit cost reduced for easier scope
Highland Chemical Building	CUB YD	134	$24	$3,216	Highland - unit cost reduced for easier scope
Highland Pump Station	CUB YD	667	$92	$61,277	Highland - 36" agg base under slab
Lanpher Chemical Building	CUB YD	134	$92	$12,311	Lanpher - 36" agg base under slab
Highland Chemical Building	CUB YD	84	$92	$7,717	Highland - 36" agg base under slab
Trench excavation for piping					
96" RCP - Aspinwall filtered water	LIN FT	300	$238	$71,484	
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$219	$372,640	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$219	$219,200	
72" RCP - Breuken suction line	LIN FT	170	$200	$34,083	
48" DIP - Highland Transfer Water Main	LIN FT	5570	$200	$1,116,729	
16" DIP - Fox Chapel force main	LIN FT	350	$25	$8,848	
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$219	$54,800	
Pipe Trench Backfill					
96" RCP - Aspinwall filtered water	LIN FT	300	$324	$97,062	
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$324	$550,018	
48" DIP - Highland Transfer Water Main	LIN FT	5570	$324	$1,802,118	
16" DIP - Fox Chapel force main	LIN FT	350	$324	$113,239	

PITTSBURGH WATER AND SEWER AUTHORITY
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Clearwell Improvements
Alternative 5 CT Obtained in Lanpher Reservoir

Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$324	$80,885	
Utility Relocation	LS	1	$70,000	$70,000	
PIPING					
Pipe Installation					
96" RCP filtered water conduit	LIN FT	300	$222	$66,741	
60 inch PCCP Rising Main Total Price from the study	LIN FT	22000	$2,000	$44,000,000	
48" H2 Transmission Main	LIN FT	5570	$222	$1,239,158	
16" Fox Chappel Force Main	LIN FT	350	$56	$19,467	
Pipe Material					
96" RCP filtered water conduit	LF	300	$623	$186,900	
16" Fox Chapel Force Main	lf	350	$93	$32,375	
48" H2 transmission Main	LF	5570	$370	$2,060,900	
48" River crossing	LF	1500	$1,500	$2,250,000	
Flowable pavement	LF	4170	$196	$817,820	
MOT from Lanpher	lf	4170	$119	$494,437	
Grind and pave 2"	sqyd	11120	$16	$177,920	
surface restoration non paved surface	sqyd	9840	$3	$29,520	
Large diameter valves	EA	10	$25,000	$250,000	
Subtotal Division 2				**$57,956,380**	

DIVISION 3 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
Reinforced Concrete for Highland 2 PS	CY	550	$1,000	$550,000	
Reinforced Concrete for Aspinwall Wet Well	CY	1030	$1,000	$1,030,000	
Piles Aspinwall	SF	7500	$75	$562,500	
Reinforced Concrete for Lanpher Booster Station	CY	100	$1,000	$100,000	
Subtotal Division 3				**$2,142,500**	

DIVISION 4 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
BUILDING CONSTRUCTION - ARCHITECTURAL					
Highland Transfer Pump Station	SF	5000	$300.00	$1,500,000	
Chem Facility lanpher	SF	1000	$100.00	$100,000	
Chem Facility Highland	SF	650	$100.00	$65,000	
Structural Improvements PS	LS	1	$500,000.00	$500,000	
Subtotal Division 4				**$2,165,000**	

DIVISION 11 ITEM DESCRIPTION	**UNIT**	**ESTIMATED QUANTITY**	**UNIT PRICE**	**EXTENDED PRICE**	**Notes**
Pumps at Aspinwall	Ea	4	$500,000	$2,000,000	
Aspinwall Appurtenances	LS	1	$500,000	$500,000	
Highland 2 PS ancillary	LS	1	$300,000	$300,000	
Pumps at Highland Transfer Pump Station	Ea	3	$300,000	$900,000	
Highland 2 - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	2	$18,600	$37,200	
Highland 2 - Sodium Hypochlorite Day Tank, 540 gal	Ea	1	$3,630	$3,630	
Highland 2 - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Highland 2 - Sample Pumping System	LS	1	$15,000	$15,000	
Highland 2 - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Lanpher - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	1	$18,600	$18,600	
Lanpher - Sodium Hypochlorite Day Tank, 230 gal	Ea	1	$3,100	$3,100	
Lanpher - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Lanpher - Sample Pumping System	LS	1	$15,000	$15,000	
Lanpher - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Estimated Labor @ 70% of Equipment Cost				$2,731,771	
Profit and Overhead on Equipment				$574,880	
Subtotal Division 11				**$7,209,181**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 5 CT Obtained in Lanpher Reservoir

DIVISION 16 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	NOTES
Aspinwall Pump Station Motors	each	4	$250,000	$1,000,000	Estimated based on previous projects with similar upgrades
Aspinwall PS VFD	each	4	$450,000	$1,800,000	
Aspinwall new electrical service	LS	1	$4,500,000	$4,500,000	
Highland Transfer Pump Station	LS	1	$2,000,000	$2,000,000	Estimated based on previous projects with similar upgrades
Lanpher Booster Chlorination Station	LS	1	$15,000	$15,000	
Highland Booster Chlkorination	LS	1	15000	15000	
Subtotal Division 16				**$9,330,000**	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT in Highland 2 Reservoir
Mar-2017

ITEM DESCRIPTION	EXTENDED PRICE
Division 0 - General Conditions	$2,280,000
Division 2 - Sitework	$20,730,000
Division 3 - Structural	$3,050,000
Division 4-10 - Architectural	$1,870,000
Division 11 - Equipment	$9,250,000
Division 13 I&C	$1,390,000
Div 15 HVAC, Plumbing and Fire	$710,000
Div 16 - Electrical	$8,530,000
Subtotal Div 0-16	$47,810,000
Contingencies @ 40%	$19,120,000
Engineering, CM, Legal, PM @ 25%	$16,730,000
Total Estimated Capital Cost	$83,660,000

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT Obtained in Highland 2 Reservoir

DIVISION 2 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
PERMITS					
Construction Permits	LS	1	$10,000	$10,000	
SWWP Erosion Control					
Silt Fence - Aspinwall	LIN FT	3000	$3	$9,000	
Construction Entrance - Aspinwall	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Aspinwall	LUMP	1	$1,500	$1,500	
Misc. SWPP Work - Aspinwall	LUMP	1	$2,500	$2,500	
Silt Fence - Breuken	LIN FT	1000	$3	$3,000	
Construction Entrance - Breuken	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Breuken	LUMP	1	$500	$500	
Misc. SWPP Work - Breuken	LUMP	1	$1,000	$1,000	
Silt Fence - Highland	LIN FT	600	$3	$1,800	
Construction Entrance - Highland	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Highland	LUMP	1	$500	$500	
Misc. SWPP Work - Highland	LUMP	1	$1,000	$1,000	
Silt Fence - Lanpher	LIN FT	600	$3	$1,800	
Construction Entrance - Lanpher	SQ YD	400	$36	$14,400	
Inlet Filters on Existing - Lanpher	LUMP	1	$500	$500	
Misc. SWPP Work - Lanpher	LUMP	1	$1,000	$1,000	
Site Demo-Removals					
Remove Existing Obstructions - Aspinwall	LUMP	1	$33,550	$33,550	
Remove Existing Obstructions - Breuken	LUMP	1	$33,550	$33,550	
Demo. Ex. Maint. Bldg - Breuken	SQ FT	6000	$12	$72,000	
Clearing for Clearwell Bypass (heavy) - Aspinwall; 1400 LF x	ACRE	0.78	$15,000	$11,700	
Misc. Site Demo - Highland	LUMP	1	$5,000	$5,000	
Misc. Site Demo - Lanpher	LUMP	1	$5,000	$5,000	
Clearing for Highland Main - Highland; 1400 LF x 24'	ACRE	0.78	$15,000	$11,700	
EXCAVATION & SHEETING					
Excavation Support					
1.5 MG Clearwell - Breuken	SQ FT	12240	$57	$699,516	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Lanpher Chemical Building	SQ FT	0	$57	$0	Lanpher - Revised to Slab on Grade
Highland Chemical Building	SQ FT	0	$57	$0	Highland - Revised to Slab on Grade
Mass Excavation					
1.5 MG Clearwell - Breuken	CUB YD	15600	$37	$575,016	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	1120	$37	$41,283	Highland - Reduced for Slab on Grade
Lanpher Chemical Building	CUB YD	360	$37	$13,270	Lanpher - Reduced for Slab on Grade
Highland Chemical Building	CUB YD	164	$37	$6,045	Highland - Reduced for Slab on Grade
Mass Backfill					
1.5 MG Clearwell - Breuken	CUB YD	5520	$42	$232,226	Breuken - 1.5 MG Clearwell - Breuken - Breuken
Highland Pump Station	CUB YD	507	$24	$12,168	Highland - unit cost reduced for easier scope
Lanpher Chemical Building	CUB YD	280	$24	$6,720	Lanpher - unit cost reduced for easier scope
Highland Chemical Building	CUB YD	134	$24	$3,216	Highland - unit cost reduced for easier scope
Highland Pump Station	CUB YD	667	$92	$61,277	Highland - 36" agg base under slab
Lanpher Chemical Building	CUB YD	134	$92	$12,311	Lanpher - 36" agg base under slab
Highland Chemical Building	CUB YD	84	$92	$7,717	Highland - 36" agg base under slab
Trench excavation for piping					
84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$219	$372,640	Aspinwall clearwell bypass
84" RCP - Breuken in/out/overflow	LIN FT	1000	$219	$219,200	Breuken in/out/overflow
72" RCP - Breuken suction line	LIN FT	170	$200	$34,083	Breuken suction line
48" DIP - Highland Transfer Water Main	LIN FT	5570	$200	$1,116,729	Highland Transfer Water Main
16" DIP - Fox Chapel force main	LIN FT	350	$25	$8,848	Fox Chapel force main
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$219	$54,800	sized as 84" pipe
Pipe Trench Backfill					

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
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Alternative 6: CT Obtained in Highland 2 Reservoir

84" RCP - Aspinwall clearwell bypass	LIN FT	1700	$324	$550,018	
84" RCP - Breuken in/out/overflow	LIN FT	1000	$324	$323,540	
72" RCP - Breuken suction line	LIN FT	170	$324	$55,002	
48" DIP - Highland Transfer Water Main	LIN FT	5570	$324	$1,802,118	
16" DIP - Fox Chapel force main	LIN FT	350	$324	$113,239	
Valves (6 EACH at 25 LF) - sized as 84" pipe	LIN FT	250	$324	$80,885	
PIPING					
Pipe Installation					
84 inch clearwell bypass	LIN FT	1700	$222	$378,199	
84" Bruecken Overflow	LIN FT	1000	$222	$222,470	
72 inch RCP pump suction line connection	LIN FT	170	$222	$37,820	
Inspection and rehab of 2-48" Bruecken to H2 RM	LIN FT	12,000	$400	$4,800,000	
48" H2 transmission Main	LIN FT	5570	$222	$1,239,158	
Pipe Material					
84 inch clearwell bypass	LIN FT	1,700	$440	$748,000	
84" Bruecken Overflow	LIN FT	1,000	$440	$440,000	
72" Bruecken suction	LIN FT	170	$373	$63,410	
48" H2 transmission Main	LIN FT	5570	$370	$2,060,900	
48" river crossing	LIN FT	1500	$2,500	$3,750,000	
Utility Relocation	EA	1	$70,000	$70,000	
Large diameter valves	EA	10	$25,000	$250,000	
Subtotal Division 2				**$20,726,024**	

DIVISION 3 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Reinforced Concrete for Highland 2 PS	CY	550	$1,000.00	$550,000	
Piles Bruecken	SF	10000	$75.00	$750,000	
Reinforced Concrete for Bruecken Wet Well	CY	1350	$1,000.00	$1,350,000	
Reinforced Concrete for Lanpher Booster Station	CY	200	$1,000.00	$200,000	
Highland Chemical Building	CY	200	$1,000.00	$200,000	
Subtotal Division 3				**$3,050,000**	

DIVISION 4 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
BUILDING CONSTRUCTION - ARCHITECTURAL					
Highland Transfer Pump Station	SF	5000	$300.00	$1,500,000	previous projects
Chem Facility lanpher	SF	1000	$100.00	$100,000	
Chem Facility Highland	SF	650	$100.00	$65,000	
Structural Improvements PS	LS	1	$200,000.00	$200,000	
Subtotal Division 4				**$1,865,000**	

DIVISION 11 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	Notes
Pumps at Bruecken Pump Station	Ea	3	$700,000	$2,100,000	RAM quotes
Bruecken valves appurtenances	Ea	1	$1,500,000	$1,500,000	
Highland 2 PS ancillary	LS	1	$300,000	$300,000	
Pumps at Highland Transfer Pump Station	Ea	3	$300,000	$900,000	
Highland 2 - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	2	$18,600	$37,200	
Highland 2 - Sodium Hypochlorite Day Tank, 540 gal	Ea	1	$3,630	$3,630	
Highland 2 - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Highland 2 - Sample Pumping System	LS	1	$15,000	$15,000	
Highland 2 - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Lanpher - Sodium Hypochlorite Bulk Tank, 6150 gal	Ea	1	$18,600	$18,600	
Lanpher - Sodium Hypochlorite Day Tank, 230 gal	Ea	1	$3,100	$3,100	
Lanpher - Sodium Hypochlorite Feed Pumps	Ea	4	$10,000	$40,000	
Lanpher - Sample Pumping System	LS	1	$15,000	$15,000	
Lanpher - pH and Chlorine Residual Analyzers	LS	1	$15,000	$15,000	
Estimated Labor @ 70% of Equipment Cost				$3,501,771	
Profit and Overhead on Equipment				$750,380	

PITTSBURGH WATER AND SEWER AUTHORITY
PITTSBURGH, PA
Clearwell Improvements
Alternative 6: CT Obtained in Highland 2 Reservoir

Sub Total Division 11				**$9,254,681**

DIVISION 16 ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED PRICE	NOTES
Bruecken Pump Station Motors	LS	1	$2,500,000	$2,500,000	Estimated based on previous projects with similar upgrades
Bruecken Electrical Upgrade	LS	1	$4,000,000	$4,000,000	
Highland Transfer Pump Station	LS	1	$2,000,000	$2,000,000	Estimated based on previous projects with similar upgrades
Lanpher Booster Chlorination Station	LS	1	$15,000	$15,000	
Highland Booster Chlkorination	LS	1	15000	15000	
Subtotal Division 16				**$8,530,000**	

Exhibit RAW/C-31

Policy: Lead Line Replacement Program

Effective Date: 1/26/2018
Approved By: _____
Robert A. Weimar
Revision No.: 1.0
Revision Date:

1. Overview

In efforts to reduce the amount of lead in the Pittsburgh Water and Sewer Authority's (PWSA's) water distribution system, mitigate lead exposure through water consumption for the customer, and comply with state and federal regulations, the PWSA Board of Directors is asked to authorize a revised residential Lead Service Line Replacement (LSLR) program which includes the replacement of both the public and private portion of lead service lines (LSLs) located in PWSA's drinking water service area.

2. Purpose

This Policy would serve as the principle guidance by which the PWSA can implement a full-line LSLR strategy to comply with the Pennsylvania Department of Environmental Protection (DEP) requirements included in the November 17, 2017 Consent Order and Agreement (COA) between PWSA and DEP. The guidance shall also satisfy the PWSA Board of Directors' previously stated policy to refrain from performing partial lead service line replacements at residential properties.

3. Policy

The PWSA Board of Directors adopts this policy to allow for the goal of full-line LSLR at residential properties with no more than four (4) dwelling units with service lines 1-inch in diameter or less, for which the PWSA has maintenance responsibility for the water service line from the water main to and including the curb stop, as more fully described in PWSA Rules and Regulations (**eligible residential property**). This policy commits PWSA to full-line lead line replacement in various circumstances detailed in the procedures section of this policy. Because galvanized iron has been proven to release lead into water, galvanized iron service lines will be treated as lead service lines and replaced under this policy.

1. Any **eligible residential property** receiving a partial replacement after February 1, 2016 due to a PWSA action such as a water main replacement or PWSA's Operations' public side service line replacement, will be eligible to have their private side lead service line replaced by PWSA, at no charge to the customer.

2. If **an eligible residential property** owner replaced their private side LSL as a result of a PWSA public side replacement under an LSLR contract, PWSA operations replacement, or water main replacement between 2/1/2016 and 12/31/2018, PWSA will offer a reimbursement. The reimbursement amount will be based on the average

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Policy: Lead Line Replacement Program

Effective Date: 1/26/2018
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cost of replacement for private line segments replaced during the 2018 construction period. This reimbursement amount will be subject to formal review and approval by the PWSA Board of Directors no later than June 30, 2019. Customers who opted to replace their private lead service line on their own (i.e. unrelated to a public side replacement) are not eligible for reimbursement.

3. If PWSA determines, in its sole discretion, that replacement of the portion of the lead water service line owned by the property owner at a particular residence or related interior plumbing modification is not technically feasible, the residence is unsafe from a structural or sanitary condition, or will result in excess expense, due to conditions such as length, terrain, obstructions, structures, pavement, trees, or other utilities, PWSA may exclude such residence from the Program and not replace the portion of the lead water service line owned the property owner. These locations will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement will not, however, be completed if the property owner does not live at the property location, unless it is a relay or emergency situation.

4. **Procedure**

1. Contracts, Agreements and Purchases shall be awarded only to responsible firms or individuals that possess the ability to perform successfully under the terms and conditions of a proposed contract.

2. PWSA contracts for LSLR shall accomplish the full LSLR through various contractual approaches.

   a. **Full LSLR:** PWSA will coordinate with customers identified as having private LSL to replace the full line during construction at no cost to the property owner. The overall work orders will be prioritized based on the prevalence of children under six years of age and women of child bearing age, and incidences of high blood lead levels in the City areas being addressed

   b. **Full LSLR, targeting at-risk households using funding from the DEP Community Environmental Project (CEP):** PWSA's program will target its private LSLRs to households with income levels below 250 percent of the federal poverty level, as adjusted annually.

   c. **Emergency LSLRs:** PWSA will address replacement of the private LSL when PWSA's operations crew replaces a public LSL as a result of line breaks and leaks. This construction contract shall address partial LSLR caused by

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Policy: Lead Line Replacement Program

Effective Date: 1/26/2018
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unplanned emergency replacements. These private replacements will be offered at no cost to the property owner.

d. **Water Main Relays:** When replacing water mains (referred to as a water main relay), PWSA will offer to replace the private side lead service line when it replaces the public service line. These private side replacements will be at PWSA's cost.

3. Property owners eligible for private LSLRs under the program described in 2(a) will be contacted ahead of time and asked to enter into an agreement to allow PWSA employees and contractors to gain access to their private property in order to replace their private LSL. The agreement that will allow PWSA employees and contractors to gain access to the private property in order to replace LSLs will include provisions that require that the property owner(s) release and hold harmless the PWSA from any and all claims, causes of action, damages or losses, of any nature, whatsoever with respect to the work performed by PWSA or its contractors. Homeowners will then be asked to cooperate with PWSA's timeline for replacement and allow workers access to the service line.

4. Replacements performed under the CEP described in 2(b) will be identified by customer-requests and vetted through a third-party administrator. Details of the program associated with the November 2017 consent order and agreement with between PWSA and DEP are approved by DEP. Funds for this program are limited and are available from a settlement of an enforcement action between PWSA and the Pennsylvania Department of Environmental Protection.

5. Property owners who are in a position to receive a full LSLR per program described in 2(c) will be asked to coordinate with PWSA in an expedited fashion. PWSA will work to make the replacement process as convenient for the homeowner as possible.

6. Property owners who do not agree to PWSA's terms for full LSLR will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement will not, however, be completed in the event that the property owner does not live at the property location, unless it is a relay or emergency situation.

7. PWSA will restore roadways and public sidewalks, backfill any trenches excavated as part of the replacement process and will fill and seal any wall or floor penetrations in the private home. No other restoration will be conducted in for the private side replacement. PWSA will not replace any landscaping, interior finishes, paving, seeding, or walkways. All restoration costs shall be borne by the homeowner.

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Policy: Lead Line Replacement Program

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8. PWSA's management shall monitor all contracts to ensure that this policy is carried out and will report to the PWSA Board of Directors routinely on the status of the LSLR program.

9. PWSA management will evaluate the efficacy of each program and may propose policy modifications to the Board from time to time.

10. If a homeowner elects to replace their lead service line at their own cost, PWSA will agree to the following:
    a. PWSA will replace the public portion of the lead service line at no cost to the homeowner, including sidewalk public replacement.
    b. PWSA will not charge a tapping fee for this service.
    c. If it is to the homeowner's or PWSA's benefit to tap into a different main for ease of connection, PWSA can agree to this on a case by case basis and will waive any tapping fee for this service. The homeowner will be wholly responsible for terminating the service line at the point of the original connection.

DRAFT

Exhibit RAW/C-32

Chronology of 2019 LSLR Outreach Efforts		
Date	**Description**	**Participants**
10/23/18	Community Meeting at Homewood Cluster 4 Association	Weimar, Rampa, Duffy
11/9/18 to 11/15/18	Agreement Packets Mailed to 7,032 locations	All
11/15/18	Community Meeting at Mt. Washington CDC Community Forum	Pickering, Duffy
11/26/18	Meeting with Councilor O'Connor	Pawlak, Duffy
11/27/18	Meeting with Councilor Lavelle and Councilor Kraus	Pawlak, Duffy
11/27/18	Meeting at Perry Hilltop and Fineview Citizens Council	Duffy
12/1/18	First robocall to unresponsive locations	McLaughlin, Lead Help
12/1/18	The Northside Chronicle 2019 LSLR Advertisement	Rampa
12/3/18	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
12/5/18	PUC Meeting with Rep. Gainey	Rampa, Customer Assistance
12/6/18	PRINT 2019 LSLR Advertisement	Rampa
12/10/18	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
12/12/18	Second robocall to all who have not returned agreements	McLaughlin, Lead Help
12/12/18	PUC Meeting with Rep. Wheatley	Rampa, Customer Assistance
12/13/18	PRINT 2019 LSLR Advertisement	Rampa
12/14/18	List of unresponsive locations to Council Districts	Rogers/Rampa
12/17/18	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
Week of 12/17/18	Drive thru of all work order locations to get a general understanding of vacants and street condition	Field Liaisons
12/18/18	Meeting with Councilor Rev. Burgess	Pawlak, Duffy
12/20/18	PRINT 2019 LSLR Advertisement	Rampa
12/24/18	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
12/28/19	Third robocall to all who have not returned agreements	McLaughlin, Lead Help
12/31/18	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
1/1/19	The Northside Chronicle 2019 LSLR Advertisement	Rampa
1/2/19 - 1/11/19	Door Hangers for Unresponsive locations	Lead Help, Field Liaison, Communications, etc.
1/2/19	Meeting at the Homewood Concerned Citizens Council Monthly Meeting	Rampa, Duffy, Lead Help
1/7/19 to 1/18/19	Canvassing in Perry North	Lead Help, Field Liaison, Communications, etc.
1/7/19 to 1/21/19	Canvassing in Perry South	Lead Help, Field Liaison, Communications, etc.
1/7/19	Fourth robocall to all who have not returned agreements	McLaughlin, Lead Help
1/9/19 to 1/24/19	Canvassing in Homewood	Lead Help, Field Liaison, Communications, etc.
1/10/19	PRINT 2019 LSLR Advertisement	Rampa
1/15/19	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa

1/16/19	Observatory Hill Inc. Community Meeting	Rampa, Duffy, Lead Help
1/17/19	PRINT 2019 LSLR Advertisement	Rampa
1/17/19 to 1/23/19	Distribute lists of unresponsive locations to City Councilor Offices for outreach assistance	Rampa
1/18/19	Fifth robocall to all who have not returned agreements.	McLaughlin, Lead Help
1/22/19 to 2/4/19	Canvassing in Mt. Washington	Lead Help, Field Liaison, Communications, etc.
1/22/19	Perry Hilltop Citizens Council Joint Community Meeting	Rampa, Duffy, Lead Help
1/24/19	PRINT 2019 LSLR Advertisement	Rampa
1/24/19	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
1/24/19	Homewood Community Group Meeting	Rampa, Duffy
1/27/19	Greenfield Community Association Annual Meeting	Rampa, Lead Help
1/28/19	Sixth robocall to all who have not returned agreements.	McLaughlin, Lead Help
1/29/19	South Pittsburgh Reporter 2019 LSLR Advertisement	Rampa
1/29/19 to 2/8/19	Canvassing in Southside Slopes	Lead Help, Field Liaison, Communications, etc.
1/31/19	PRINT 2019 LSLR Advertisement	Rampa
2/5/19 to 2/11/19	Canvassing in Morningside	Lead Help, Field Liaison, Communications, etc.
2/6/19	Homewood Concerned Citizens Council	Rampa, Duffy, Lead Help
2/7/19 start	Canvassing in Greenfield	Lead Help, Field Liaison, Communications, etc.
2/11/19	Distribute lists of unresponsive locations to City Councilor Offices for outreach assistance	Rampa
2/15/19	Sixth robocall to all who have not returned agreements.	McLaughlin, Lead Help
2/16/19 start	Canvassing in Perry	Lead Help, Field Liaison, Communications, etc.
2/16/19 start	Canvassing in Homewood	Lead Help, Field Liaison, Communications, etc.
2/18/19 start	Canvassing in Northside	Lead Help, Field Liaison, Communications, etc.
2/21/19	Reached out to Homewood Children's Village about setting up meeting (Already working with Operation Better Block via Homewood Cluster 4)	Rampa
2/22/19 start	Canvassing in South Side	Lead Help, Field Liaison, Communications, etc.
2/27/19	Meeting with Councilor Harris	Pawlak, Duffy
2/28/19	Homewood Cluster 4 Meeting	Lead Help, Communications, Duffy
2/28/19	WPXI ran story on canvassing efforts	Lead Help, Communications
3/5/19	Meeting with Councilwoman Kali-Smith	Pawlak
3/6/29	Homewood Concerned Citizens Monthly Council Meeting	Lead Help, Duffy, Rampa
3/11/19 to 3/13/19	Distribute lists of unresponsive locations to City Councilor Offices for outreach assistance	Rampa
3/12/19	South Side Slopes Community Meeting	Lead Help, Duffy, Rampa
3/18/19	Reminder robocall for Squirrel Hill community meeting	McLaughlin, Lead Help

3/19/19	Squirrel Hill Urban Coalition Community Meeting	Lead Help, Weimar, McLaughlin
3/21/19	Mount Washington CDC Meeting	Lead Help, Duffy, Rampa
3/22/19	Seventh robocall to all who have not returned agreements	McLaughlin, Lead Help
3/28/19	Rep. Gainey Lead Meeting	Lead Help, Rampa, Pickering
3/28/19	Operation Better Block Community Meeting	Lead Help, McLaughlin
4/8/19	Eighth robocall to all who have not returned agreements	McLaughlin, Lead Help
4/11/19	Distribute lists of unresponsive locations to City Councilor Offices for outreach assistance	Rampa
4/25/19	Rep. Wheatley Golden Luncheon	Lead Help, Rampa
4/25/19	Evening Canvassing for Unresponsive Locations WOB02A	Lead Help, Field Liaison
4/25/19	Evening Canvassing for Unresponsive Locations WOB04A	Lead Help, Field Liaison
4/29/19	Evening Canvassing for Unresponsive Locations WOB01	Lead Help, Field Liaison
4/29/19	Outreach to Mayor's office for CEP and LSLR Programs	Rampa
5/1/19	Evening Canvassing for Unresponsive Locations WOB02A	Lead Help, Field Liaison
5/1/19	Morningside Community Meeting	Rampa, Duffy
Week of 5/6/19	Evening Canvassing for Unresponsive Locations WOB01 & B04A	Lead Help, Field Liaison
6/10/19	Allen Services Community Meeting	Weimar, Rampa, Lead Help

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

SUPPLEMENTAL DIRECT TESTIMONY OF

ROBERT A. WEIMAR

ON BEHALF OF
THE PITTSBURGH WATER
AND SEWER AUTHORITY

Docket Nos. M-2018-2640802 and M-2018-2640803

Pittsburgh Water and Sewer Authority
Compliance Filing Proceeding

Procedural Updates
PWSA Compliance Plan Progress Report
Additional Documents
Infrastructure and Operations
LTIIP
Lead Remediation

August 2, 2019

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PWSA Exhibits

Exh. No.	Document
RAW/C-28(A)	PWSA Second Compliance Plan Progress Report current through July 31, 2019 [L0824454]
Updated RAW/C-10 (clean version)	PWSA Capital Improvement Projects Highlighting DEP Admin Order Ones [L0824432]
Updated RAW/C-10 (red-line version)	PWSA Capital Improvement Projects Highlighting DEP Admin Order Ones [L0824433]
RAW/C-33	PWSA Letter to DEP Nov 20 2017 in Response to Oct 25 2017 DEP Administrative Order [L0789908]
RAW/C-34	PWSA Project Operators for Open and Active Projects as of 7/31/19 [L0823921]
RAW/C-35	PWSA Board Resolution 91 Authorizing Exec Dir To Prioritize CIP To Designate High Priorities May 17 2019 [L0813752]
RAW/C-36	PWSA Water Distribution System Master Plan Scope of Work and Draft Table of Contents [L0818114]
RAW/C-37	Buchart Horn Proposal For 2019 Unmetered & Flat Rate Properties Evaluation Project Dated April 17, 2019 [L0818525]
RAW/C-38	PWSA Presentation Re: Status of Metering Plan dated May 29, 2019 [L0823990]
RAW/C-39	PWSA Presentation Re: Leak Detection dated June 7, 2019 [L0824027]
RAW/C-40	PWSA System Flow Meter Operation Status current as of 7/31/19 [L0824040]
RAW/C-41	PWSA SOP for Reporting Low Pressure Readings, Breaks, and Boil Water Advisories [L0824045]
RAW/C-42	PWSA Internal Work Flow Processes For Reporting Low Pressure Readings, Breaks, and Boil Water Advisories [L0824061]
RAW/C-43	Revised Pages From PWSA's LTIIP Filed On September 28, 2019 [L0824399]
RAW/C-44	PWSA Service Line Material Inventory Revised Approach July 31, 2019 [L0823910]
RAW/C-45	PWSA Lead Line Replacement Program Policy – May 24, 2019 [L0824079]
RAW/C-46	PWSA Lead Service Line Replacement Policy Approved July 26, 2019 [L0824078]

Documents to be Entered By Stipulation

Exh. No.	Directed Question Reference	Document Title
Stip Doc - 1	1.5	Performance Audit of PWSA by the Office of City Controller dated Feb 2017 [L0790106]
Stip Doc - 2	1.6	IMG Briefing to the Blue Ribbon Panel on the PWSA Restructuring Options Assessment dated November 8, 2017 [L0790110]
Stip Doc - 3	1.7	PA Auditor General Performance Audit Report of PWSA dated November 2017 [L0824466]
Stip Doc - 4	1.7	County of Allegheny Controller Performance Audit Report ACHD Programs Re Lead Dated July 25, 2017 [L0756918]
Stip Doc - 5	1.12	DEP/EPA Results of Comprehensive Performance Evaluation For PWSA Aspinwall Water Filtration Plant, Sep 18-22, 2017 [L0790113]

I. INTRODUCTION AND PROCEDURAL UPDATE

Q. PLEASE STATE YOUR NAME AND CURRENT POSITION WITH PWSA.

A. My name is Robert "Bob" A. Weimar. My position with The Pittsburgh Water & Sewer Authority ("PWSA" or "Authority") is Executive Director.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY IN THIS PROCEEDING?

A. Yes. On February 14, 2019, I submitted direct testimony marked as PWSA St. No. C-1. The direct testimony was accompanied by 27 exhibits marked as RAW/C-1 through RAW/C-27. On May 6, 2019, I served rebuttal testimony marked as PWSA St. C-1R. The rebuttal Testimony was accompanied by five exhibits marked RAW/C-28 through RAW/C-32.

Q. WHAT IS THE PURPOSE OF YOUR SUPPLEMENTAL DIRECT TESTIMONY?

A. The purpose of my supplemental direct testimony is to discuss certain developments that have occurred since submitting written direct and rebuttal testimonies in this proceeding and to provide additional information related to the following topics that I addressed in my direct and rebuttal testimonies:

- PWSA Compliance Plan Progress Report,
- Additional Documents,
- Infrastructure and Operations,
- Long Term Infrastructure Improvement Plan; and,
- Lead Remediation.

II. PROCEDURAL UPDATES SINCE REBUTTAL TESTIMONY

Q. PLEASE EXPLAIN WHY YOU ARE SUBMITTING SUPPLEMENTAL DIRECT TESTIMONY.

A. Upon PWSA's review of the written direct testimony of the Bureau of Investigation and Enforcement, the Office of Consumer Advocate, the Office of Small Business Advocate,

Pittsburgh UNITED, and Pennsylvania-American Water Company (collectively, the "Parties"), we concluded that there appeared to be a significant number of issues which we thought could be resolved through further discussions with the Parties. Given the number and complexity of these issues, as well as the litigation schedule that had been previously established, however, there was not enough time to allow those discussions to occur prior to the then-scheduled technical hearings. To address this, PWSA and the Parties jointly requested that the Commission grant: (1) a three-month extension of the then existing litigation deadlines; and, (2) that specific consumer service issues be moved from Stage 1 to Stage 2.[1] The Commission granted this request via Secretarial Letter dated May 15, 2019.

Q. FOLLOWING THE COMMISSION'S MAY 15, 2019 SECRETARIAL LETTER WAS A NEW LITIGATION SCHEDULE DEVELOPED?

A. Yes. A prehearing conference was held on June 7, 2019, during which a new litigation schedule was developed. The new schedule included the opportunity for PWSA and the Parties to serve supplemental written direct and rebuttal testimony.

Q. ARE OTHER PWSA WITNESSES PRESENTING SUPPLEMENTAL WRITTEN DIRECT TESTIMONY?

A. Yes, supplemental written direct testimony is being provided by all of PWSA's witnesses, which includes Debbie Lestitian, Jennifer Presutti, and Julie Quigley.

Q. WHAT IS THE GENERAL PURPOSE OF PWSA'S SUPPLEMENTAL TESTIMONY?

A. Each of PWSA's witnesses will be providing updated information about their topic areas in their respective supplemental testimonies. In the three months that have passed since

[1] *See,* Expedited Motion for Extension of Commission-Created Deadlines dated May 13, 2019.

PWSA's written rebuttal testimony, PWSA's business operations directly impacting the issues in this Compliance Plan Stage 1 proceeding have continued to move forward. Therefore, one purpose for PWSA's supplemental direct testimony is to provide updated information regarding PWSA's previously served direct and rebuttal testimony.

Q. CAN YOU PROVIDE A BROAD OVERVIEW OF THE DISCUSSIONS AMONG PWSA AND THE PARTIES OVER THE PAST THREE MONTHS?

A. Yes. Since May 22, 2019, PWSA and the Parties have been meeting on a regular basis (nearly weekly) to work through the issues of this Stage 1 proceeding. PWSA has found these meetings to be extremely helpful to better understand the Parties' various positions. These meetings have also provided PWSA with a welcome forum to better explain its operations and how it is working toward compliance with the Commission's requirements. During these meetings, each topic under consideration in Stage 1 has been discussed and – through the constructive discourse between PWSA and the Parties – a settlement in principle has been reached on a substantial number of these topics. With the exception of PWSA's lead service line remediation program, the remaining issues have all either been resolved or (for a relatively small number) identified as ones that are to be reserved for litigation. PWSA and the Parties are continuing to discuss the lead service line remediation program, and I am hopeful that we will be able to reach settlement regarding a substantial number of issues related to this topic as well.

Q. HAVE THESE DISCUSSIONS ALSO INFORMED THE PURPOSE FOR PWSA'S SUPPLEMENTAL DIRECT TESTIMONY?

A. Yes. PWSA and the Parties have spent much time over the last three months drafting written stipulations that will be presented to the Commission for its approval. In the course of this process, information needed to support the agreed-to stipulations was identified. PWSA is including this information in its supplemental direct testimony for

the Commission's consideration as it evaluates the proposed settlement PWSA and the Parties are planning to file.

III. PWSA COMPLIANCE PLAN PROGRESS REPORT

Q. IN YOUR REBUTTAL TESTIMONY, YOU PROVIDE PWSA'S FIRST COMPLIANCE PLAN PROGRESS REPORT (PWSA ST. NO. C-1R AT 3; EXH. RAW/C-28). DO YOU HAVE ANY UPDATES SINCE THIS EXHIBIT WAS PROVIDED?

A. Yes. Attached to this supplemental testimony is Exh. RAW/C-28(A), which is PWSA's Second Compliance Plan Progress Report that updates the information contained in RAW/C-28 through July 30, 2019 and provides some additional information consistent with the agreements reached with the Parties.

Q. WHAT IS THE PURPOSE OF THE COMPLIANCE PLAN PROGRESS REPORTS?

A. As explained in my rebuttal testimony, the Compliance Plan Progress Report provides an on-going and updated status report about PWSA's progress toward satisfying the commitments made in its initial Compliance Plan filed on September 28, 2018, its Compliance Plan Supplement filed February 1, 2019, and as part of the Commission's approval of PWSA's rate case (Docket No. R-2018-3002645). Going forward, PWSA also plans to include in these Compliance Plan Progress Reports information it agrees to provide as part of the settlement with the Parties in this Stage 1 proceeding.

Q. DOES PWSA PROPOSE TO CONTINUE TO FILE THE COMPLIANCE PLAN PROGRESS REPORTS IN THE FUTURE?

A. Yes. PWSA will continue to file Compliance Plan Progress Reports with the Commission on a quarterly basis pending a Final Order in this Stage 1 proceeding. The October 31, 2019 and January 30, 2020 Compliance Plan Progress Report, which will be filed with the Commission, will include the information PWSA agrees to provide as part

of the settlement with the Parties in this Stage 1 proceeding. Thereafter, and subject to the Commission's approval, PWSA proposes to continue to update this report and file it with the Commission on a quarterly basis through October 31, 2025, unless the date is otherwise extended by the Commission or through mutual agreement with the parties.

IV. ADDITIONAL DOCUMENTS IN RESPONSE TO COMMISSION DIRECTED QUESTIONS

Q. DID YOU PREVIOUSLY SPONSOR DOCUMENTS INTENDED TO BE RESPONSIVE TO THE COMMISSION'S DIRECTED QUESTION IDENTIFYING SPECIFIC DOCUMENTS AND REQUESTING THAT PWSA INTRODUCE INTO EVIDENCE THOSE MATERIALS IT INTENDS TO USE AS SUPPORT FOR THE COMPLIANCE PLAN (PWSA EXHIBIT RAW/C-1 AT 1, QUESTION NO. 1)?

A. Yes. PWSA Exhibits RAW/C-3 through RAW/C-11 were included with my direct testimony. As explained further in my direct and rebuttal testimonies, these documents were selected as the ones PWSA intends to use as support for the Compliance Plan. I also identified those documents that PWSA did not view as necessary to support the Compliance Plan and the reason for that decision with regard to each document identified in the Commission's Directed Questions. However, as stated in my rebuttal testimony, PWSA is willing to provide copies of any documents referenced in the Commission's Directed Questions. (PWSA St. No. C-1 at 8-12; PWSA St. No. C-1R at 6-7).

Q. DO YOU HAVE ANY UPDATES TO THESE PREVIOUSLY PROVIDED EXHIBITS?

A. Yes. Information regarding all of PWSA's Capital Improvement Projects was included as Exh. RAW/C-10 with my direct testimony.[2] This exhibit has been reviewed and the

[2] While all the information included in Exh. RAW/C-10 is also provided in Exh. RAW/C-29 that I included with my rebuttal testimony, Exh. RAW/C-29 added information regarding the Consultant/Contract for each project.

information updated as appropriate. Exh. Updated RAW/C-10, which is being included with this testimony, provides the updated information. I am including both a clean and red-lined version of this updated exhibit.

Q. WHY ARE YOU PROVIDING THIS UPDATED INFORMATION?

A. As I stated earlier, PWSA's operations are continuing to move forward and, as a part of that, our capital plans are continuing to progress. As explained in my direct testimony, each year PWSA staff prepares a capital expenditure budget and capital commitment budget that is presented to the PWSA Board for approval for the upcoming year. (PWSA St. No. 1-C at 11-12). This process is currently underway, but it has not yet been finalized. However, given the passage of time since these exhibits were previously submitted, PWSA concluded that providing the Commission with the most up-to-date information available as of the time of this supplemental testimony is important.

Q. RECOGNIZING CONCERNS RAISED BY I&E REGARDING THE DOCUMENTS THAT HAVE NOT PREVIOUSLY BEEN PROVIDED, HOW DOES PWSA PROPOSE TO PROCEED?

A. As a result of further discussions with the Parties, attached as PWSA Exhibit RAW/C- 33 is PWSA's November 20, 2017 letter to the Department of Environmental Protection ("DEP") in response to the October 25, 2017 DEP Administrative Order. I am sponsoring this document in response to the Commission's Directed Question Number 1.11 (as numbered on PWSA Exhibit RAW-C-1).

Q. ARE YOU PROVIDING ADDITIONAL DOCUMENTS AS PART OF THIS SUPPLEMENTAL TESTIMONY?

A. Yes. Consistent with an agreement reached among the Parties, I am including the following non-PWSA documents with this testimony which we propose to enter into the record by stipulation.

Exh. No.	Directed Question Reference	Document Title
Stip Doc - 1	1.5	Performance Audit of PWSA by the Office of City Controller dated FEB 2017
Stip Doc - 2	1.6	IMG Briefing to the Blue Ribbon Panel on the PWSA Restructuring Options Assessment dated November 8, 2017
Stip Doc - 3	1.7	PA Auditor General Performance Audit Report of PWSA dated November 2017
Stip Doc - 4	1.7	County of Allegheny Controller Performance Audit Report ACHD Programs Re Lead Dated July 25, 2017
Stip Doc - 5	1.12	DEP/EPA Results of Comprehensive Performance Evaluation For PWSA Aspinwall Water Filtration Plant, Sep 18-22, 2017

Q. WHY ARE YOU PROPOSING TO ENTER THESE DOCUMENTS VIA STIPULATION IN LIEU OF PWSA SPONSORING THE DOCUMENTS?

A. None of these documents were prepared by PWSA, and PWSA does not necessarily support the conclusions and/or characterizations about PWSA contained in these documents. While these documents are instructive for the purposes of illustrating the number of reviews and studies that PWSA has undergone over the years, it is important to reiterate that PWSA does not support many of the characterizations and/or conclusions of these various studies. With that said, I understand that the Commission has requested these documents, and the position of some Parties is that the documents should be included in the record. Therefore, I am including them with this supplemental testimony.

Q. RECOGNIZING THAT PWSA IS NOT SPONSORING THESE DOCUMENTS, WHY ARE YOU INCLUDING THEM WITH YOUR SUPPLEMENTAL DIRECT TESTIMONY?

A. For administrative efficiency. Rather than submitting these documents for the record as part of the hearing, or packaging them with a settlement document to be filed, PWSA determined that pre-marking these exhibits as “Stip Doc-” and providing them to the

parties, the Administrative Law Judges and, ultimately, the Commission as part of this supplemental testimony is the most efficient way to proceed.

Q. ARE THERE OTHER DOCUMENTS REFERENCED IN DIRECTED QUESTION NUMBER 1 THAT PWSA HAS NOT INCLUDED WITH ANY OF ITS TESTIMONY?

A. Yes, PWSA has not provided documents in response to Directed Question Numbers 1.2, 1.3, 1.4, 1.13, 1.13 and 1.14 because all of these documents relate to Stage 2 stormwater issues. In addition, many of these documents are voluminous, and some are still in the process of being developed. While I recognize that the Commission requested these documents as part of its Directed Questions for this Stage 1 of the proceeding even while deferring stormwater issues to Stage 2, PWSA proposes to defer submission of these documents to the Stage 2 process. Of course, if the Commission directs otherwise in its final order for Stage 1, PWSA will provide the responsive documents available at that time.

Q. SETTING ASIDE THE STORMWATER RELATED DOCUMENTS, ARE ALL THE STAGE 1 DOCUMENTS THAT HAVE BEEN PROVIDED IN RESPONSE TO DIRECTED QUESTION NUMBER ONE THOSE THAT PWSA TOOK INTO CONSIDERATION DURING THE DRAFTING OF ITS COMPLIANCE PLAN.

A. Yes.

V. INFRASTRUCTURE AND OPERATIONS

(A) Construction Project Processes and Contractors

Q. HAS PWSA ALREADY PROVIDED A LIST OF CURRENT PROJECTS, THEIR STATUSES, THE ASSIGNED CONSULTANTS, NOMINAL COMPLETION SCHEDULES AND CURRENT RISKS?

A. Yes. This information was provided in RAW/C-29 which contained the same information included with RAW/C-10 but added a column entitled “Consultant/Contract”

to provide the name of the consultant/contractor. (PWSA St. No. C-1 at 12; Exh. RAW/C-10 and PWSA St. No. C-1R at 9; Exh. RAW/C-29).

Q. ARE YOU PROVIDING ADDITIONAL INFORMATION HERE TO BE RESPONSIVE TO THE COMMISSION'S DIRECTED QUESTION NUMBER 6 REQUEST, IN PART, FOR "THE INDIVIDUAL DESIGN ENGINEER AND COMPANY AFFILIATION" FOR PWSA'S CAPITAL PROJECTS?

A. Yes. Based on further discussions with the Parties, PWSA has prepared a list of all project operators for open and active projects as of July 31, 2019. This list is included here as Exhibit RAW/C-34.

(B) Clearwell Improvements Projects

Q. YOU DISCUSS PWSA'S ASPINWALL CLEARWELL IMPROVEMENT PROJECT IN DETAIL IN YOUR REBUTTAL TESTIMONY (PWSA ST. NO. C-1R AT 9-11). IS THE ASPINWELL CLEARWELL PROJECT A HIGH PRIORITY OF PWSA'S?

A. Yes. On May 16, 2019, PWSA Board Resolution 91 was adopted. This resolution authorizes PWSA's Executive Director to accelerate implementation of highly critical facilities, consistent with state and federal agency recommendations and requirements. The Resolution identifies the repair and replacement of the Aspinwall Clearwell as one of PWSA's high priority projects. A copy of the Board Resolution 91 is attached hereto as Exhibit RAW/C-35.

Q. DO YOU HAVE ANY UPDATE REGARDING THE DEP PROPOSED ADMINISTRATIVE ORDER YOU DISCUSSED IN YOUR REBUTTAL TESTIMONY (PWSA ST. NO. C-1R AT 11)?

A. Yes. PWSA and the Pennsylvania Department of Environmental Protection ("DEP") are actively negotiating the terms of a Consent Order and Agreement ("COA") which will address the key projects that must be implemented on the schedule as set forth in the Consent Order and Agreement. As this process involves settlement negotiations between PWSA and DEP, PWSA is not in a position to share the draft COA that is currently under

discussion. However, I expect that a final COA will be executed in September, and PWSA will provide a copy of the final executed COA to the Parties when it becomes available.

Q. PLEASE EXPLAIN THE RELEVANCE OF THE COA TO PWSA'S CAPITAL PROJECT PLANNING AND ITS LONG-TERM INFRASTRUCTURE IMPROVEMENT PLAN.

A. The pending COA will establish the projects and timelines for the Clearwell Improvement and other associated projects as may be included in the COA. PWSA will use this information to inform its planning related to its Capital Improvement Program, which will then be used to amend/update PWSA's Long-Term Infrastructure Improvement Plan in the future.

(C) 52 Pa. Code § 65.17 – Standards of Design and Replacement of 4-Inch Diameter Water Mains

Q. PLEASE PROVIDE AN UPDATE REGARDING THE STATUS OF PWSA'S ON-GOING PROCESS TO UPDATE THE WATER DISTRIBUTION SYSTEM MASTER PLAN.

A. As explained in my direct testimony, PWSA is in the process of updating its current engineering plan (as contained in PWSA Exh. RAW/C-7). (PWSA St. No. C-1 at 11). This master planning will develop a detailed process to clearly identify needed improvements to the distribution system, to develop criteria for evaluating and ranking candidate water mains for renewal, present an assessment of expected growth in the system, assess vertical assets and recommend a five year plan of capital improvements and annual priorities. In addition, the Final Water Distribution System Master Plan will also address master metering, non-revenue water, a water audit, pressure zones and gradients, pumping, storage, transmission mains, distribution mains, and system emergency interconnections. As such, the master planning effort is an integral part of

assisting PWSA in its transition to complying with the Commission's regulations and identifying the improvements needed in the distribution system. The Final Water Distribution System Plan will inform any future revisions that may be needed to PWSA's LTIIP which will be presented for the Commission's consideration as part of the LTIIP process. To provide more detailed substantive context about the scope of PWSA's Water Distribution System Master Plan process, I am including the Scope of Work and Draft Table of Contents for the Water Distribution System Master Plan as Exh. RAW/C-36.

Q. WHAT IS THE CURRENT TARGETED COMPLETION DATE FOR THE FINAL WATER DISTRIBUTION SYSTEM PLAN?

A. The targeted completion date is late 2019 to mid-2020.

Q. HOW WILL THE FINAL WATER DISTRIBUTION SYSTEM MASTER PLAN INFORM PWSA'S REPLACEMENT OF 4-INCH DIAMETER WATER MAINS?

A. As I previously testified, PWSA currently places a high priority on the replacement of 4-inch diameter mains as part of the 2019 and 2020 Small Diameter Water Main Replacement Program and is incorporating the Commission's design requirements, specifications, and standard details into a formalized design manual. (PWSA St. No. C-1 at 17; PWSA St. No. C-1R at 15). A prioritization matrix is to be developed as part of the Water Distribution System Master Plan, which will inform the ranking of PWSA's various projects to include the replacement of 4-inch diameter water mains.

(D) UnMetered/Unbilled Service And Meter Testing

1) Overall Metering Plan

Q. CAN YOU PLEASE SUMMARIZE THE ISSUES RELATED TO PWSA'S METERS?

A. Yes. Currently, there are customers utilizing PWSA's water and there is no meter on their property. Some customers are receiving bills pursuant to PWSA's flat rates. Some

customers are unbilled. Also, a substantial number of PWSA's meters are aged. Therefore, part of the process of coming into compliance with Commission requirements involves PWSA comprehensively addressing all of these issues.

Q. PLEASE PROVIDE AN UPDATE AS TO PWSA'S PLANS TO IDENTIFY UNMETERED/UNBILLED AND FLAT RATE PROPERTIES.

A. As I explained in my rebuttal testimony, PWSA has selected a consultant and awarded a contract to assist in identifying and evaluating unmetered facilities and flat rate customers. The PWSA Board approved the consulting contract with the accepted vendor on April 26, 2019. PWSA St. No. C-1R at 17. To provide some additional and current information, the selected Professional Engineering Consultant is Buchart Horn. Pursuant to the Buchart Horn Proposal, Buchart Horn will investigate more than 700 properties that are either unmetered or are currently being billed on a flat rate to determine the extent of improvements required to comply with PWSA's current backflow and metering requirements. The current process for identifying these properties is described in detail in Buchart Horn's Proposal entitled "2019 Unmetered & Flat Rate Properties Evaluation Project," and dated April 17, 2019. Buchart Horn's Proposal is attached hereto as Exhibit RAW/C-37. PWSA has started the site inspections of these unmetered facilities. As is outlined in the Buchart Horn Proposal, PWSA will actively search for additional municipal, flat rate, and other unmetered properties through various Geographic Information System ("GIS") and other data sources. When found, these properties will be added to the list of properties requiring meters. Consistent with the Buchart Horn Proposal, PWSA anticipates that all unmetered and/or unbilled locations will be identified by June 29, 2020.

Q. WHAT IS THE CURRENT STATUS OF PWSA'S METER TESTING AND REPLACEMENT PLAN, AS DESCRIBED IN YOUR DIRECT AND REBUTTAL TESTIMONIES (PWSA ST. NO C-1 AT 31- 34; PWSA ST. NO. C-1R AT 24-27)?

A. PWSA's Meter Upgrade Program is a concerted effort of PWSA's Customer Service and Field Operations departments. The status of PWSA's Metering Plan as of May 29, 2019 is set forth in detail in RAW/C-38. In March 2019, PWSA purchased and installed a state of the art water meter testing bench in its Central Warehouse for the testing of meters 2" or less. In April 2019, PWSA implemented a Meter Upgrade Program, wherein Customer Service and Field Operations personnel embarked on a concerted effort to gain access to customer buildings in order to upgrade water meters. The campaign includes mailing letters, calling customers, scheduling appointments, and keeping the appointments to replace water meters. The final number of meters upgraded in April 2019 was 884. An additional 723 meters were upgraded as of May 29, 2019. Of these 1,607 upgraded meters, 1,561 were 5/8" to 1" meters, 29 were 1 ½" to 2" meters, and 17 were meters measuring 3" and greater. Also as of May 29, 2019, all 2" or less meters pulled from service were being tested. As of the same date, 1,849 meters measuring 5/8" to 1" and 13 meters measuring 1 ½" to 2" have been tested. I am happy to report that PWSA's metering program is going very well. From April through July 2019, PWSA has upgraded over 3,000 meters. Based on these results, I am comfortable increasing my initial upgrade estimate of 1,000 meters in 2019 to over 6,000 meters by the end of 2019.

Additionally, PWSA has entered into a contract with Vanguard to test meters that are 3" and greater. All meters that are 3" or greater and have been in service longer than 8 years will either be tested or replaced, whichever is more cost-effective. If the meter is tested and fails testing, it will be replaced. With the addition of this vendor and the state

of the art water meter testing bench in PWSA's Central Warehouse, PWSA will be able to accommodate customer-generated meter testing requests.

Q. PLEASE EXPLAIN HOW PWSA'S CURRENT METER TESTING PLAN ADDRESSES THE COMMISSION DIRECTED QUESTION NUMBER 27 REQUESTING PARTIES TO DISCUSS "THE FEASIBILITY OF IMPLEMENTING A METER TESTING TRIAGE PLAN."

A. PWSA will prioritize the testing/replacement of large meters (meters 3 inches and larger), and will make its best efforts to complete the testing/replacement of all large meters/measuring chambers and registers within 3 years. PWSA intends to replace all intermediate meters (meters equal to or larger than 1 ½ inch in diameter and equal to or smaller than 2 inches) that have been in service more than 8 years, or where the installation date is unknown, and will make its best efforts to complete the replacement of intermediate meters within 3-5 years. PWSA intends to replace all of these small meters (meters one inch in diameter and smaller) that have been in service more than 20 years, or where the installation date is unknown, and will make its best efforts to complete the replacement of small meters within 5-7 years. PWSA's recent efforts enable it to now accommodate customer-generated meter testing requests.

2) <u>Billing Of and Payment For Meter Installation for Municipal Meters/Properties Within The City Of Pittsburgh</u>

Q. DO MUNICIPAL PROPERTIES WITHIN THE CITY OF PITTSBURGH PRESENT SPECIAL ISSUES WITH REGARD TO PWSA'S OVERALL METER PLAN?

A. Yes. The payment for service specifically to municipal properties within the City of Pittsburgh has historically been governed by a Cooperation Agreement between PWSA and the City. The costs of new meters for these properties is similarly an issue that would historically be governed by the Cooperation Agreement. While Ms. Lestitian will provide more information related to current negotiations for a new Cooperation

Agreement, I want to make the point here that PWSA's meter program applies to all properties in its service territory. Therefore, as non-municipal properties are metered, those customers will be fully billed pursuant to PWSA's tariffs. The costs of metering the meter installations for these non-municipal properties will be in accordance with PWSA's Commission approved tariff. Regarding the installation costs and future billing for the municipal properties within the City of Pittsburgh, as I explained in my direct testimony, PWSA and the City have been negotiating a path forward which involves the "phased-in" and "stepped" approach and an installation cost sharing. (PWSA St. No. C-1 at 18). I recognize that not all the Parties support this approach and that PWSA's filing of the new Cooperation Agreement with the details about the approach will be subject to Commission review but, again, I feel it is important to reiterate that the billing and costs of installation of meters for municipal properties within the city of Pittsburgh is just one part of PWSA's overall metering plan.

(E) Water Conservation Measures, Accounted-For Water and Leak Detection and Leak Surveying

1) Leak Detection and Leak Survey

Q. IN YOUR DIRECT AND REBUTTAL TESTIMONIES, YOU DISCUSS PWSA'S EFFORTS TO FORMALIZE ITS LEAK DETECTION PROGRAM (PWSA ST. NO. C-1 AT 39-42; PWSA ST. NO. C-1R AT 31). PLEASE PROVIDE AN UPDATE REGARDING THESE EFFORTS.

A. PWSA's Leak Detection Program was launched in April 2019 to modernize leak detection equipment, to enhance leak detection accuracy, and to improve coverage as well as to adopt new leak detection technology to accurately locate breaks. More information about PWSA's Lead Detection program is included in Exh. RAW/C-39. I am proud to report that the PWSA's Leak Detection Program is already showing significant results. During the month of May 2019, PWSA located and repaired 63 main

line leaks, 52 service line leaks, 6 leaking hydrants, and 12 leaking valves. Because of the upgrades and reorganization of personnel, PWSA has been more proactive in locating and pin pointing leaks. PWSA's launch of the SpryMobile platform in October 2018 has enabled us to convert plumbers and field technicians from paper work orders to a web-based application that will track system repairs, inspections, preventative and corrective maintenance, and will more efficiently record with GIS mapping the numerous field activities that occur over a long duration. PWSA's leak detection activities and outcomes will be tracked via the SpryMobile app.

2) <u>52 PA Code § 65.14 Source of Supply Measurement</u>

Q. DO YOU HAVE AN UPDATE REGARDING THE STATUS OF THE ROSS PUMP STATION METER?

A. Yes. As explained in my direct testimony, PWSA brings in water from the Allegheny River to the water treatment plant via the Ross Pump Station. (PWSA St. No. C-1 at 43). I can now report that this meter is operational, recently rehabilitated, tested and found accurate.

Q. YOU PREVIOUSLY TESTIFIED THAT PWSA IS REFURBISHING THE EXISTING FLOW METERS IN THE BRUECKEN AND ASPINWALL PUMP STATIONS TO ESTABLISH SEVERAL POINTS TO MEASURE WATER FLOWS AND TO ASSESS WATER LOSSES IN THE PUMP STATION. (PWSA ST. NO. C-1R AT 35). PLEASE PROVIDE AN UPDATE ON THE CURRENT STATUS OF THIS PROJECT.

A. All flow meters at the Aspinwall Pump Station are operational. Flow meters at the Bruecken Pump Station for the flow to Highland 2 Reservoir are operational. Flow meters at the Bruecken Pump Station for the flow to Highland 1 Reservoir are still being rehabilitated. Insertion-type flow meters were installed at the Highland 1 Reservoir primary rising mains to monitor flow going directly into the system from the Bruecken Pump Station.

Q. CAN YOU PROVIDE A CURRENT STATUS OF PWSA'S SYSTEM FLOW METER OPERATION?

A. Yes. Exh. RAW/C-40 included here provides the PWSA System Flow Meter Operation Status, which is current as of July 31, 2019.

Q. PLEASE PROVIDE AN UPDATE OF PWSA'S CURRENT METER OPERABILITY AND MEASUREMENT PLAN.

A. Further projects related to meter operability and measurement are being evaluated with a targeted completion date of late 2019. PWSA's flow metering program is anticipated to include: 1) a testing and calibration plan for all facility flow meters; 2) the rehabilitation and calibration of flow meters at existing pump stations (Herron Hill Pump Station, Herron Hill Tank Pump Station, Howard Pump Station, Mission Pump Station, Lincoln Pump Station, and Saline Pump Station); 3) the installation of district flow meters at locations recommended by the Water Distribution System Master Plan within the distribution system; and 4) the installation of flow meters at existing booster chlorination facilities as part of a booster chlorination system rehabilitation project.

(F) System Reliability, Emergencies, Service Disruptions

1) PWSA Emergency Response Plan

Q. PLEASE PROVIDE AN UPDATE REGARDING THE STATUS OF PWSA'S CURRENT EMERGENCY RESPONSE PLAN.

A. As explained in my direct testimony, PWSA's current Emergency Response Plan was most recently revised and updated in 2016. PWSA is in the process of revising the current version of the Emergency Response Plan to incorporate, among other things, the various Commission requirements related to reliability and reporting. (PWSA St. No. 1 at C-1 at 46). A part of this process includes ensuring PWSA's compliance with the

America Water Infrastructure Act ("AWIA").[3] The AWIA requires drinking water systems to complete a risk and resilience assessments ("RRAs") and emergency response plans (ERPs) every five years. To demonstrate compliance with AWIA, utilities must certify to EPA that their RRAs and ERPs have been completed. PWSA is required to conduct an RRA by March 31, 2020 and to finalize its ERP by September 30, 2020. Guidance from the Environmental Protection Agency ("EPA") was just released on August 1, 2019. This guidance includes baseline information on threat categories and the likelihood of malevolent acts that are relevant to water systems, an updated vulnerability self-assessment tool, and an updated ERP template with instructions.[4] Now that PWSA has received this guidance, it will need to review it and undertake the process of performing its RRA so that it can finalize its ERP. The reason this is relevant for purposes of this proceeding is that PWSA's final ERP will include the internal processes and procedures being developed (or already developed) by PWSA to comply with Commission regulations.

[3] 42 U.S.C. §300i-2.

[4] *See* https://www.epa.gov/waterresilience/americas-water-infrastructure-act-2018-risk-assessments-and-emergency-response-plans

2) Unscheduled/Emergency Service Disruptions and Low Pressure Incidents Required to be Reported to DEP

Q. IN YOUR REBUTTAL TESTIMONY, YOU INDICATED THAT PWSA WAS ADVERTISING FOR AN ENVIRONMENTAL HEALTH AND SAFETY PROFESSIONAL WHO WILL BE TASKED WITH DEVELOPING AND COMMUNICATING A STANDARD OPERATING PROCEDURE ("SOP") RELATED TO UNSCHEDULED/EMERGENCY SERVICE DISRUPTIONS AND LOW PRESSURE INCIDENTS (*SEE* PWSA ST. NO. C-1R AT 30, 36). DO YOU HAVE ANY UPDATES TO PROVIDE RELATED TO THESE EFFORTS?

A. Yes. PWSA anticipates that the Environmental Health and Safety professional will be hired in 2019. Pending this, a consultant is currently serving in this role to assist in developing an SOP for communicating Emergency Service Disruptions to the Commission and to the public, among others. The SOP for reporting low pressure readings, breaks, and boil water advisories has been completed, and a copy of this SOP is included as Exhibit RAW/C-41. PWSA's internal work flow processes for reporting low pressure readings, breaks and boil water advisories is included as Exhibit RAW/C-42.[5] PWSA's revised communication protocols include notification to the Commission: (1) to comply with 52 Pa. Code § 69.1601 (unscheduled water service interruptions and associated actions); and, (2) to report any low pressure incident or other service interruption for which it notifies DEP.

VI. LONG-TERM INFRASTRUCTURE IMPROVEMENT PLAN (LTIIP)

Q. IS PWSA PROPOSING TO REVISE THE LTIIP FILED ON SEPTEMBER 28, 2019 FOR THE COMMISSION'S CONSIDERATION IN THIS PROCEEDING?

A. Yes. As a result of the testimony served by the Parties and further discussions with the Parties, PWSA is proposing to make some revisions to the LTIIP that it filed on September 28, 2019 for the Commission's consideration in this proceeding.

[5] The phone numbers for the staff persons referenced in these two exhibits have been redacted.

Q. HOW DOES PWSA PROPOSE TO IDENTIFY ITS PROPOSED REVISIONS AND SUBMIT THE REVISED LTIIP TO THE COMMISSION FOR ITS REVIEW?

A. Included with this testimony is Exh. RAW/C-43. This exhibit includes the specific pages from PWSA's September 28, 2019 LTIIP as filed, noting in red-line the revisions we are proposing to make as a part of this proceeding. PWSA is proposing to submit the LTIIP with these revisions for the record at the same time it submits its testimony and exhibits for the record. The revisions we are proposing to PWSA's as-filed LTIIP are included with this supplemental testimony as Exhibit RAW/C-43.

(A) Metering Unmetered Properties

Q. WILL PWSA INCLUDE INFORMATION IN ITS AMENDED LITTP ABOUT ITS PLAN AND TIMELINE TO METER UNMETERED PROPERTIES?

A. Yes. The information is added to page 26 of PWSA's LTIIP filed on September 28, 2019 as shown in Exhibit RAW/C-43.

(B) Workforce Development

Q. YOU DISCUSS PWSA'S LTIIP IN YOUR PRIOR TESTIMONIES (PWSA ST. NO. C-1 AT 65-75; PWSA ST. NO. C-1R AT 68-73), AND YOU SPECIFICALLY PROVIDE TESTIMONY RELATED TO THE WORKFORCE DEVELOPMENT PROVISIONS OF PWSA'S LTIIP (PWSA ST. NO. C-1R AT 70-71). DO YOU HAVE ANY UPDATES TO PROVIDE RELATED TO THESE PROVISIONS OF PWSA'S LTIIP?

A. Yes. PWSA is proposing to revise its LTIIP to: (1) include the information that I explained on pages 70-71 of my rebuttal testimony; (2) provide additional information related to workforce challenges and PWSA's plans to address the issues identified in PWSA's Compliance Plan at Appendix A, pages 5 and 8; and, (3) include information explaining how PWSA intends to build a workforce to meet the needs of increased capital spending, including specific detail for how staffing projections were quantified and, to the extent available, an estimate of required contractors. The information is added to

pages 48-51 of PWSA's LTIIP filed on September 28, 2019 as shown in Exhibit RAW/C-43. While PWSA expects that it will need to hire additional contractors to accomplish the work associated with the Capital Improvement Plan, PWSA is not able at this time to provide any meaningful estimate of the number of contractors that may be required. This is because the actual number that will be needed is dependent on the progress of building an internal workforce and the final determination of the actual needs and scope of the projects associated with the CIP. PWSA is committing, though, as part of the proposed revisions "to continue to update its project schedules based on the availability and capability of its workforce, and the commitments of its Consultants and Contractors."

(C) Construction Coordination with Other Utilities and Municipalities

Q. IN YOUR REBUTTAL TESTIMONY, YOU ALSO SPECIFICALLY ADDRESSED THE PROVISIONS OF PWSA'S LTIIP RELATED TO CONSTRUCTION COORDINATION WITH OTHER UTILITIES AND MUNICIPALITIES (PWSA ST. NO. C-1R AT 72). DO YOU HAVE ANY UPDATES TO PROVIDE RELATED TO THESE PROVISIONS OF PWSA'S LTIIP?

A. Yes. Exhibit RAW/C-43 includes revisions to the Outreach and Coordination Activities (Section 9) of PWSA's September 28, 2018 filed LTIIP. These proposed revisions provide: (1) the additional information set forth on page 72 of my rebuttal testimony; (2) further information related to PWSA's use of resources, such as the Pennsylvania 811 Coordinate web service application, to identify opportunities for collaboration between projects and to meet the need for increased coordination with local utilities and local, state, county, and city government agencies; and, (3) further information related to PWSA's efforts to address the need for additional engineering staff as well as other necessary actions that are being explored to address this issue.

Q. DOES PWSA HAVE RECENT EXPERIENCE RELATED TO THE NEED TO COLLABORATE WITH VARIOUS ENTITIES FOR CONSTRUCTION PROJECTS?

A. Yes. PWSA was recently recognized by the Society of American Military Engineers for successfully completing the largest project in PWSA's history. This project took eleven months and involved restoration of the northern portion of Smallman Street to replace water lines, storm, and sanitary sewers in the Strip District. The construction management team was able to extend the work to upgrade even more aging water mains and to coordinate with Peoples Gas work in that same area. In addition to coordinating with the City and other utilities, PWSA's project management team worked closely with merchants of this historic neighborhood to accommodate busy shopping seasons and events throughout the year, while still maintaining an aggressive construction schedule. The team canvassed the neighborhood to ensure merchants had a direct line to the PWSA construction team if they had questions or concerns, attended multiple meetings per week with the business owners in the corridor, and planned several media events throughout to promote the project. It was crucial to work with the Strip District community and remind the Pittsburgh region that businesses in the Strip remained open during the extensive construction work. This project is a great example of the capacity and ability of PWSA to ensure that its construction projects proceed with optimal coordination, not only with various utilities and governing authorities but also with the impacted community members.

VII. LEAD REMEDIATION

(A) Orthophosphate; Corrosion Control Project

Q. IN YOUR DIRECT AND REBUTTAL TESTIMONIES, YOU DISCUSS PWSA'S CORROSION CONTROL PROJECT (PWSA ST. NO. C-1 AT 48-49); PWSA ST. NO. C-1R AT 2-3, 37-38). DOES PWSA HAVE ANY UPDATES TO PROVIDE

REGARDING ITS CORROSION CONTROL PROJECT AND THE INTRODUCTION OF ORTHOPHOSPHATE INTO ITS SYSTEM?

A. Yes. PWSA began adding orthophosphate into its system to reduce lead levels in drinking water in April 2019. Two, consecutive 6 month systemwide customer lead test results at less than 15 parts per billion will eliminate the 7% per year replacement of remaining lead service lines required by the Pennsylvania Department of Environmental Protection. PWSA received 176 water samples during the most recent sampling period from January 1, 2019 to June 30, 2019. The samples were analyzed by a third-party laboratory and evaluated to determine whether 10 percent of the total samples exceeded the U.S. Environmental Protection Agency lead action level of 15 parts per billion. The 90^{th} percentile results from the latest round of testing were 17.52 ppb, which is just above the action level.

Q. DO THE RESULTS OF THE MOST RECENT COMPLIANCE TESTING DEMONSTRATE THAT THE ORTHOPHOSPHATE IS WORKING?

A. Yes, the compliance test results demonstrate that lead levels are trending downward since orthophosphate was added to PWSA's system in April 2019. While PWSA's June 2019 compliance test results exceed EPA's lead action level, the results are significantly lower than PWSA's December 2018 test results that reflected that the 90^{th} percentile results from the latest round of testing were 20 ppb. The orthophosphate can take up to six months from introduction to reach its full effect. I expect that lead levels will be reduced to single digit or non-detectable levels at most homes with lead service lines or plumbing as the effectiveness of orthophosphate continues to increase.

(B) <u>Lead Service Line Replacement Project</u>

Q. IN YOUR REBUTTAL TESTIMONY, YOU INDICATED THAT PWSA WOULD PRESENT A REVISED COMPREHENSIVE PLAN TO INVENTORY THE SERVICE LINE MATERIALS IN ITS DISTRIBUTION SYSTEM TO PA DEP.

(PWSA ST. NO. CR-1 AT 60-61). DO YOU HAVE ANY UPDATES TO PROVIDE RELATED TO THIS EFFORT?

A. Yes. On July 24, 2019, PWSA presented a revised comprehensive plan to inventory the service line materials in its distribution system to PA DEP. Pursuant to discussions with PA DEP, PWSA modified its Service Line Material Inventory Revised Approach and submitted it to PA DEP on August 1, 2019. A copy of the revised comprehensive plan is provided in Exhibit RAW/C-44.

Q. DOES PWSA HAVE ANY UPDATES REGARDING ITS LEAD SERVICE LINE REPLACEMENT PROGRAM POLICY?

A. Yes. I described in my direct testimony that in January 2018, PWSA adopted a lead service line policy that mandates and pays for replacement of certain public and privately owned portions of lead service lines. (PWSA St. No. C-1 at 51). In rebuttal testimony, I reported that PWSA's Board was planning to review the LSLR Policy at its May 2019 Board meeting and provided the parties of the draft revised policy in Exhibit RAW/C-31. On May 24, 2019, PWSA's Board approved a revised LSLR Policy based on newly acquired information and factors such as: (1) the number of lead service lines; (2) where the lead service lines are located; (3) whether PWSA will continue to pay for the replacement of private side lines and if there should be an income based cost sharing; and (4) how many lines PWSA can afford to replace. A copy of the LSLR Policy adopted by the Board at its May 24, 2019 meeting ("May 2019 Policy") is provided in Exhibit RAW/C-45.

Q. HOW DID THE MAY 2019 POLICY MODIFY PWSA'S PREVIOUSLY EXISTING LEAD LINE REPLACEMENT PROGRAM POLICY?

A. Under PWSA's 2018 Lead Line Replacement Program Policy ("2018 Policy"), several of the provisions expired at the end of 2018. The May 2019 policy extended several of

those provisions through the end of 2019. There are numerous other modifications the May 2019 Policy made to the 2018 Policy.

Q. HAS PWSA'S LEAD SERVICE LINE REPLACEMENT PROGRAM POLICY BEEN UPDATED SINCE MAY 2019?

A. Yes. On July 26, 2019, PWSA adopted a revised Lead Service Line Replacement Program Policy. A copy of the Lead Service Line Replacement Program Policy adopted by PWSA's Board on July 26, 2019 ("July 2019 Policy"), is provided in Exhibit RAW/C-46.

Q. DID THE PENNSYLVANIA PUBLIC UTILITY COMMISSION OR THE COMMISSION'S BUREAU OF INVESTIGATION AND ENFORCEMENT AGREE WITH THE TERMS OF THE JULY 2019 POLICY PRIOR TO ITS ADOPTION?

A. No. Neither the Commission nor the Commission's Bureau of Investigation and Enforcement approved any of the terms of the July 2019 Policy prior to its adoption.

Q. WAS PWSA OBLIGATED TO ENACT THE MAY OR JULY POLICIES FOR LEAD SERVICE LINE REPLACEMENT?

A. No, and the July 2019 Policy contains significant additional steps that PWSA is taking voluntarily to respond to what it believes is the sentiment in the community and among policymakers to go above and beyond what is required by environmental regulations or any federal or state mandates with regard to lead. As I explain above, I expect PWSA's orthophosphate program shortly to reduce lead levels in PWSA's system to well below the "action level" at which federal regulations require PWSA to undertake specific lead line replacement efforts. However, as a public entity, PWSA has determined that it can and should take additional operationally feasible steps in order to try to eliminate the lead in its own inventory (to the extent operationally feasible) as soon as reasonably possible. In addition, PWSA has elected to go well beyond any "post-action level" obligation and

to replace a residential customer-owned private side lead line without charge whenever PWSA replaces the public side, and to do so without charging the customer. I am aware of only one other PAPUC regulated utility (York Water) that has taken any such step. PWSA has also determined to reimburse residential customers when they decide to replace their line on their own, using a sliding scale of reimbursement that will have PWSA pay all the cost for low income customers and provide at least a $1,000 stipend even to non-low income customers. We believe that this policy fairly balances the needs and concerns of the community with PWSA's other substantial construction and operational obligations. Again, we do not believe that these steps are mandated or required by any state or federal law or regulation, including the Public Utility Code, since water quality is the province of the PA Department of Environmental Protection, which has not and does not require the steps that PWSA has voluntarily elected to pursue.

Q. WHY DID PWSA UPDATE ITS LEAD SERVICE LINE REPLACEMENT PROGRAM POLICY?

A. PWSA adopted the July 2019 Policy, in part, to remove language from the May 2019 Policy that would terminate provisions at the end of 2019. PWSA modified a provision that offers private-side replacements at no cost to the homeowner when: (1) PWSA's operations crew replaces a public service line as a result of line breaks and leaks; and (2) when PWSA replaces water mains. (July 2019 Policy §§ 4.2.c.-d.). PWSA removed language that terminated those provisions at the end of 2019. In addition, PWSA established the July 2019 Policy to establish an income-based reimbursement program for customers who replace their private side lead service lines on their own initiative.

Q. DOES PWSA'S JULY 2019 POLICY PROVIDE FOR THE REPLACEMENT OF PRIVATE SIDE LEAD SERVICE LINES AT NO COST TO THE CUSTOMER WHEN PWSA REPLACES THE PUBLIC SIDE OF THE SERVICE LINE?

Yes, the July 2019 Policy provides that where PWSA replaces the public side of the service line at an eligible residential property, private side lead service lines will be replaced at no cost to the customer. (July 2019 Policy § 3). The July 2019 Policy defines eligible residential properties to include residential properties with no more than four dwelling units with services lines 1-inch in diameter or less, for which the PWSA has maintenance responsibility for the water service line from the water main to and including the curb stop. (July 2019 Policy § 3).

Q. PURSUANT TO THE JULY 2019 POLICY, THROUGH WHICH APPROACHES DOES PWSA REPLACE PRIVATE SIDE LEAD SERVICE LINES?

A. PWSA utilizes a few programs or approaches to replace private side lead service lines. The first is PWSA's 2019 Lead Service Line Replacement program. Through PWSA's 2019 Lead Service Line Replacement program, PWSA has replaced the full line during construction at no cost to the property owner. Replacements completed through the program are prioritized based on the prevalence of children under six years of age, women of child bearing age, and incidences of high blood lead levels. (July 2019 Policy § 4.2.a.). It is anticipated that PWSA's 2019 Lead Service Line Replacement program will extend through September 2020.

The second program, the Community Environmental Project ("CEP"), targets private lead service line replacements for households with income levels below 250% of the federal poverty level, as adjusted annually. (July 2019 Policy § 4.2.b.). The CEP is a product of the November 2017 Consent Order and Agreement that PWSA entered into

with PA Department of Environmental Protection, which allowed it to apply $1.8 million of what would have been a civil penalty to a private lead line replacement program.

PWSA also addresses replacement of private side lead service lines when its operations crew replaces a public service line as a result of line breaks or leaks. Under these unplanned emergency replacements, private side replacements are performed at no cost to the property owner. (July 2019 Policy § 4.2.c.).

Lastly, when PWSA replaces water mains, PWSA offers to replace a private side lead service line when it replaces the public side service line. These private side lead service line replacements are offered at no cost to the property owner. (July 2019 Policy § 4.2.d.).

Q. HOW DOES THE JULY 2019 POLICY ADDRESS ELIGIBLE RESIDENTIAL PROPERTIES THAT RECEIVED A PARTIAL PUBLIC SERVICE LINE REPLACEMENT AFTER FEBRUARY 1, 2016 DUE TO A PWSA ACTION?

A. The July 2019 Policy offers to provide private lead service line replacements at no charge for eligible properties that received a partial public service line replacement after February 1, 2016, due to a PWSA action such as a water main replacement or operations public side lead service line replacement. (July 2019 Policy § 3.1).

Q. IF AN ELIGIBLE RESIDENTIAL PROPERTY OWNER REPLACED THEIR OWN PRIVATE SIDE LEAD SERVICE LINE AS A RESULT OF A PWSA PUBLIC SIDE REPLACEMENT, WHAT DOES THE JULY 2019 POLICY OFFER?

A. PWSA's July 2019 Policy offers reimbursement to eligible residential property owners who replaced their private side lead service line as a result of a PWSA public side replacement under a lead service line replacement contract, PWSA operations replacement, or water main replacement between February 1, 2016 and December 31, 2018. PWSA offers a direct reimbursement for costs incurred up to a maximum of

$5,500 based on the average cost for PWSA to replace private lead service lines. (July 2019 Policy § 3.2). The Policy further provides that customers who opted to replace their private side lead service line on their own, unrelated to a public side replacement, are not eligible for reimbursement. (July 2019 Policy § 3.2).

Q. HOW MANY RESIDENTIAL PROPERTY OWNERS ARE ELIGIBLE TO SEEK REIMBURSEMENT FOR A PRIVATE-SIDE LEAD SERVICE LINE THAT THEY REPLACED BETWEEN FEBRUARY 1, 2016 AN DECEMBER 31, 2018 AS A RESULT OF A PUBLIC SERVICE LINE REPLACEMENT?

A. PWSA performed 456 partial lead service line replacements between February 1, 2016 and December 31, 2018, under circumstances that rendered the residential property owner eligible to seek reimbursement for replacement of their private-side lead service line. PWSA has offered to replace the private side lead service line at all of those locations. To date, 254 eligible property owners have accepted PWSA's offer to have their private-side line replaced, and PWSA has performed replacements at 215 of those locations. A total of 79 eligible property owners declined to have their line replaced, and the remainder (123) were unresponsive. Twenty-five of the locations were determined to be non-lead after verification.

Q. HOW DOES THE JULY 2019 POLICY ADDRESS PARTIAL SERVICE LINE REPLACEMENTS ON A GOING FORWARD BASIS?

A. While PWSA is committed to preventing partial lead service line replacements and avoiding the harmful health effects of partial lead service line replacements, PWSA's July 2019 Policy reflects certain realities. PWSA's July 2019 Policy reflects that some locations may be subject to a partial lead service line replacement. More specifically, the policy provides that PWSA may perform a partial replacement if PWSA determines that replacement of the private side lead service line or related interior plumbing modification is not technically feasible, the residence is unsafe from a structural or sanitary condition,

or will result in excess expense due to conditions such as length, terrain, obstructions, structures, pavement, trees or other utilities. (July 2019 Policy § 3.3).

PWSA's July 2019 Policy provides that property owners who do not agree to PWSA's terms for a full lead service line replacement will be subject to a partial lead service line replacement. (July 2019 Policy § 4.6). The potential health risks of a partial replacement are to be communicated to the homeowner, pursuant to the policy. Notwithstanding the foregoing, the July 2019 Policy establishes that a partial replacement will not be completed in the event that the property owner does not live at the property location, unless it is a relay or emergency situation. (July 2019 Policy § 4.6).

Q. HOW DOES PWSA'S JULY 2019 POLICY ADDRESS INSTANCES WHERE HOMEOWNERS ELECT TO REPLACE THEIR OWN LEAD SERVICE LINES AFTER JANUARY 1, 2019?

A. PWSA's July 2019 Policy provides that if a homeowner elects to replace their own lead service line at their own cost after January 1, 2019, that: (1) PWSA will replace the public portion of the lead service line at no cost to the homeowner, including public sidewalk replacement; (2) PWSA will not charge a tapping fee; and (3) PWSA can agree on a case by case basis to allow a customer to tap into a different main for ease of connection and that PWSA will waive any tapping fee for that service. (July 2019 Policy at § 10).

In addition, PWSA's July 2019 Policy establishes an income-based reimbursement structure for when a homeowner elects to replace their private-side lead service line after January 1, 2019. (July 2019 Policy § 10.d.). For households with income levels below 300 percent of the federal poverty level, as adjusted annually, PWSA will reimburse the entire cost of the private side lead service line replacement. PWSA will reimburse 75 percent of the cost of the private side lead service line

replacement for households with income levels between 301 and 400 percent of the federal poverty level, as adjusted annually. For households with income levels between 401 percent and 500 percent of the federal poverty level, as adjusted annually, PWSA will reimburse 50% of the cost of the private side lead service line replacement. The policy provides that all other households will be offered a $1,000 stipend towards the replacement cost of a private side lead service line replacement. (July 2019 Policy § 10.d).

Q. PLEASE PROVIDE AN ESTIMATE OF THE PERCENTAGE OF HOUSEHOLDS IN PWSA'S TERRITORY THAT WILL QUALIFY FOR EACH TIER OF REIMBURSEMENTS UNDER THE INCOME-BASED PROGRAM.

PWSA estimates that approximately 53.3% of households in its service territory will qualify for full reimbursement of costs of the private-side lead service line replacement, 12.1% will qualify for 75% reimbursement of the private-side lead service line replacement and 9.0% will qualify for a 50% reimbursement of the private-side lead service line replacement. Approximately 75% of households will qualify to receive a reimbursement for at least 50% of those costs.

Q. WHY DID PWSA ESTABLISH A TIERED COST REIMBURSEMENT POLICY FOR HOMEOWNERS WHO ELECT TO REPLACE THEIR OWN LEAD SERVICE LINES?

A. PWSA established a tiered cost reimbursement policy for homeowners who elect to replace their own private side lead service lines after January 1, 2019, so that those with the greatest financial need are fully reimbursed for the replacement and that financial assistance is provided to those with less financial constraints, depending on their household income levels.

PWSA analyzed the cost to pay for all private side lead service line replacements with the costs of the income-based reimbursement program that is set forth in the July

2019 Policy. Based on PWSA's analysis, PWSA expects to save between $12 million and $25 million (depending on the total number of private side lead service lines located) by utilizing an income-based program. PWSA submits that this tiered income-based reimbursement approach is a fair and reasonable approach to assisting customers with private side lead service line replacements, especially as this assistance is provided to those who elect to replace their private side line on their own initiative.

(C) Community Environmental Project

Q. IN YOUR DIRECT TESTIMONY YOU DESCRIBED PWSA'S COMMUNITY ENVIRONMENTAL PROJECT. (PWSA ST. C-1 AT 55-56). DO YOU HAVE ANY UPDATES REGARDING THE COMMUNITY ENVIRONMENTAL PROJECT?

A. Yes. As of July 29, 2019, a total of 269 customers have qualified to have their private side lead service lines replaced free of charge as part of the Community Environmental Project ("CEP") and have returned the customer consent agreement necessary for PWSA to perform the replacement. Households that qualify have income levels below 250 percent of the federal poverty level. (July 2019 Policy § 4.2.b.). PWSA believes that the amount of interest the program has received is attributable to its outreach efforts and its partner in administering the program, the Dollar Energy Fund, Inc. PWSA has completed the work to verify the service line material on a total of 185 CEP locations. Of these locations, PWSA has found non-lead lines on both sides of the curb stop at 79 locations. PWSA has replaced the private-side line at 74 locations and has completed a public side replacement at 66 locations, as some of the locations required a full replacement. Work on the remaining locations is pending.

Q. YOU INDICATED IN DIRECT AND REBUTTAL TESTIMONY THAT PWSA IS COMMITTED TO USING AS MUCH OF THE $1.8 MILLION IN FUNDS FOR THE CEP AS IT POSSIBLY CAN. (PWSA ST. C-1 AT 55-56 AND C-1R AT 43-

45). DO YOU HAVE ANY UPDATES ON THE AMOUNT OF MONEY PWSA HAS SPENT TO DATE ON CEP REPLACEMENTS?

A. Yes. As of June 30, 2019, PWSA has expended a total of $233,897.50 of CEP funds. In addition, PWSA has spent $382,217.00 (from other funds) on the public side and other CEP-location related work that is not eligible to be funded from the $1.8 million.

VIII. CONCLUSION

Q. DOES THAT COMPLETE YOUR SUPPLEMENTAL DIRECT TESTIMONY?

A. Yes.

Exhibit RAW/C-10
(updated – Clean)

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2020 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2021 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2022 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
CMMS (Computerized Maintenance Management System)	Acquire, install, develop, and implement a Computerized Maintenance Management System, including training staff to assist with capital investment prioritization.	The CMMS will be used by field and engineering staff to record, house, track, and identify short-term and long-term asset investment needs. A properly developed CMMS can identify efficiency improvements, increase levels of asset renewal, and reduce operation, maintenance, and capital costs. The CMMS will communicate with the GIS system and be able to coordinate with eBuilder as well as the Authority's finance system.	$10,000,000	Borrowed	July 2019	December 2026
2018 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units, stormwater control reliability, and minimize disturbance to the community.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$10,392,500	Borrowed	August 2018	August 2019
2019 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,320,000	Borrowed	August 2019	August 2020
2020 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,660,000	Borrowed	August 2020	August 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,030,000	Borrowed	August 2021	August 2022
2022 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,380,000	Borrowed	August 2022	August 2023
2023 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,720,000	Borrowed	August 2023	August 2024
MS4 Compliance Projects	Four stormwater BMP projects that will reduce pollutants to impaired waters, which include stream restoration and inlet inserts at various sites.	These projects are required to comply with the current MS4 NPDES permit cycle (2019-2023) application submitted to the Pennsylvania Department of Environmental Protection.	$1,955,000	Borrowed	October 2021	August 2022
Saw Mill Run MS4 & CSO Compliance Projects	Multiple projects that will reduce pollutants to impaired waters and reduce CSO volume, which includes stream restoration, green stormwater infrastructure, and other BMPs at various sites.	These projects are required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed. Project also required to address PADEP Consent Order for CSO compliance.	$8,500,000	Borrowed	June 2023	December 2025
Maytide Storm and Sanitary Sewer System Improvements	Reconstruction of storm infrastructure from Merritt Avenue to the storm interceptor on Ravilla Avenue, the realignment of the sanitary sewer on Maytide (Sanderson to Valline), and the rehabilitation and/or reconstruction of the sanitary sewer mains on the undeveloped right-of-ways in the vicinity. .	Localized property and street flooding has been well-documented for several years at this location and the undeveloped right-of-way of Sanderson has significantly deteriorated. Additionally, inspections of the sanitary sewers in the vicinity revealed structural and construction defects	$6,520,000	Borrowed	March 2018	March 2020
2019 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$3,580,000	Borrowed	June 2019	July 2020
2020 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$3,960,000	Borrowed	August 2019	July 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,045,000	Borrowed	August 2020	July 2022
2022 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,230,000	Borrowed	August 2021	July 2023
2023 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,375,000	Borrowed	August 2022	July 2024
2024 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,490,000	Borrowed	August 2023	July 2025
Saw Mill Run Stream Bank Restoration	Stream restoration of approximately 1,500 linear feet of the Saw Mill Run Creeks to reduce pollutants in the impaired waterway.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,385,000	Borrowed	October 2018	April 2020
Volunteer's Field Storm Water Management	Installation of BMPs to reduce sediment, other pollutant loads, stormwater volume, and peak flows to the Saw Mill Run watershed. This project has been broken into 2 phases, the first project is a bioretention facility. The second project is regrading of the ballfields to reduce sediment runoff into the storm system to be in compliance with the EPA approved sediment TMDL.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,465,000	Borrowed	October 2018	December 2020
Saw Mill Run Watershed Water Quality Improvement Project (formally known as Overbrook Pollution and Flood Reduction)	Implementation of stormwater treatment and reconnection of streams to vegetated floodplains to help mitigate stormwater peak flows, reduce flooding, reduce sediment, other pollutant loads, and reduce CSO volume	This project will demonstrate the effectiveness of Stormwater Management Project in reducing pollutants, controlling CSO/SSOs, and restoring the health of the aquatic ecosystems in the Saw Mill Run watershed to comply with MS4 NPDES permit and PADEP CO regulatory obligations.	$6,500,000	Borrowed	October 2019	November 2021
Tide Gate Installations	Installation of tide gates at 44 combined sewer overflow diversion chamber locations to assist in preventing river water intrusion. Construction for this project is anticipated to occur in multiple phases.	This project is required to reduce CSO volume to address PADEP Consent Order for CSO compliance. Project to be completed in multiple phases and construction contracts.	$4,500,000	Borrowed	May 2019	June 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Wightman Park Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Squirrel Hill neighborhood of the City of Pittsburgh, which is tributary to the M-29 combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,365,000	Borrowed	March 2018	September 2020
Wightman Park Stormwater Management Project Phase 2 and 3	Phase 2 and 3 will use the available detention storage in the park from Phase 1 and reach out into the Squirrel Hill Neighborhood to convey additional stormwater runoff to the park. This is tributary to the M-29 combined sewer outfall.	This project area was identified during the Phase 1 planning and design as a high yield drainage area for capturing stormwater runoff to reduce CSO and flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,371,000	Borrowed	May 2019	November 2021
Woods Run Stream Removal -Phase 1	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently discharging directly into a 36-inch diameter combined sewer on Mairdale Avenue.	This project area was identified in the PWSA Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,296,000	Borrowed	October 2017	October 2020
Woods Run Stream Removal -Phase 2	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow from several streams currently discharging directly into the sewer system in the O-27 Sewershed.	This project area was identified in the PWSA Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,405,000	Borrowed	January 2021	November 2022
Woods Run Stream Removal -Phase 3	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow from the remaining streams currently discharging directly into the sewer system in the O-27 Sewershed.	This project area was identified in the PWSA Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,775,000	Borrowed	January 2022	November 2023
Panther Hollow/Four Mile Green/Stormwater Infrastructure	Sewer separation, stream restoration, stream daylighting, bioretention, and underground storage to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in M-29.	This project area was identified in the PWSA Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$29,400,000	Borrowed	May 2018	August 2021
Spring Garden Stream Removal	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-60.	This project area was identified in the PWSA Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$10,710,000	Borrowed	April 2019	July 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
MLK Field Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Hill District/Uptown area of the City of Pittsburgh, which is tributary to the M-19 combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,402,000	Borrowed	March 2019	September 2021
Woodland Drive Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets and steeply sloping hillside within Chatham University, which is Tributary to the A-22 combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,195,000	Borrowed	October 2018	November 2020
Thomas and McPherson Stormwater Management Project	Installation of roadside bioretention features to capture and detain impervious road runoff in the North Point Breeze neighborhood of the City of Pittsburgh, which is tributary to the A-42 combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,650,000	Borrowed	October 2018	September 2020
Bus Rapid Transit (BRT) Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from 5th Avenue and Forbes Ave in the City of Pittsburgh, which is tributary to multiple CSO outfalls. Project being coordinated with and constructed in phases with City road reconstruction project of 5th Avenue and Forbes Ave.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$6,050,000	Borrowed	January 2020	December 2023
Negley Run/Washington Boulevard Stormwater Management Project	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-42.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$15,390,000	Borrowed	January 2019	December 2021
Lawn and Ophelia Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the South Oakland neighborhood, which is tributary to the M-19B combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$785,000	Borrowed	May 2018	November 2020
South Side Park/S 21st Street Stormwater Management Project	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently within the Park and downstream adjacent streets tributary to the M-16 combined sewer outfall.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$8,694,000	Borrowed	December 2018	September 2022
Maryland Avenue Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from Maryland Ave and the adjacent streets which is tributary to the A-22 combined sewer outfall. Project being split into 3 primary phases.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$9,384,000	Borrowed	January 2018	September 2022

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
St. Johns Stormwater Management Project	Preliminary design of stormwater management features to capture and detain impervious acres tributary to the former St. John's hospital site now scheduled to be green space, which is tributary to the O-27 combined sewer outfall. Design and construction will be through a future project to be developed after preliminary design is complete.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$5,309,000	Borrowed	December 2018	November 2021
A-41 Stormwater Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-41 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$600,000	Borrowed	May 2019	June 2020
M-29 Stormwater Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the M-29 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	June 2020
A-42 Stormwater Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-42 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	June 2020
Smallman Street Reconstruction	The installation of approximately 2,500 linear feet of new storm sewer piping ranging in size from 24-inch to 54-inch, 2,000 linear feet of new sanitary sewer piping ranging in size from 18-inch to 48-inch, 2,000 linear feet of new 12-inch water main, and 1,500 linear feet of new 36-inch water transmission main.	Sewer separation and water main replacement due to the redevelopment of the Produce Terminal Building, realignment of the streetscape, and the location of the existing combined sewer infrastructure, which is located under the existing building.	$16,867,000	Borrowed	September 2017	May 2019
Sewer Master Plan	Comprehensive plan of the sewer system, including risked based prioritization for internal inspection purposes and assessment of the four pump stations.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$500,000	Borrowed	March 2019	September 2019
2018 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,470,000	Borrowed	January 2018	March 2019
2019 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	March 2019	March 2020
2020 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2020	March 2021
2021 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2021	March 2022
2022 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2022	March 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2023 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	March 2023	March 2024
2018 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following four sites have been identified: Ellsworth Avenue (695 linear feet of 20-inch vitrified clay, combined sewer main located 5135 Ellsworth Avenue), Oakwood Bridge (215 linear feet of 24-inch vitrified clay, combined sewer main located adjacent to the Oakwood Road Bridge), South 16th Street (700 linear feet of 20 and 24-inch vitrified clay, combined sewer main located under the Union Supply Company building, CSX railroad tracks, and the Three Rivers Heritage Trail), and Centre Avenue (575 linear feet of 15-inch vitrified clay, combined sewer main located under a 20-inch water main that serves UPMC Shadyside and a telecommunications duct bank.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$6,680,000	Borrowed	March 2018	December 2020
2019 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following three sites have been identified: Flemington Street (740 linear feet of 15-inch and 20-inch vitrified clay, combined sewer main. located under 1075 Flemington Street and on an inaccesible steep slope (>35 percent) to Beechwood Boulevard), Washington Landing River Crossing (282 linear feet of 8-inch ductile iron, sanitary sewer main located under the Allegheny River), an Seaton Avenue (402 linear feet of 8-inch vitrified clay, sanitary sewer main. located under a building addition and swimming pool).	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,120,000	Borrowed	April 2019	June 2021
2020 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,400,000	Borrowed	August 2019	February 2022
2021 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,415,000	Borrowed	August 2020	February 2023
2022 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a	$7,795,000	Borrowed	August 2021	February 2024

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
		proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.				
2023 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$8,055,000	Borrowed	August 2022	February 2025
2024 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$8,325,000	Borrowed	August 2023	February 2026
2019 Wastewater System Improvements	Reconstruction of existing structurally deficient sewer mains on Wiese Street, Wilbur Street, Creedmoor Avenue, Ornament Way, Cooperfield Avenue, N. Sheridan Avenue, Port Way, and Swimburne Street.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$5,350,000	Borrowed	August 2018	January 2021
2018 Sewer Rehabilitation (Annual IDIQ Contract)	Trenchless rehabilitation of less than 24-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$1,910,000	Borrowed	September 2018	September 2019
2019 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,260,000	Borrowed	January 2019	April 2020
2020 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,500,000	Borrowed	June 2019	December 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$14,690,000	Borrowed	March 2020	September 2021
2022 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,090,000	Borrowed	March 2021	September 2022
2023 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,600,000	Borrowed	March 2022	September 2023
2024 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,820,000	Borrowed	March 2023	September 2024
2020 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$3,800,000	Borrowed	February 2019	May 2020
2021 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,200,000	Borrowed	January 2020	April 2021
2022 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,310,000	Borrowed	January 2021	April 2022
2023 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,440,000	Borrowed	January 2022	April 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2024 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,570,000	Borrowed	January 2023	April 2024
31st Ward Sewer System Improvements	Evaluation to identify and locate the source(s) of the infiltration and inflow (I/I), removal of public I/I sources, and rehabilitation/replacement of the Rogers Street and Mifflin Road Pump Station and force main. Project will be designed and constructed in a minimum of two phases to ensure the pump stations are properly sized and the flow conveyed will not negatively impact the downstream sewer subshed.	Both sewage pump stations and the force main that convey flow to the Streets Run Sanitary Trunk Sewer were constructed in the late 1940's and are reaching the end of their useful life. Additionally, studies suggest this sewershed is significantly impacted by high levels of infiltration/inflow.	$13,700,000	Borrowed	March 2017	February 2021
Larimer Avenue Sewer and 28th Street Stabilization	Evaluation of rerouting storm laterals, sewer televising, geotechnical investigations, and slope stabalization to address a structurally deficient 18-inch combined sewer that has severely eroded the ground surface on the slope below Brereton Street and above the Port Authority of Allegheny County's East Busway.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$695,901	Borrowed	January 2018	October 2019
Ivyglen and Odette Sewer Reconstruction and Separation Project	The installation of a new sanitary sewer and storm sewer on Odette and Ivyglen, which will eliminate the combined sewer outfall and a sewer on an unstable slope.	During the weekend of June 23, 2018, PGH2O was informed of a landslide that occurred in the hillside in rear of 2604 Ivyglen, which collapsed a manhole and potentially compromised the 8-inch sanitary sewer that exists on the slope. Considering the current steepness of the slope, the presence of Saw Mill Run at the toe of the slope, and the unknown location of the sewer, it does not appear that there is an expeditious and safe way to readily repair the sewer and/or protect the sewer from damage due to additional slope movements. Further disturbance of the slope with construction equipment could cause additional movements that could impact both the residential structure(s) at the crest and Saw Mill Run below. Additionally, the Odette Street sewer main is single combined sewer segment that overflows into the creek during wet weather events.	$1,900,000	Borrowed	July 2018	June 2019
M-29 Outfall Improvements	Structural improvements and rehabilitation of the the M-29 combined sewer outfall diversion structure. Repairs to the diversion structure include lowering of the weir wall height and safety improvements for maintenance of the structure. The outfall pipeline requires extensive repairs and installation of a new flap gate to the outfall on the Monongahela River.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure.	$1,845,000	Borrowed	November 2018	November 2019
2019 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,335,000	Borrowed	January 2019	April 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2020 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,430,000	Borrowed	September 2019	April 2021
2021 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2020	April 2022
2022 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2021	April 2023
2023 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,575,000	Borrowed	September 2022	April 2024
2019 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,565,000	Borrowed	January 2019	April 2020
2020 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,805,000	Borrowed	September 2019	April 2021
2021 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,920,000	Borrowed	September 2020	April 2022
2022 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,150,000	Borrowed	September 2021	April 2023
2023 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,400,000	Borrowed	September 2022	April 2024
2018 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	May 2018	September 2019

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2019	October 2020
2020 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,720,000	Borrowed	June 2020	October 2021
2021 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2021	October 2022
2022 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2022	October 2023
2023 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2023	October 2024
2018 Small Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. In 2018, the following mains have been selected for replacement: Hamilton Avenue from N. Dallas Avenue to N. Homewood Avenue; Railroad Street from 25th Street to 32nd Street; and S. Millvale Avenue from Liberty Avenue to Friendship Avenue.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,680,000	Borrowed	December 2017	December 2019
2019 Small Diameter Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,880,000	Borrowed	FMarch 2019	December 2020
2020 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$54,340,000	Borrowed	March 2019	December 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$114,770,000	Borrowed	January 2020	December 2021
2022 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$120,060,000	Borrowed	Janurary 2021	December 2022
2023 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$58,860,000	Borrowed	January 2022	December 2023
2024 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$60,700,000	Borrowed	January 2023	December 2024
District Water and Pressure Meters	Installation of water meters and pressure monitors in the distribution system to determine water usage and loss, and pressure loss.	Pressure Monitors are required per PUC. District Metering will be used for water auditing and leak detection.	$2,705,000	Borrowed	January 2019	October 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Ft. Duquesne Bridge Water Air Release	Perform transient analysis along existing 30-inch water main that is suspended from the Fort Duquesne Bridge. Design and construct new pipe supports, couplings, and thrust restraint based on the results of the analysis. Includes the replacement of the existing air-release valve on the 30-inch water main, including insulation or heat tracing to reduce potential for freezing and cracking of the valve.	A recent PENNDOT inspection of the Fort Duquesne Bridge identified priority code 1 defects in the support of the existing 30-inch diameter water main. Additionally, the existing 2-inch diameter air-release valve located on the main has a history of failure. The water main is located below the lower deck of the Fort Duquesne Bridge and serves as an emergency interconnection between pressure gradients and is a vital component to the system operation.	$2,850,000	Borrowed	January 2017	December 2019
Washout Disconnection	Investigation and, if necessary, disconnection of large water main washouts from the sewer system.	A number of older washouts on larger mains were directly connected to sewers with a closed valve during construction. These washouts (cross connections) must be completely disconnected from the sewer.	$13,140,000	Borrowed	October 2018	September 2023
2019 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,840,000	Borrowed	March 2019	March 2020
2020 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,975,000	Borrowed	March 2020	March 2021
2021 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,100,000	Borrowed	March 2021	March 2022
2022 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,245,000	Borrowed	March 2023	March 2024
2023 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,360,000	Borrowed	March 2024	March 2025
2019 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019
2020 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020
2021 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021
2022 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022
2023 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023
2019 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019
2020 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020
2021 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021
2022 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022
2023 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023
2018 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$43,300,000	Borrowed	March 2018	February 2019

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$49,128,403	Borrowed/Grant	October 2018	February 2020
2018 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$2,980,134	Borrowed	December 2017	March 2019
2019 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	April 2020	March 2020
2020 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	February 2019	March 2021
2019 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections. In 2019, Rising Mains 3 and 4 from the Bruecken Pump Station have been selected for improvements, which is approximatly 2.3 miles of main.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Rising Mains 3 and 4 from Bruecken Pump Station to Highland 2 Reservoir were chosen for the 2019 Large Diameter Water Main Improvements Program due to their criticality when the clearwell is being rebuilt.	$23,550,000	Borrowed	February 2019	March 2022

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2020 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$11,940,000	Borrowed	January 2019	August 2022
2021 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,170,000	Borrowed	January 2020	August 2023
2022 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,430,000	Borrowed	January 2021	August 2024

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2023 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$26,410,000	Borrowed	January 2022	August 2025
Aspinwall Pump Station to Lanpher Reservoir Rising Main	Construction of a new, redundant rising main from Aspinwall Pump Station to Lanpher Reservoir.	The existing 60-inch rising main that supplies the Lanpher Reservoir is a 150 year old riveted steel pipe, has several tap connections to critical and bulk customers, and has experienced recent pipe failures. The proposed rising main would serve as a primary supply source for Lanpher Reservoir during the Clearwell Replacement Project and a redundant supply line in case of a failure or planned cleaning and rehabilitation of the existing 60-inch supply main.	$49,454,000	Borrowed	September 2018	September 2022
Aspinwall Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The current pump station was constructed in 1914 and many of the components were installed in 1958.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff.	$29,690,000	Borrowed	May 2019	March 2023
Bruecken Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The pump station was constructed in 1931.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff. This project is a critical component of the clearwell replacement project.	$24,990,000	Borrowed	April 2019	February 2023
Aspinwall Water Treatment Plant High Service Pump Station	In lieu of Aspinwall and Bruecken Pump Stations, a new high service pump station may be constructed to service Highland Reservoir 1, Highland Reservoir 2, Lanpher Reservoir, and Fox Chapel.	If this project moves forward, the Aspinwall Pump Station Imrpvements and Bruecken Pump Station Improvements Project would be reduced to only what is necessary to keep the stations operational until the new station is online. This project is a critical component of the clearwell replacement project.	$53,620,000	Borrowed	October 2018	February 2023
Ross Pump Station Improvements	Replacement of aged pump and valve equipment, meters, SCADA, electrical equipment, HVAC, and auxiliary systems and the rehabilitation of the building architectural and energy management systems.	The Ross Pump Station is the only feed to the water treatment plant. This station is in need of renewal.	$43,000,000	Borrowed	August 2018	TBD

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Chlorine Booster Station Improvements	Rehabilitation or replacement of the existing sodium hypochlorite booster stations in the distribution system, excluding Lanpher and Herron Hill. Includes installation of flow meters, if necessary.	Existing chlorine injections systems at satellite storage facilities are in need of renewal. Without upgrade of these facilities, the system would be in violation of residual chlorine levels required by PA DEP.	$10,090,000	Borrowed	December 2018	December 2021
Garfield Tank Improvements	Perform a comprehensive inspection of the existing elevated storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional storage tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,050,000	Borrowed	September 2018	April 2021
Lincoln Tank Improvements	Perform a comprehensive inspection of the existing storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,195,000	Borrowed	September 2018	April 2021
Herron Hill Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Reservoir liner and cover is close to the end of its design life where patching and regular maintenance will no longer be effective.	$5,520,000	Borrowed	October 2018	December 2020
Lanpher Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Work required as a result of a failure of the reservoir floating cover in September 2017. Sodium hypochlorite feed system is reaching the end of its design life.	$29,643,000	Borrowed	September 2017	June 2019
Highland No. 2 Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including new outlet piping for Highland Pump Station and Rising Main, Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Upgrade of outlet structure to allow increased capacity for the Highland Reservoir Pump Station. Replace liner and cover.	$27,510,000	Borrowed	March 2019	March 2022

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Highland Reservoir Pump Station and Rising Main	Construction of a new finished water pump station and transmission main to supply water to the Highland No.1 Service Area from Highland No. 2 Reservoir	All compliant water supply for the Highland No. 1 Service Area currently flows through the Highland No. 1 Reservoir and the Membrane Filtration Plant (MFP) or directly into the system. There is no online storage for the system, and there is no other source water supply for the Highland No. 1 Service Area. In addition to providing alternate supply, this project will temporarily provide finished water that meets the chlorine disinfection rules to the Highland No. 1 Service Area during the Clearwell Replacement Project. Additionally, this new facility will also be designed to service the Garfield pressure district, thus eliminating the need to rehabilitate the (New) Highland Pump Station.	$37,130,000	Borrowed	March 2017	June 2022
Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	Inspection and rehabilitation and/or replacement of the fiberglass reinforced plastic chemical tanks.		$294,000	Borrowed	April 2017	June 2019
Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	Improvements to pretreatment chemical systems, clarifiers, sedimenation, and associated systems to provide enhanced water treatment.	Chemical treatment systems are a critical component to producing safe drinking water. Components of the chemical treatment systems can no longer be operated in a safe, effective, or reliable manner to meet water quality requirements. Many bulk water treatment chemicals present safety hazards to staff. The storage and pumping systems associated with these chemicals have reached the end of their useful life. Failures resulting in dust creation and chemical spills can place operators in unsafe working conditions and can cause physical damage to equipment and structures, as well as environmental contamination.	$27,310,000	Borrowed	March 2017	February 2023
Aspinwall Water Treatment Plant Electrical and Backup Power Improvements	Improvements to electrical systems at Aspinwall Water Treatment Plant, including provisions for backup power systems, upgrades to existing electrical distribution system, and replacement of motor control centers.	Electrical systems at the Aspinwall Water Treatment Plant have generally met the end of their useful lives and spare/replacement parts are unavailable. Electrical panels do not meet current safety standards, including lack of arc flash protection. Additionally, the Aspinwall Water Treatment Plant does not have redundant power systems or a means for stand-by power for critical pumping and treatment systems.	$26,520,000	Borrowed	March 2017	February 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Aspinwall Water Treatment Plant Raw Water Intakes	Project will include renewing or replacing the existing West and East Raw Water Intake Gate House buildings and associated systems, including gates, screens, and associated mechanical equipment as well as the addition of SCADA. Influent piping through the Ross Pump Station will also be addressed.	Only one intake is currently operable. Both intakes are in need of renewal.	$45,000,000	Borrowed	August 2018	TBD
Clearwell Emergency Response Project	Construction of piping, suction wells, if necessary, and appurtenances to bypass the existing clearwell.	This project will provide a means to bypass the existing clearwell. Note: Disinfection requirements will not be achieved while bypassing is occurring. Additionally, this infrastructure will be required to maintain water supply to PWSA's customers for the rehabilitation or replacement of the existing clearwell.	$27,670,000	Borrowed	March 2017	April 2022
Clearwell Improvements	Replacement of the existing 108 year old, single cell clearwell (finished water structure). The clearwell was constructed in 1908 and has not undergone any major modifications or upgrades since. It has two main functions: providing equalization storage that allows the filters to operate independently of potential fluctuations in system demands and providing sufficient retention contact time for disinfection to meet the requirements of the Federal Surface Water Treatment Rule and Long-Term 2 Enhanced Surface Water Treatment Rule.	Considering the age and condition of the clearwell, it is the water system's weakest link as there are no practical means to deliver water by bypassing the clearwell, while maintaining the required volume, quality, and contact time.	$67,810,000	Borrowed	April 2019	March 2024
Corrosion Control Chemical Storage and Feed Systems	Installation of phosphoric acid storage and feed systems located at Aspinwall Pump Station, Bruecken Pump Station, and near the Membrane Filtration Plant to provide corrosion control in the distribution system.	Addition of a new corrosion control chemical was required per PA DEP Consent Order.	$3,960,000	Borrowed	May 2018	March 2019
Highland Park Membrane Filtration Module Replacement Program	Replace membrane modules, which includes a total of 10 racks each with 80 modules. Note: Four racks were replaced in 2017.	Replacement necessary to maintain operation of the MFP.	$21,717,711	Borrowed	May 2017	January 2020
Highland Park Membrane Filtration Plant UV System	Installation of a UV treatment system and appurtenances at the Highland Park Membrane Filtration Plant (MFP).	To comply with the 1 log inactivation of Giardia cysts and the PADEP Administrative Order dated October 25, 2017.	$5,855,000	Borrowed	October 2017	April 2019
MFP Assessment and Critical Process Improvements	Complete a condition assessment of systems supporting the treatment process and perform critical improvements to maintain water treatment and allow full warranty of replacement modules. Improvements may include electrical, chemical feed, strainers, and other support systems.		$1,755,500	Borrowed	March 2017	December 2018
Water System GIS Improvements	Rescan Water Record Books, Input material and pipe age into GIS. Update valve layer.	GIS upgrade required in order to prioritize mains for renewal.	$1,200,000	Borrowed	May 2019	May 2021
Water Master Plan	Comprehensive plan, including analysis of demands, future demands, capacities, and pipe condition based assessment.	Master Plan required to prioritize water mains, pump stations, and storage for renewal, identify and refine future CIP projects.	$500,000	Borrowed	March 2019	October 2019
Low Pressure Area Remediation	Fix chronically low pressure areas by either extending neighboring higher pressure districts into the area, booster pump stations, or household booster pumps.	This project is in response to the low pressure monitors required by the October 2017 Administrative Order.	$2,000,000	Borrowed	January 2019	January 2021

Notes:

Required per November 17, 2017 Consent Order and Agreement with PA DEP
Required per October 25, 2017 PA DEP Administrative Order
Projects noted in October 25, 2017 PA DEP Administrative Order

1. Pressure Sensors, as required by October 25, 2017 PA DEP Administrative Order purchased under Highland Park Membrane Filtration Plant UV System.
2. Bruecken Pump Station improvements required per October 25, 2017 PA DEP Administrative Order covered under existing project, Bruecken Pump Station Improvements, not listed on this table.

Exhibit RAW/C-10
(updated – Redlined)

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2020 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2021 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
2022 Utility Cost Shares	Infrastructure replacement due to coordination with other agencies or utilities.	Coordination with other utililties can reduce expenditures up to 75% of the total project cost and reduces the length of time that the public is inconvenienced due to construction efforts.	$3,000,000	Borrowed	N/A	N/A
CMMS (Computerized Maintenance Management System)	Acquire, install, develop, and implement a Computerized Maintenance Management System, including training staff to assist with capital investment prioritization.	The CMMS will be used by field and engineering staff to record, house, track, and identify short-term and long-term asset investment needs. A properly developed CMMS can identify efficiency ~~imp798528]rovements~~improvements, increase levels of asset renewal, and reduce operation, maintenance, and capital costs. The CMMS will communicate with the GIS system and be able to coordinate with eBuilder as well as the Authority's finance system.	$10,000,000	Borrowed	July 2019	December 2026
2018 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units, stormwater control reliability, and minimize disturbance to the community.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$10,392,500	Borrowed	August 2018	August 2019
2019 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,320,000	Borrowed	August 2019	August 2020
2020 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$11,660,000	Borrowed	August 2020	August 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,030,000	Borrowed	August 2021	August 2022
2022 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,380,000	Borrowed	August 2022	August 2023
2023 Catch Basin and Inlet Replacement (Annual IDIQ Contract)	Strategic replacement of approximately 840 catch basins and storm inlets throughout the system to replace failed units.	Provides increase in stormwater control reliability, minimizes disturbance to the community, and by maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$12,720,000	Borrowed	August 2023	August 2024
MS4 Compliance Projects	Four stormwater BMP projects that will reduce pollutants to impaired waters, which include stream restoration and inlet inserts at various sites.	These projects are required to comply with the current MS4 NPDES permit cycle (2019-2023) application submitted to the Pennsylvania Department of Environmental Protection.	$1,955,000	Borrowed	October ~~2018~~2021	August ~~2020~~2022
Saw Mill Run MS4 & CSO Compliance Projects	Multiple projects that will reduce pollutants to impaired waters and reduce CSO volume, which includes stream restoration, green stormwater infrastructure, and other BMPs at various sites.	These projects are required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed. Project also required to address PADEP Consent Order for CSO compliance.	$8,500,000	Borrowed	June ~~2021~~2023	December ~~2023~~2025
Maytide Storm and Sanitary Sewer System Improvements	Reconstruction of storm infrastructure from Merritt Avenue to the storm interceptor on Ravilla Avenue, the realignment of the sanitary sewer on Maytide (Sanderson to Valline), and the rehabilitation and/or reconstruction of the sanitary sewer mains on the undeveloped right-of-ways in the vicinity. .	Localized property and street flooding has been well-documented for several years at this location and the undeveloped right-of-way of Sanderson has significantly deteriorated. Additionally, inspections of the sanitary sewers in the vicinity revealed structural and construction defects	$6,520,000	Borrowed	March 2018	March 2020
2019 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$3,580,000	Borrowed	June 2019	July 2020
2020 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$3,960,000	Borrowed	August 2019	July 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2021 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,045,000	Borrowed	August 2020	July 2022
2022 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,230,000	Borrowed	August 2021	July 2023
2023 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,375,000	Borrowed	August 2022	July 2024
2024 Storm System Improvements	Strategic replacement or rehabilitation of storm mains or structures to improve system reliability and minimize disturbance to the community, including reducing flooding.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost	$4,490,000	Borrowed	August 2023	July 2025
Saw Mill Run Stream Bank Restoration	Stream restoration of approximately 1,500 linear feet of the Saw Mill Run Creeks to reduce pollutants in the impaired waterway.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,385,000	Borrowed	October 2018	~~December 2019~~April 2020
Volunteer's Field Storm Water Management	Installation of BMPs to reduce sediment, other pollutant loads, stormwater volume, and peak flows to the Saw Mill Run watershed. This project has been broken into 2 phases, the first project is a bioretention facility. The second project is regrading of the ballfields to reduce sediment runoff into the storm system to be in compliance with the EPA approved sediment TMDL.	This project is required to comply with the MS4 NPDES permit application submitted to the Pennsylvania Department of Environmental Protection and to meet the waste load reductions required in the EPA-approved Sediment TMDL in the Saw Mill Run watershed.	$1,465,000	Borrowed	October 2018	December ~~2019~~2020
Saw Mill Run Watershed Water Quality Improvement Project (formally known as Overbrook Pollution and Flood Reduction)	Implementation of stormwater treatment and reconnection of streams to vegetated floodplains to help mitigate stormwater peak flows, reduce flooding, reduce sediment, other pollutant loads, and reduce CSO volume	This project will demonstrate the effectiveness of ~~green infrastructure~~Stormwater Management Project in reducing pollutants, controlling CSO/SSOs, and restoring the health of the aquatic ecosystems in the Saw Mill Run watershed to comply with MS4 NPDES permit and PADEP CO regulatory obligations.	$6,500,000	Borrowed	~~May~~October 2019	~~June~~November 2021
Tide Gate Installations	Installation of tide gates at 44 combined sewer overflow diversion chamber locations to assist in preventing river water intrusion. Construction for this project is anticipated to occur in multiple phases.	This project is required to reduce CSO volume to address PADEP Consent Order for CSO compliance. Project to be completed in multiple phases and construction contracts.	$4,500,000	Borrowed	May 2019	June 2023
~~EPA 308/City of Pittsburgh Source Reduction Response~~	~~Modeling of the remaining priority combined sewersheds within the City of Pittsburgh, as well as the separate sewersheds within the City in order to meet an EPA submission requirements.~~	~~This project is required to comply with regulatory obligations.~~	~~$750,000~~	~~Borrowed~~	~~June 2017~~	~~December 2019~~

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Wightman Park ~~Green Infrastructure~~Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Squirrel Hill neighborhood of the City of Pittsburgh, which is tributary to the M-29 combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,365,000	Borrowed	March 2018	September 2020
Wightman Park Stormwater Management Project Phase 2 and 3	Phase 2 and 3 will use the available detention storage in the park from Phase 1 and reach out into the Squirrel Hill Neighborhood to convey additional stormwater runoff to the park. This is tributary to the M-29 combined sewer outfall.	This project area was identified during the Phase 1 planning and design as a high yield drainage area for capturing stormwater runoff to reduce CSO and flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,371,000	Borrowed	May 2019	November 2021
Woods Run Stream Removal -Phase 1	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently discharging directly into a 36-inch diameter combined sewer on Mairdale Avenue.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,296,000	Borrowed	October 2017	~~June~~October 2020
Woods Run Stream Removal -Phase 2	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow from several streams currently discharging directly into the sewer system in the O-27 Sewershed.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$2,405,000	Borrowed	January 2021	November 2022
Woods Run Stream Removal -Phase 3	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow from the remaining streams currently discharging directly into the sewer system in the O-27 Sewershed.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,775,000	Borrowed	January 2022	November 2023
Panther Hollow/Four Mile Green/Stormwater Infrastructure	Sewer separation, stream restoration, stream daylighting, bioretention, and underground storage to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in M-29.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$~~41,100,000~~29,400,000	Borrowed	May 2018	August 2021
Spring Garden Stream Removal	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-60.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a stream inflow point to the combined sewer system for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$10,710,000	Borrowed	April 2019	July 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
MLK Field ~~Green Infrastructure~~Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the Hill District/Uptown area of the City of Pittsburgh, which is tributary to the M-19 combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$3,402,000	Borrowed	March 2019	September ~~2020~~2021
Woodland Drive ~~Green Infrastructure~~Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets and steeply sloping hillside within Chatham University, which is Tributary to the A-22 combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,195,000	Borrowed	October 2018	November ~~2019~~2020
Thomas and McPherson ~~Green Infrastructure~~Stormwater Management Project	Installation of roadside bioretention features to capture and detain impervious road runoff in the North Point Breeze neighborhood of the City of Pittsburgh, which is tributary to the A-42 combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$4,650,000	Borrowed	October 2018	September 2020
~~Homewood Park Green/Stormwater Infrastructure~~	~~Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the City of Pittsburgh, which is tributary to the M-29 combined sewer outfall.~~	~~This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.~~	~~$2,720,000~~	~~Borrowed~~	~~April 2019~~	~~October 2020~~
Bus Rapid Transit (BRT) ~~Green~~ Stormwater ~~Infrastructure~~Management Project	Installation of stormwater management features to capture and detain impervious acres from 5th Avenue and Forbes Ave in the City of Pittsburgh, which is tributary to multiple CSO outfalls. Project being coordinated with and constructed in phases with City road reconstruction project of 5th Avenue and Forbes Ave.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$6,050,000	Borrowed	January 2020	December ~~2022~~2023
Negley Run/Washington Boulevard ~~Green~~ Stormwater ~~Infrastructure~~Management Project	Sewer separation, stream restoration, bioretention, and underground storage (if necessary) to remove the existing stream base and wet weather flow currently discharging into the combined sewer located in A-42.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$15,390,000	Borrowed	January 2019	~~January 2020~~December 2021
Lawn and Ophelia ~~Green Infrastructure~~Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from the adjacent streets into the park in the South Oakland neighborhood, which is tributary to the M-19B combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$785,000	Borrowed	May 2018	November ~~2019~~2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
South Side ~~Green/~~Park/S 21st Street Stormwater ~~Infrastructure~~Management Project	Installation of stormwater management features to detain and slow release the existing stream base and wet weather flow currently within the Park and downstream adjacent streets tributary to the M-16 combined sewer outfall.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$8,694,000	Borrowed	December 2018	~~July 2021~~September 2022
Maryland Avenue ~~Green Infrastructure~~Stormwater Management Project	Installation of stormwater management features to capture and detain impervious acres from Maryland Ave and the adjacent streets which is tributary to the A-22 combined sewer outfall. Project being split into 3 primary phases.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$9,384,000	Borrowed	January 2018	September ~~2021~~2022
~~Shamrock Way Green/Stormwater Infrastructure~~	~~Preliminary design of stormwater management features to capture and detain impervious acres from Shamrock Way and the adjacent streets which is tributary to the A-22 combined sewer outfall. Design and construction will be through a future project to be developed after preliminary design is complete.~~	~~This project area was identified in the PWSA Green First Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.~~	~~$40,000~~	~~Borrowed~~		
St. Johns ~~Green/~~Stormwater ~~Infrastructure~~Management Project	Preliminary design of stormwater management features to capture and detain impervious acres tributary to the former St. John's hospital site now scheduled to be green space, which is tributary to the O-27 combined sewer outfall. Design and construction will be through a future project to be developed after preliminary design is complete.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$~~75,000~~5,309,000	Borrowed	December 2018	~~September 2020~~November 2021
~~Heth's Run/~~A-41 ~~Green/~~Stormwater ~~Infrastructure~~Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-41 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$~~600.000~~600,000	Borrowed	May 2019	~~January~~June 2020
M-29 ~~Green/~~Stormwater ~~Infrastructure~~Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the M-29 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	~~December 2019~~June 2020
A-42 ~~Green/~~Stormwater ~~Infrastructure~~Management Implementation Project	Preliminary design of stormwater management features to capture and detain impervious acres within the identified high yield stormwater capture areas of the A-42 CSO sewershed. Design and construction will be through multiple future projects to be developed after preliminary design is complete.	This project area was identified in the PWSA ~~Green First~~Integrated Plan as a high yield drainage area for capturing stormwater runoff to reduce CSO and mitigate flooding to comply with PADEP Consent Order regulatory obligations for CSO compliance.	$1,700,000	Borrowed	April 2019	~~December 2019~~June 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Smallman Street Reconstruction	The installation of approximately 2,500 linear feet of new storm sewer piping ranging in size from 24-inch to 54-inch, 2,000 linear feet of new sanitary sewer piping ranging in size from 18-inch to 48-inch, 2,000 linear feet of new 12-inch water main, and 1,500 linear feet of new 36-inch water transmission main.	Sewer separation and water main replacement due to the redevelopment of the Produce Terminal Building, realignment of the streetscape, and the location of the existing combined sewer infrastructure, which is located under the existing building.	$16,867,000	Borrowed	September 2017	May 2019
Sewer Master Plan	Comprehensive plan of the sewer system, including risked based prioritization for internal inspection purposes and assessment of the four pump stations.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$500,000	Borrowed	March 2019	September 2019
2018 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,470,000	Borrowed	January 2018	March 2019
2019 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	March 2019	March 2020
2020 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2020	March 2021
2021 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2021	March 2022
2022 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	March 2022	March 2023
2023 Sewer Reconstruction (Annual IDIQ Contract)	Reconstruction of existing sewers, manholes, catch basins, and inlets due to emergency situations or pipe failures.	The existing sewer system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	March 2023	March 2024
2018 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following four sites have been identified: Ellsworth Avenue (695 linear feet of 20-inch vitrified clay, combined sewer main located 5135 Ellsworth Avenue), Oakwood Bridge (215 linear feet of 24-inch vitrified clay, combined sewer main located adjacent to the Oakwood Road Bridge), South 16th Street (700 linear feet of 20 and 24-inch vitrified clay, combined sewer main located under the Union Supply Company building, CSX railroad tracks, and the Three Rivers Heritage Trail), and Centre Avenue (575 linear feet of 15-inch vitrified clay, combined sewer main located under a 20-inch water main that serves UPMC Shadyside and a telecommunications duct bank.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$6,680,000	Borrowed	March 2018	December 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes. The following three sites have been identified: Flemington Street (740 linear feet of 15-inch and 20-inch vitrified clay, combined sewer main. located under 1075 Flemington Street and on an inaccesible steep slope (>35 percent) to Beechwood Boulevard), Washington Landing River Crossing (282 linear feet of 8-inch ductile iron, sanitary sewer main located under the Allegheny River), an Seaton Avenue (402 linear feet of 8-inch vitrified clay, sanitary sewer main. located under a building addition and swimming pool).	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,120,000	Borrowed	April 2019	June 2021
2020 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,400,000	Borrowed	August 2019	February 2022
2021 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,415,000	Borrowed	August 2020	February 2023
2022 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$7,795,000	Borrowed	August 2021	February 2024
2023 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost.	$8,055,000	Borrowed	August 2022	February 2025
2024 Sewers Under Structures	Rehabilitation, relocation, and abandonment, if applicable, of existing sewer infrastructure located under or adjacent to buildings, bridges, or railroads or located on steep slopes.	In recent years, there has been an increasing rate of failure of this asset type due to limited accessibility and pipe age. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before	$8,325,000	Borrowed	August 2023	February 2026

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
		their failure, thus saving in overall replacement cost.				
2019 Wastewater System Improvements	Reconstruction of existing structurally deficient sewer mains on Wiese Street, Wilbur Street, Creedmoor Avenue, Ornament Way, Cooperfield Avenue, N. Sheridan Avenue, Port Way, and Swimburne Street.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$5,350,000	Borrowed	August 2018	January 2021
2018 Sewer Rehabilitation (Annual IDIQ Contract)	Trenchless rehabilitation of less than 24-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$1,910,000	Borrowed	September 2018	September 2019
2019 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,260,000	Borrowed	January 2019	April 2020
2020 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$9,500,000	Borrowed	June 2019	December 2020
2021 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$14,690,000	Borrowed	March 2020	September 2021
2022 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,090,000	Borrowed	March 2021	September 2022
2023 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,600,000	Borrowed	March 2022	September 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2024 Small Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 6 miles of less than 36-inch diameter sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning, pre and post construction CCTV inspections, and if necessary, excavated point repairs and manhole rehabilitation.	Provides the Authority a means to address inflow and infiltration and several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$17,820,000	Borrowed	March 2023	September 2024
2020 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$3,800,000	Borrowed	February 2019	May 2020
2021 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,200,000	Borrowed	January 2020	April 2021
2022 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,310,000	Borrowed	January 2021	April 2022
2023 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,440,000	Borrowed	January 2022	April 2023
2024 Large Diameter Sewer Rehabilitation	Proactive, trenchless rehabilitation of approximately 0.5 mile of 36-inch diameter or greater sewer mains to restore structural integrity, reduce root intrusion, and reduce infiltration and inflow, includes cleaning and pre and post construction CCTV inspections.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure. This trenchless pipe renewal method eliminates disruptive digging and restoration and is cost effective.	$4,570,000	Borrowed	January 2023	April 2024
31st Ward Sewer System Improvements	Evaluation to identify and locate the source(s) of the infiltration and inflow (I/I), removal of public I/I sources, and rehabilitation/replacement of the Rogers Street and Mifflin Road Pump Station and force main. Project will be designed and constructed in a minimum of two phases to ensure the pump stations are properly sized and the flow conveyed will not negatively impact the downstream sewer subshed.	Both sewage pump stations and the force main that convey flow to the Streets Run Sanitary Trunk Sewer were constructed in the late 1940's and are reaching the end of their useful life. Additionally, studies suggest this sewershed is significantly impacted by high levels of infiltration/inflow.	$13,700,000	Borrowed	March 2017	February 2021
Larimer Avenue Sewer and 28th Street Stabilization	Evaluation of rerouting storm laterals, sewer televising, geotechnical investigations, and slope stabalization to address a structurally deficient 18-inch combined sewer that has severely eroded the ground surface on the slope below Brereton Street and above the Port Authority of Allegheny County's East Busway.	Repairs were issued on previous annual contracts; however, were not performed due to utility conflicts and limited site access.	$695,901	Borrowed	January 2018	October 2019

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Ivyglen and Odette Sewer Reconstruction and Separation Project	The installation of a new sanitary sewer and storm sewer on Odette and Ivyglen, which will eliminate the combined sewer outfall and a sewer on an unstable slope.	During the weekend of June 23, 2018, PGH2O was informed of a landslide that occurred in the hillside in rear of 2604 Ivyglen, which collapsed a manhole and potentially compromised the 8-inch sanitary sewer that exists on the slope. Considering the current steepness of the slope, the presence of Saw Mill Run at the toe of the slope, and the unknown location of the sewer, it does not appear that there is an expeditious and safe way to readily repair the sewer and/or protect the sewer from damage due to additional slope movements. Further disturbance of the slope with construction equipment could cause additional movements that could impact both the residential structure(s) at the crest and Saw Mill Run below. Additionally, the Odette Street sewer main is single combined sewer segment that overflows into the creek during wet weather events.	$1,900,000	Borrowed	July 2018	June 2019
M-29 Outfall Improvements	Structural improvements and rehabilitation of the the M-29 combined sewer outfall diversion structure. Repairs to the diversion structure include lowering of the weir wall height and safety improvements for maintenance of the structure. The outfall pipeline requires extensive repairs and installation of a new flap gate to the outfall on the Monongahela River.	Provides the Authority a means to address several moderate/major structural defects in a pipe segment prior to complete failure.	$1,845,000	Borrowed	November 2018	November 2019
2019 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,335,000	Borrowed	January 2019	April 2020
2020 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,430,000	Borrowed	September 2019	April 2021
2021 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2020	April 2022
2022 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,450,000	Borrowed	September 2021	April 2023
2023 Hydrant Replacement (Annual IDIQ Contract)	Replacement of approximately 100 broken or older model type hydrants throughout the water distribution system, excluding hydrants replaced during relays.	Increasing the number of operational hydrants provides better fire protection for the City of Pittsburgh.	$1,575,000	Borrowed	September 2022	April 2024

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2019 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,565,000	Borrowed	January 2019	April 2020
2020 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,805,000	Borrowed	September 2019	April 2021
2021 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$6,920,000	Borrowed	September 2020	April 2022
2022 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,150,000	Borrowed	September 2021	April 2023
2023 Valve Replacement (Annual IDIQ Contract)	Replacement of defective or non-operational valves on transmission and distribution mains throughout the water distribution system, excluding valves replaced during relays. Includes locating, assessing and documenting the operability, raising to grade, and/or cleaning existing buried or obstructed valves.	Increasing the number of operable valves in the system will reduce the number of customers that may be impacted and the number of valves that would need to be closed during emergency conditions.	$7,400,000	Borrowed	September 2022	April 2024
2018 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,620,000	Borrowed	May 2018	September 2019
2019 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2019	October 2020
2020 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,720,000	Borrowed	June 2020	October 2021
2021 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,750,000	Borrowed	June 2021	October 2022
2022 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2022	October 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2023 Water Relay (Annual IDIQ Contract)	Replacement of existing water mains, valves, fittings, service connections, and hydrants due to emergency situations.	The existing water distribution system is aging and immediate repairs are required to address failures that could be significant public safety hazards.	$1,880,000	Borrowed	June 2023	October 2024
2018 Small Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. In 2018, the following mains have been selected for replacement: Hamilton Avenue from N. Dallas Avenue to N. Homewood Avenue; Railroad Street from 25th Street to 32nd Street; and S. Millvale Avenue from Liberty Avenue to Friendship Avenue.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,680,000	Borrowed	December 2017	December 2019
2019 Small Diameter Water Main Replacement	Strategic replacement of water mains to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$10,880,000	Borrowed	FMarch 2019	December 2020
2020 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$54,340,000	Borrowed	March 2019	December 2020
2021 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$114,770,000	Borrowed	January 2020	December 2021

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2022 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$120,060,000	Borrowed	Janurary 2021	December 2022
2023 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$58,860,000	Borrowed	January 2022	December 2023
2024 Small Diameter Water Main Replacement	Strategic replacement of water mains, including lead service lines, to improve system reliability as well as improve water pressure, maintain water quality, and minimize disturbance to the community. By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality and available hydrant flows will also improve by removing tuberculated mains.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus saving in overall replacement cost. Additionally, projects will be coordinated with other utilities to minimize disturbance to the community and street surface restoration costs. Water quality will also improve by removing tuberculated mains.	$60,700,000	Borrowed	January 2023	December 2024
District Water and Pressure Meters	Installation of water meters and pressure monitors in the distribution system to determine water usage and loss, and pressure loss.	Pressure Monitors are required per PUC. District Metering will be used for water auditing and leak detection.	$2,705,000	Borrowed	January 2019	October 2020
Ft. Duquesne Bridge Water Air Release	Perform transient analysis along existing 30-inch water main that is suspended from the Fort Duquesne Bridge. Design and construct new pipe supports, couplings, and thrust restraint based on the results of the analysis. Includes the replacement of the existing air-release valve on the 30-inch water main, including insulation or heat tracing to reduce potential for freezing and cracking of the valve.	A recent PENNDOT inspection of the Fort Duquesne Bridge identified priority code 1 defects in the support of the existing 30-inch diameter water main. Additionally, the existing 2-inch diameter air-release valve located on the main has a history of failure. The water main is located below the lower deck of the Fort Duquesne Bridge and serves as an emergency interconnection between pressure gradients and is a vital component to the system operation.	$2,850,000	Borrowed	January 2017	December 2019

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Washout Disconnection	Investigation and, if necessary, disconnection of large water main washouts from the sewer system.	A number of older washouts on larger mains were directly connected to sewers with a closed valve during construction. These washouts (cross connections) must be completely disconnected from the sewer.	$13,140,000	Borrowed	October 2018	September 2023
2019 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,840,000	Borrowed	March 2019	March 2020
2020 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$4,975,000	Borrowed	March 2020	March 2021
2021 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,100,000	Borrowed	March 2021	March 2022
2022 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,245,000	Borrowed	March 2023	March 2024
2023 Unmetered and Flat Rate Properties	Metering unmetered and flat rate properties as required by the PUC	Ensure capture of all revenue	$5,360,000	Borrowed	March 2024	March 2025
2019 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019
2020 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020
2021 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021
2022 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022
2023 Large Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023
2019 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,100,000	Pay Go	December 2018	December 2019
2020 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2019	December 2020
2021 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,200,000	Pay Go	December 2020	December 2021
2022 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,300,000	Pay Go	December 2021	December 2022
2023 Small Water Meters	Replacement of meters as required by the PUC	Ensure capture of all revenue	$2,400,000	Pay Go	December 2022	December 2023
2018 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$43,300,000	Borrowed	March 2018	February 2019
2019 Lead Service Line Replacement	Replacement of 7% of lead service lines, both public and private.	Due to the exceedance of the action levels from compliance tests for lead and copper, the Pennsylvania Department of Environmental Protection required the Authority to perform additional distribution system water quality monitoring, optimization of corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.	$49,128,403	Borrowed/Grant	October 2018	February 2020

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2018 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$2,980,134	Borrowed	December 2017	March 2019
2019 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	April 2020	March 2020
2020 Curb Box Inspections	Curb Box Inspections provide the Authority with a cost effective way to visually identify the material on both the public and private sides of the water service lines. Curb Boxes typically require moderate cleaning through a combination of vacuum extraction, high pressure air and high pressure water before a clear visual of the service line can be obtained.	Locating lead service lines allows the Authority to identify both individual service lines to replace and waterlines that have a particularly high amount of lead service lines that can be replaced to facilitate the lead service line replacements.	$3,960,000	Borrowed	February 2019	March 2021
2019 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections. In 2019, Rising Mains 3 and 4 from the Bruecken Pump Station have been selected for improvements, which is approximatly 2.3 miles of main.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Rising Mains 3 and 4 from Bruecken Pump Station to Highland 2 Reservoir were chosen for the 2019 Large Diameter Water Main Improvements Program due to their criticality when the clearwell is being rebuilt.	$23,550,000	Borrowed	February 2019	March 2022

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2020 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$11,940,000	Borrowed	January 2019	August 2022
2021 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,170,000	Borrowed	January 2020	August 2023
2022 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$12,430,000	Borrowed	January 2021	August 2024

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
2023 Large Diameter Water Main Improvements	Strategic replacement or rehabilitation of large diameter water mains (16-inch and larger) and appurtenances to improve system reliability and hydraulics, including internal and external inspections.	By maintaining a proactive approach to asset management, efforts can be directed towards remedying assets before their failure, thus resulting in a savings in the replacement cost as compared to emergency/reactive repair costs. Typically, large diameter pipe is not readily available and has a 6 to 8 week lead time for delivery. A large percentage of the Authority's large diameter mains are riveted steel, which cannot be easily repaired without the use of field fabricated specialty fittings. Mains chosen for 2020 for renewal will be based on the outcome of the Water Distribution System Master Plan.	$26,410,000	Borrowed	January 2022	August 2025
Aspinwall Pump Station to Lanpher Reservoir Rising Main	Construction of a new, redundant rising main from Aspinwall Pump Station to Lanpher Reservoir.	The existing 60-inch rising main that supplies the Lanpher Reservoir is a 150 year old riveted steel pipe, has several tap connections to critical and bulk customers, and has experienced recent pipe failures. The proposed rising main would serve as a primary supply source for Lanpher Reservoir during the Clearwell Replacement Project and a redundant supply line in case of a failure or planned cleaning and rehabilitation of the existing 60-inch supply main.	$49,454,000	Borrowed	September 2018	September 2022
Aspinwall Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The current pump station was constructed in 1914 and many of the components were installed in 1958.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff.	$29,690,000	Borrowed	May 2019	March 2023
Bruecken Pump Station Improvements	Replacement of aged pump and valve equipment, electrical equipment, HVAC, and auxiliary systems and rehabilitation of the building architectural and energy management systems. The pump station was constructed in 1931.	The pump station is in need of renovations and upgrades to maintain service, restore a 20 to 25 year useful life expectancy, and to provide safer conditions for the staff. This project is a critical component of the clearwell replacement project.	$24,990,000	Borrowed	April 2019	February 2023
Aspinwall Water Treatment Plant High Service Pump Station	In lieu of Aspinwall and Bruecken Pump Stations, a new high service pump station may be constructed to service Highland Reservoir 1, Highland Reservoir 2, Lanpher Reservoir, and Fox Chapel.	If this project moves forward, the Aspinwall Pump Station Imrpvements and Bruecken Pump Station Improvements Project would be reduced to only what is necessary to keep the stations operational until the new station is online. This project is a critical component of the clearwell replacement project.	$53,620,000	Borrowed	October 2018	February 2023
Ross Pump Station Improvements	Replacement of aged pump and valve equipment, meters, SCADA, electrical equipment, HVAC, and auxiliary systems and the rehabilitation of the building architectural and energy management systems.	The Ross Pump Station is the only feed to the water treatment plant. This station is in need of renewal.	$43,000,000	Borrowed	August 2018	TBD

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Chlorine Booster Station Improvements	Rehabilitation or replacement of the existing sodium hypochlorite booster stations in the distribution system, excluding Lanpher and Herron Hill. Includes installation of flow meters, if necessary.	Existing chlorine injections systems at satellite storage facilities are in need of renewal. Without upgrade of these facilities, the system would be in violation of residual chlorine levels required by PA DEP.	$10,090,000	Borrowed	December 2018	December 2021
Garfield Tank Improvements	Perform a comprehensive inspection of the existing elevated storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional storage tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,050,000	Borrowed	September 2018	April 2021
Lincoln Tank Improvements	Perform a comprehensive inspection of the existing storage tank, evaluate the system's need for additional storage for regulatory compliance, the need for an additional tank, and rehabilitation of the existing tank. Evaluation of storage capacity will be based on outcome of the Water Distribution System Master Plan.	Renewal of storage tanks is necessary to ensure a safe and reliable water supply. Garfield Tank has been identified based on the 40-year master plan as well as recent leaks for priority for renewal. Tank size may need to be increased based on outcome of Water Distribution System Master Plan.	$4,195,000	Borrowed	September 2018	April 2021
Herron Hill Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Reservoir liner and cover is close to the end of its design life where patching and regular maintenance will no longer be effective.	$5,520,000	Borrowed	October 2018	December 2020
Lanpher Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Work required as a result of a failure of the reservoir floating cover in September 2017. Sodium hypochlorite feed system is reaching the end of its design life.	$29,643,000	Borrowed	September 2017	June 2019
Highland No. 2 Reservoir Improvements	Installation of new liner and cover and provide ancillary improvements to the entire facility, including new outlet piping for Highland Pump Station and Rising Main, Sodium Hypochlorite injection system, SCADA system improvements, site electrical improvements, sluice gate rehabilitation, dewatering pumps, concrete repairs and necessary site work.	Upgrade of outlet structure to allow increased capacity for the Highland Reservoir Pump Station. Replace liner and cover.	$27,510,000	Borrowed	March 2019	March 2022

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Highland Reservoir Pump Station and Rising Main	Construction of a new finished water pump station and transmission main to supply water to the Highland No.1 Service Area from Highland No. 2 Reservoir	All compliant water supply for the Highland No. 1 Service Area currently flows through the Highland No. 1 Reservoir and the Membrane Filtration Plant (MFP) or directly into the system. There is no online storage for the system, and there is no other source water supply for the Highland No. 1 Service Area. In addition to providing alternate supply, this project will temporarily provide finished water that meets the chlorine disinfection rules to the Highland No. 1 Service Area during the Clearwell Replacement Project. Additionally, this new facility will also be designed to service the Garfield pressure district, thus eliminating the need to rehabilitate the (New) Highland Pump Station.	$37,130,000	Borrowed	March 2017	June 2022
Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	Inspection and rehabilitation and/or replacement of the fiberglass reinforced plastic chemical tanks.		$294,000	Borrowed	April 2017	June 2019
Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	Improvements to pretreatment chemical systems, clarifiers, sedimenation, and associated systems to provide enhanced water treatment.	Chemical treatment systems are a critical component to producing safe drinking water. Components of the chemical treatment systems can no longer be operated in a safe, effective, or reliable manner to meet water quality requirements. Many bulk water treatment chemicals present safety hazards to staff. The storage and pumping systems associated with these chemicals have reached the end of their useful life. Failures resulting in dust creation and chemical spills can place operators in unsafe working conditions and can cause physical damage to equipment and structures, as well as environmental contamination.	$27,310,000	Borrowed	March 2017	February 2023
Aspinwall Water Treatment Plant Electrical and Backup Power Improvements	Improvements to electrical systems at Aspinwall Water Treatment Plant, including provisions for backup power systems, upgrades to existing electrical distribution system, and replacement of motor control centers.	Electrical systems at the Aspinwall Water Treatment Plant have generally met the end of their useful lives and spare/replacement parts are unavailable. Electrical panels do not meet current safety standards, including lack of arc flash protection. Additionally, the Aspinwall Water Treatment Plant does not have redundant power systems or a means for stand-by power for critical pumping and treatment systems.	$26,520,000	Borrowed	March 2017	February 2023

Project Name	Project Descriptions	Project Justification	Budgeted Cost	Funds	Start Date	Date of Completion & In Service
Aspinwall Water Treatment Plant Raw Water Intakes	Project will include renewing or replacing the existing West and East Raw Water Intake Gate House buildings and associated systems, including gates, screens, and associated mechanical equipment as well as the addition of SCADA. Influent piping through the Ross Pump Station will also be addressed.	Only one intake is currently operable. Both intakes are in need of renewal.	$45,000,000	Borrowed	August 2018	TBD
Clearwell Emergency Response Project	Construction of piping, suction wells, if necessary, and appurtenances to bypass the existing clearwell.	This project will provide a means to bypass the existing clearwell. Note: Disinfection requirements will not be achieved while bypassing is occurring. Additionally, this infrastructure will be required to maintain water supply to PWSA's customers for the rehabilitation or replacement of the existing clearwell.	$27,670,000	Borrowed	March 2017	April 2022
Clearwell Improvements	Replacement of the existing 108 year old, single cell clearwell (finished water structure). The clearwell was constructed in 1908 and has not undergone any major modifications or upgrades since. It has two main functions: providing equalization storage that allows the filters to operate independently of potential fluctuations in system demands and providing sufficient retention contact time for disinfection to meet the requirements of the Federal Surface Water Treatment Rule and Long-Term 2 Enhanced Surface Water Treatment Rule.	Considering the age and condition of the clearwell, it is the water system's weakest link as there are no practical means to deliver water by bypassing the clearwell, while maintaining the required volume, quality, and contact time.	$67,810,000	Borrowed	April 2019	March 2024
Corrosion Control Chemical Storage and Feed Systems	Installation of phosphoric acid storage and feed systems located at Aspinwall Pump Station, Bruecken Pump Station, and near the Membrane Filtration Plant to provide corrosion control in the distribution system.	Addition of a new corrosion control chemical was required per PA DEP Consent Order.	$3,960,000	Borrowed	May 2018	March 2019
Highland Park Membrane Filtration Module Replacement Program	Replace membrane modules, which includes a total of 10 racks each with 80 modules. Note: Four racks were replaced in 2017.	Replacement necessary to maintain operation of the MFP.	$21,717,711	Borrowed	May 2017	January 2020
Highland Park Membrane Filtration Plant UV System	Installation of a UV treatment system and appurtenances at the Highland Park Membrane Filtration Plant (MFP).	To comply with the 1 log inactivation of Giardia cysts and the PADEP Administrative Order dated October 25, 2017.	$5,855,000	Borrowed	October 2017	April 2019
MFP Assessment and Critical Process Improvements	Complete a condition assessment of systems supporting the treatment process and perform critical improvements to maintain water treatment and allow full warranty of replacement modules. Improvements may include electrical, chemical feed, strainers, and other support systems.		$1,755,500	Borrowed	March 2017	December 2018
Water System GIS Improvements	Rescan Water Record Books, Input material and pipe age into GIS. Update valve layer.	GIS upgrade required in order to prioritize mains for renewal.	$1,200,000	Borrowed	May 2019	May 2021
Water Master Plan	Comprehensive plan, including analysis of demands, future demands, capacities, and pipe condition based assessment.	Master Plan required to prioritize water mains, pump stations, and storage for renewal, identify and refine future CIP projects.	$500,000	Borrowed	March 2019	October 2019
Low Pressure Area Remediation	Fix chronically low pressure areas by either extending neighboring higher pressure districts into the area, booster pump stations, or household booster pumps.	This project is in response to the low pressure monitors required by the October 2017 Administrative Order.	$2,000,000	Borrowed	January 2019	January 2021

Notes:

Required per November 17, 2017 Consent Order and Agreement with PA DEP
Required per October 25, 2017 PA DEP Administrative Order
Projects noted in October 25, 2017 PA DEP Administrative Order

1. Pressure Sensors, as required by October 25, 2017 PA DEP Administrative Order purchased under Highland Park Membrane Filtration Plant UV System.
2. Bruecken Pump Station improvements required per October 25, 2017 PA DEP Administrative Order covered under existing project, Bruecken Pump Station Improvements, not listed on this table.

Exhibit RAW/C-28(A)

To Commissioners of the Pennsylvania Public Utilities Commission:

On December 21, 2017, pursuant to Act 65 of 2017, the Pennsylvania Public Utility Commission (PUC) was granted jurisdiction over the provision of water, wastewater, and stormwater utility service by entities created by Pennsylvania cities of the second class under the Municipal Authorities Act. As a newly regulated utility, the Pittsburgh Water and Sewer Authority (PWSA or the Authority) filed a Compliance Plan on September 28, 2018 and agreed as part of its Tariff Filing Settlement of February 1, 2019 to complete and report on critical activities to the PUC and interested parties on a regular basis.

As part of its reporting requirements, PWSA has prepared an update on each of the areas where it is required to provide information and compiled them in a standard format. These areas include Operations, Billing and Customer Service, Lead, Infrastructure/Engineering, Finance and Accounting, and Contractual/Other Issues. Each section is organized according to the requirements associated with the Master List of Stipulations, the Compliance Plan Supplement, and the Compliance Plan. PWSA intends to use this format to streamline the process of tracking progress toward meeting agreed to activities in the Tariff Filing Settlement and in the Compliance Plan and Supplement.

Robert Weimar, PE

Executive Director, Pittsburgh Water and Sewer Authority

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1. Operations

Operations activities are those that involve operations and maintenance (O&M) in the water, wastewater and stormwater systems. This includes O&M activities at the Aspinwall Water Treatment Facility, as well as O&M activities in the water transmission, storage and distribution systems and the wastewater/stormwater collection and conveyance systems.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including hydrant replacement, leak detection, valve maintenance, metered service, meter testing/replacement, operational effectiveness, and an expanded use of mobile work, as shown in Table 1. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative describing each task yet to be completed. Completed tasks are also shown in Appendix A.

Table 1: Compliance Plan Supplement Requirements - Operations

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Replace one hundred hydrants per year.	2019 and 2020	On-Target
Develop a leak detection program and restructure staff to add more personnel for leak detection.	April 2019	On-Target
Install a new meter test station for testing 5/8" to 2" meters.	April 2019	Complete
Hire a private contractor to test meters that are 3" and above on site or at their facility.		The PWSA Board of Directors awarded this contract to Vanguard on April 26, 2019.
Record water used for flushing after main breaks by having crews record the time flushed and flow gauges to record water used.	October 2019	On-Target
Provide water meters for each DPW division and have them installed on hydrants.	October 2019	On-Target
Restructure to support delivery of formal valve operation, flushing, and leak detection programs.	April 2019	Restructuring is in progress; program formalization is underway.
Develop a plan to track age of customer meters and to test and/or replace meters over 20 years old.		On-target to replace 4,500-5,000 meters in 2019.
Track the 20 Operating Metrics identified in I&E St. No. 4, p. 5.		Initial metric definitions and data (as available) is included in Appendix C.

i) Replace one hundred hydrants per year.

PWSA agreed to replace one hundred hydrants per year in 2019 and 2020. The replacement program is focused on removing older models from service on larger diameter mains and is currently on-schedule for 2019. The work associated with this task is being completed using both contractors and in-house staff. In the future, hydrant replacements will be coordinated with the small diameter main replacement program so that new hydrants are installed on new mains that replace older 4- and 6-inch mains that provide inadequate flow and/or pressure.

ii) Develop a leak detection program and restructure staff to add more personnel for leak detection

PWSA has hired a manager with considerable utility expertise to oversee its leak detection program. The new manager has initiated weekly meetings with the other operations managers to start formalizing a program, and has initiated cross-training of crews, with the idea being that all crews have some leak detection capability, but that the two designated leak detection crews can focus their efforts on programmatic surveying and more difficult detections. The Authority has also upgraded its leak detection equipment with new correlators and ground microphones to facilitate faster and more accurate leak detection. PWSA will start reporting data on leaks (number, type, etc.) in future progress reports.

iii) Record water used for flushing after main breaks

PWSA committed to recording water used for flushing by having crews record the time flushed and using flow gauges to record the water used. PWSA is in the process of shifting a manager to oversee its flushing program, and has developed a system-wide flushing plan, which has already been approved by the Pennsylvania DEP. This program is on track to be in place by October 2019 and will be more fully discussed in subsequent sections.

iv) Provide water meters for each Department of Public Works (DPW) division and have them installed on hydrants

The goal of this initiative is to record water use for street sweeping, and to help PWSA reduce its unaccounted-for water. PWSA has contacted the City of Pittsburgh's DPW to determine appropriate sites for meters for filling street sweeping vehicles. While meter installation has not yet started, PWSA anticipates that this task is on-schedule for completion by October 2019. However, there will need to be some training and culture change with City staff to get them accustomed to using the metered locations.

v) Restructure to support delivery of formal valve operation, flushing, and leak detection programs

PWSA has assigned one of its operations managers to formalize its valve operation, flushing, and leak detection programs, and has hired three additional staff members to ensure that the programs are appropriately resourced. The Operations Department has also started a restructuring effort, which includes assigning designated crews to focus on programmatic valve operation, flushing, and leak detection activities (while supporting other crews during emergencies). While implementation of these programs has started, the programs have not yet been formalized and PWSA is working to automate the associated data collection and reporting efforts. One of the first restructuring activities has been the promotion of William "BJ" McFadden to the role of Director of operations. Mr. McFadden has considerable experience with both public and private water suppliers managing operations activities. While implementation of these programs has started, the programs have not yet been formalized and PWSA is working to automate the associated data collection and reporting efforts.

vi) Develop a plan to track age of customer meters and to test and/or replace meters over 20 years old

According to best available information, PWSA has as many as 50,000 meters that have exceeded the Commission's recommended testing schedule and will need to be tested and/or replaced. Unfortunately, much of the meter data including installation date was lost in a billing system transition, so this number cannot be validated. In its Compliance Plan, PWSA committed to increasing its plumbing staff and changing out 5,000-6,000 meters per year. PWSA currently has open advertisements for plumbers and has coupled its residential meter replacement program with its lead service line replacement program, which has decreased the number of individual appointments that need to be scheduled. Moving forward, PWSA will comply with Chapter 65.8 and begin testing meters at a regular interval, so that no small meter is in service longer than 20 years without testing. The Meter Upgrade Program is a concerted

effort of the Customer Service and Field Operations departments. From April through July 2019, PWSA has upgraded more than 3,000 meters, and is on track to complete 6,500 meter upgrades by year end.

PWSA is prioritizing the testing/replacement of large meters and will make its best efforts to complete the testing/replacement of all large meters/measuring chambers and registers within three years. The Authority has identified 806 large-diameter meters that have been in service for longer than eight years, or where the installation date is unknown, and will comply with Chapter 65.8 to ensure that no large meter is in service for longer than eight years without testing. PWSA entered into a contract in May 2019 to test water meters 3" or greater in-line or at the vendor's testing facility. With the addition of this vendor, PWSA is able to accommodate all customer-generated meter testing requests.

vii) Track the 20 Operating Metrics identified in I&E St. No. 4, p. 5

PWSA is starting to track the 20 Operating Metrics identified in I&E St. No 4, p. 5. Preliminary results of these operating metrics will be shown in Appendix C as data is available.

b. Compliance Plan Requirements

For PWSA's operational areas, the Compliance Plan addresses topics including metering unmetered accounts, residential and commercial meter change-outs and testing, flushing, and developing standard operating procedures for communications and emergency response (Table 2). Compliance tasks associated with PUC Section 65.8 (Meters – Change-outs) and 65.17 (Standards of Design – Flushing Program) have already been addressed in the Compliance Plan Supplement Requirements. As such, this section lays out each of the remaining operational requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 2: Compliance Plan Requirements - Operations

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.7 Hire a contractor to assist with inspecting, sizing, and installing meters for municipal and unmetered properties.	2024	Site inspections have started, and PWSA's Board of Directors approved a consulting contract with Buchart Horn on April 26. 2019.
65.8 Add additional plumbers to address 50,000 meters that are overdue for testing/change-out.	ASAP	Plumbing positions are currently advertised.
65.8 Develop a program to test 10-25% of commercial meters annually.	2022	On-Target
65.8 Develop criteria for when to test meters that have been pulled from service, prior to disposal.	Within 6 months of Compliance Plan Filing	On-Target
65.11 Develop SOPs, including communications protocols, for periods of mandatory conservation.	2020	On-Target
65.17 Implement a flushing program.	2020	On-Target
67.1 Develop an SOP to notify the Commission during periods of unscheduled service interruptions.	Within 6 months of Compliance Plan Filing	On-Target
69.16 Update Emergency Response Plan SOPs.	Within 6 months of Compliance Plan Filing	On-Target

i) 65.7 - Inspecting, sizing, and installing meters for municipal and unmetered properties

PWSA has committed to partnering with a contractor to inspect, size, and install meters for municipal and other unmetered accounts (PWSA estimates 200-400 of these accounts in its service area) within the next five years. PWSA developed and released an RFP for these services and has begun inspecting facilities for meter installations. PWSA's Board of Directors approved a consulting contract with the selected vendor (Buchart Horn) on April 26, 2019. These site visits are underway.

PWSA will actively search for additional municipal, flat rate, and other unmetered properties through various GIS and other data sources, which, when found, will be added to the list of properties requiring meters. PWSA anticipates that all unmetered and/or unbilled properties will be identified by June 29, 2020. Once unmetered or unbilled properties have been metered, PWSA will identify these properties in future Compliance Plan Quarterly Reports.

i) 65.8 - Develop criteria for when to test meters that have been pulled from service, prior to disposal

PWSA has installed a test bench and plans to test approximately 10% of the meters that have been pulled from service. Small meters (less than 1.5 inches in diameter) will not go back into service in the system. Operations staff have reached out to the Commission and developed a testing approach in the draft Compliance Plan settlement. PWSA believes that the last sentence of Title 55 § 65.8. Meters (d) (2), which says "Meters permanently removed from service and replaced by new meters utilizing remote reading devices are exempt from this provision." permits PWSA to only test a fraction of the meters pulled from service when they no longer going to be used in the system, in accordance with the American Water Works Association testing protocol. Specifically, PWSA will test 5-10% of the small meters pulled from service and not reused for quality control and to establish accuracy levels. PWSA uses an AMI network for getting data from meters which qualifies as a "remote reading device."

ii) 65.11 - Develop SOPs, including communications protocols, for periods of mandatory conservation

PWSA has an abundant water supply and therefore has never experienced and is not likely to experience a period where there would be inadequate source water to meet demands. However, source contamination or a significant failure in the treatment or delivery system may necessitate periods of mandatory conservation. These are extremely rare, and as such, has not yet developed Standard Operating Procedures, including communications protocols, for periods of mandatory conservation. The Authority plans to hire an Environmental Health and Safety professional in 2019, who will be tasked with developing and communicating a preliminary SOP by February 28, 2020, which will be incorporated into the Authority's Emergency Response Plan. The SOP will include provisions that, in the event that such conservation measures are required, PWSA will notify customers via traditional lines of communication (telephone calls, social media, and the website).

iii) 67.1 - Develop an SOP to notify the Commission during periods of unscheduled service interruptions

PWSA has separate processes to notify the Commission during emergency and non-emergency periods of unscheduled service interruptions. While these processes are in place, PWSA currently lacks a formal, written SOP describing this activity. As described in section 65.11, PWSA is in the process of soliciting applications for an Environmental Health and Safety professional, but pending hire, the consultant currently serving in this role is assisting in the development and communication of SOPs, including one to communicate Emergency Service Disruptions to the Commission and others. PWSA anticipates this SOP to be completed by 2019, and included in the Authority's Emergency Response Plan. Further, the Emergency Response Plan will establish the process to notify the Commission of any low pressure incident or other service disruption for which it notifies the Pennsylvania

Department of Environmental Protection, as well as a general revision of communication protocols to include notification to the Commission.

iv) 69.16 - Update Emergency Response Plan SOPs

PWSA is in the process of updating its emergency response plan and associated SOPs, and many divisions share responsibility for this development. As previously mentioned, the Authority plans to hire an Environmental Health and Safety professional in 2019, who will assist in developing and communicating this SOP. PWSA has revised its internal accident investigation operating procedure to ensure that telephone reports are made to Commission staff immediately after becoming aware of the death of a person; an occurrence of an unusual nature (whether or not death or injury of a person results), which apparently will result in a prolonged and serious interruption of normal service; and an occurrence of an unusual nature that is a physical or cyber security attack, which causes an interruption of service or more than $50,000 in damages, or both. PWSA will also update its internal written Incident Investigation Policies to incorporate telephone reports.

2. Billing/Customer Service

Many of the PUC's requirements relating to Billing and Customer Service fall under Chapter 56 of Title 52, which was created to establish and enforce "uniform, fair, and equitable residential public utility service standards." PWSA has already taken considerable steps to ensure Billing and Customer Service compliance, and many of the initiatives agreed to in the Master List of Stipulation Requirements, Tariff Settlement, Compliance Plan or the Compliance Plan Supplement have already been completed.

a. Master List of Stipulation Requirements

The Master List of Stipulation Requirements was developed in July 2019 to respond to feedback from the Parties, and to codify additional reporting requirements for PWSA. Table 3 highlights these additional reporting requirements.

Table 3: Billing/Customer Service Requirements from the Master List of Stipulations

Task	Timeline (if specified in the Master List of Stipulations)	Progress to Date
Commitments from motion to move issues from Stage 1 to Stage 2		On-Target (Moved to Stage 2)
PWSA Affordability Analysis		Presented at the June 3rd LIAAC meeting, with follow-up discussion at the July 15th meeting
BCS input on PWSA CAP Program	Next base rate case	On-Target
Commission development of a "Model Water CAP Design"		On-Target
Customer outreach		Existing outreach efforts have continued, and PWSA is soliciting the LIAAC for additional activities.
56.94 and 56.336 – Interim personal contact procedures immediately prior to termination	Quarterly Progress Reports	On-Target (Moved to Stage 2)

i) Commitments from Motion to Move Issues from Stage 1 to Stage 2

Per the Commission's directive, the following issues were moved to Stage 2 of the Compliance Plan process:

- The language, format, and method of providing suspension and termination notice pursuant to Chapter 14 of the Public Utility Code and Chapter 56 of the Commission's regulations.
- PWSA's compliance with the Discontinuance of Services to Leased Premises Act (DSLPA)
- PWSA's plan for collections (to include strategies to reduce overall un-collectables and to ensure collections practices for residential customers are consistent with legal requirements.
- Personal contact: PWSA Personal Contact Interim Process regarding additional telephone calls and monitoring/recording of information; good faith discussions of issues in Stage 2 Collaboratives; and Progress assessment of issues at 3- and 6-month intervals once Bureau of Consumer Services (BCS) discussions start.

ii) PWSA Affordability Analysis

PWSA presented an affordability analysis at the June 3, 2019 Low-Income Affordability Advisory Committee (LIAAC) meeting, with follow-up discussion on July 15, 2019. Data collection information, as agreed to in the rate case, was

also provided to the LIAAC. The LIAAC aims to meet monthly until 2020, with future meetings scheduled at the end of each meeting to best accommodate participant schedules.

iii) BCS Input on PWSA CAP Program

PWSA has committed to keeping BCS informed of all scheduled LIAAC meetings where the CAP program is to be discussed and inviting staff to participate. The Authority welcomes any feedback from BCS over the course of these meetings. To the extent that PWSA has any draft revisions to its CAP that it intends to file in the next base rate case, PWSA will directly submit that information to BCS for review and feedback. The estimated schedule for the next submittal is mid-August 2019, with the Authority needing feedback or data from BCS by mid-October 2019 to ensure that it is incorporated into the proposal for the next rate case.

iv) Commission Development of a "Model Water CAP Design"

PWSA will take the views of participants in the LIAAC meetings under advisement as it moves forward with its current CAP program and any potential revisions (which would be included in the next base rate filing). This process is underway.

v) Customer Outreach

PWSA has initiated a review of several areas to increase customer participation in the CAP and is considering possible cross-outreach efforts through Dollar Energy Fund (DEF) records. PWSA is also participating in the Western Pennsylvania Utilities Group to coordinate outreach efforts.

vi) Interim personal contact procedures

PWSA agreed to deliver the results of the interim personal contact process as part of this quarterly report. These interim results are shown in Table 4.

Table 4: Interim Personal Contact Process Results

Telephone Call Attempts	
Total Call Attempts	311
Call Completion Rate	54%
Live Answer by Customer	92
Message Left by PWSA	77
Voicemail Box Full/No Answer/No Answering Machine	101
Disconnected Number	41
Resulting Cancelations of Termination	
Total Cancelations	59
Cancelation Rate	19%
Paid in Full	46
Payment Arrangement	13
Medical Filed	0
PFA Filed	0

b. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including informal complaints, bill changes, use of collection services, customer service metrics, and creating/working with the LIAAC as shown in Table 5. This section lays out

each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each task that has yet to be completed. Tasks associated with the Compliance Plan Supplement that were completed in prior reporting periods are shown in Appendix A.

Table 5: Compliance Plan Supplement Requirements – Billing/Customer Service

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Conduct a regular review of informal complaint information to determine complaint trends and whether there is a need to implement additional or new internal training policies.		PWSA is regularly reviewing informal complaints to determine trends and the need for further training.
Work with the parties to determine an appropriate informal complaint tracking information review process.		On Target
Track whether customer complaints are related to water, sewer, or stormwater.	Monthly	Complete
Make the changes identified in Paragraphs III.1.1 through III.10 of the Settlement consistent with the timeframes established by the final order in this proceeding and to provide a copy of the changes to the LIAAC.		On Target
Suspend the use of Jordan Tax Service, Inc.	With the Commission's final order approving the Settlement	Complete
Collect and report on requested billing data (Appendix E).		Q2 data appears in Appendix E of this report.
Fund BDP program using revenues collected from approved rates in the tariff filing.		On-Going
Submit a detailed Plan that outlines the program parameters for each of its low-income assistance programs.	Next Base Rate Proceeding	On-Target for completion by October 2019.
Track the following metrics: Abandon %, ACD handling time, average speed of answer, CSR attendance, Customer satisfaction, service level % (Appendix E).	Monthly	Completed
Expand the use of the SpryMobile app.		Project is in the configuration stage and is 51% complete.

i) Conduct a regular review of informal complaint information to determine complaint trends and whether there is a need to implement additional or new internal training policies

PWSA began conducting regular reviews of informal complaint trends in 2018 and has worked to update its customer service training policies and materials since that time. Identified trends relate to catch-up consumption, high consumption, and meter testing.

ii) Work with the parties to determine an appropriate informal complaint tracking information review process

PWSA has scheduled time to work with the parties to determine an appropriate informal complaint tracking information review process. Subsequently, the Authority will work to implement the parties' review process recommendations on an appropriate timeframe.

iii) Track whether customer complaints are related to water, sewer, or stormwater

PWSA categorizes customer complaints based on water, sewer, and stormwater on an ongoing basis. This information is used for analysis and program improvement.

iv) Make the changes identified in Paragraphs III.1.1 through III.10 of the Settlement consistent with the timeframes established by the final order in this proceeding and to provide a copy of the changes to the LIAAC

PWSA is in the process of making the changes identified in Paragraphs III.1.1 through III.10 of the Settlement, consistent with the timeframes established by the final order in this proceeding. Once the changes are made, PWSA intends to provide a copy of the changes to the LIAAC.

v) Suspend the use of Jordan Tax Service, Inc.

The contract between PWSA and Jordan Tax Service, Inc. (JTS) was terminated effective June 30, 2019. PWSA accepted a file of uncollected debts from JTS on June 27, 2019 and is currently updating its CIS with debts collectible under regulation. PWSA also submitted a cover letter of explanation to affected customers to BCS for review. BCS made recommended changes, PWSA incorporated those, and BCS approved the use of said letter.

vi) Collect and report on the requested billing data

PWSA has started to track data associated with the billing metrics identified in the Compliance Plan Supplement. Appendix D contains these billing metrics.

vii) Fund Bill Discount Program (BDP) program using revenues collected from approved rates in the tariff filing

PWSA is funding the BDP program using revenues collected from the approved rates in the tariff filing, and as such, it is in compliance with this requirement.

viii) Submit a detailed Plan that outlines the program parameters for each of its low-income assistance programs

PWSA has initiated development of this plan and is on-track to submit a finalized version in October 2019.

ix) Track the following metrics: Abandon %, ACD handling time, average speed of answer, CSR attendance, Customer satisfaction, service level %

These metrics listed have been tracked on a monthly basis since January 2019. Appendix E shows data by month for April through June 2019.

x) Expand the use of the SpryMobile app

PWSA is expanding the use of the SpryPoint Services, Inc.'s SpryMobile platform, which is integrated with PWSA's billing system. This platform has allowed PWSA field crews to record work performed on meters and curb boxes electronically, rather than on paper. PWSA is on track to extend the functionality of this app to water and wastewater

services and assets in the treatment, distribution and collection systems by October 2019. The project is in the configuration stage, and it is 51% complete.

c. Compliance Plan Requirements

For PWSA's customer service and billing areas, the Compliance Plan addresses topics including the bill redesign, plain language requirements, and translation assistance for shut-offs (Table 6). This section lays out each of the remaining billing and customer service requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards. Tasks that were completed and reported in previous updates have been moved to Appendix B.

Table 6: Compliance Plan Requirements – Billing and Customer Service

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
56.11-56.25 and 56.261-56.275 - Complete bill redesign project.	By the end of 2019	On-Target
56.81-56.118 and 56.321-56.358 - Meet plain language requirements for shut-off notices. (Now moved to Stage 2 of the Compliance Plan.)	March 2019	On-Target (Moved to Stage 2)

i) 56.11-56.25 and 56.261-56.275 - Complete bill redesign project

PWSA has drafted a bill redesign and has provided copies of the draft to interested parties and BCS for feedback and recommendations. The draft bill changes were provided to the interested parties and BCS on March 29, 2019. Thirty days later, PWSA received 29 change requests, agreed to all, and is working with its print and mail vendor on another round of samples.

ii) 56.81-56.118 and 56.321-56.358 - Meet plain language requirements for shut-off notices

PWSA made initial changes to revise its shut-off language to ensure compliance with the plain language requirements, and BCS has indicated that it will be requesting additional revisions. PWSA is currently awaiting a review of its termination notices by Pittsburgh UNITED. After all revisions, the shut-off notices should be at an 8th grade reading level. Note that these requirements will now be handled in Stage 2 of the Compliance Plan process, but progress in this area will continue.

3. Lead

One of the major focus areas of the Tariff and Compliance Plan Supplement was PWSA's lead remediation program. The following sections lay out the requirements related to lead, as well as the actions that PWSA has already taken or are underway to address this issue.

a. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including the Community Lead Response Advisory Committee (CLRAC), customer outreach and communication, feasibility analysis, and service line replacement practices as shown in Table 7. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area. Tasks that were completed and reported on in previous updates have been moved to Appendix A.

Table 7: Compliance Plan Supplement Requirements – Lead

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Form a Community Lead Response Advisory Committee (CLRAC).	Initiated within 30 days of Settlement Agreement	The first quarterly meeting was held January 8, 2019, and subsequent meetings occurred on February 6, 2019, March 4, 2019, April 24, 2019, and June 3, 2019.
Develop and implement a plan to encourage greater participation in the lead line replacement program.	Plan developed within 90 days of effective date of rates; customer participation reported quarterly	The Community Outreach and Communication Plan was presented to CLRAC for input and is currently being implemented. Updates are provided at each meeting.
Make best efforts to send a letter notifying the resident and property owner of the results of a curb box inspection.	Within 90 days of the completion of the inspection, but no later than 120 days	Complete.
Develop and implement a plan to encourage greater participation in the lead sampling program.	Within 90 days of effective date of rates	The Community Outreach and Communication Plan was presented to CLRAC for input and is currently being implemented. Updates are provided at each meeting.
Make all historical service line records available for public viewing on website.	Within 90 days of effective date of rates	This was completed in early January 2019.
Analyze per-line costs for replacing lead service lines.	Within 90 days of effective date of rates	This information was presented to CLRAC on April 24, 2019.
Analyze the feasibility of including all lead service lines, including private-side-only lead service lines, in PWSA's 2019 lead service line replacement program and 2020 - 2026 small diameter water main replacement program.	Within 90 days of effective date of rates	This information was presented to CLRAC on March 4, 2019.
Continue to provide NSF-certified filters/replacement cartridges free of charge until samples are below 15 ppb lead for two consecutive 6-month periods.	Within 90 days of effective date of rates	The existing program, which was developed in 2018, continues.
Develop an outreach program to notify customers of their eligibility for free filters, including at a minimum, a letter or bill insert.	Within 90 days of effective date of rates	Letters sent to all CAP customers in February 2019 with update in April and every month hereafter.

Develop and implement a plan for prioritizing lead service line replacements where curb box inspections are completed in designated neighborhoods.	Within 90 days of effective date of rates	The prioritizations were discussed during the March meeting and additional areas for potential available PENNVEST funding were selected during the April meeting.
Maintain the current outreach procedures for obtaining customer consent, and the current post-partial lead service line replacement sampling and filter-provision measures.	Through 2019	These programs are continuing.
Consult with the CLRAC regarding whether and how to seek authorization from the City of Pittsburgh to compel private-side lead service line replacements when a property owner who does not reside at the property declines a free private-side lead service line replacement.	For 2019 program	Discussion was held during the January 8, 2019 and June 3, 2018 meetings and will continue at future meetings
Consult with the CLRAC regarding whether to ask the City of Pittsburgh to establish a process through which partial lead service line replacements conducted by PWSA are documented in the property record for the relevant address.	For 2019 program	Discussion was held during the January 8, 2019 and June 3, 2018 meetings and will continue at future meetings.
Record and make publicly available on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders.	Update on a monthly basis	Online web mapping has been updated by the first of each month since the beginning of 2019.
Continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.	For 2019 program	Program is continuing.
Continue to make a good-faith effort to secure an agreement with PennVEST enabling it to obtain customer consent for private-side lead service line replacements at any point before PWSA completes lead service line replacements for the work order covering the customer's property.	For 2019 program	Approval obtained from PENNVEST.
Continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost.	Immediately after replacement	Existing program developed in 2018 continues.

i) Develop and implement a plan to encourage greater participation in the lead line replacement program

PWSA presented a Community Outreach and Communication Plan to the CLRAC on January 8, 2019. Following incorporation of the CLRAC's input, PWSA began implementing the outreach activities, and reports the efforts undertaken during the prior period at each meeting. PWSA continues to report to the CLRAC on customers' reasons for rejecting service line replacements, as well as the number of customers who consented, failed to respond, or explicitly refused to consent to the replacements.

ii) Make best efforts to send a letter notifying the resident and property owner of the results of a curb box inspection

This work is complete for the 2018 CBI program.

iii) Develop and implement a plan to encourage greater participation in the lead sampling program

PWSA continues to implement its outreach plan and provide updates to CLRAC. Suggestions of the CLRAC and PUC have been incorporated in our outreach materials.

iv) Continue to provide NSF-certified filters/replacement cartridges free of charge to CAP Customers until samples are below 15 ppb lead for two consecutive 6-month periods

This program is underway, and as new customers are enrolled each month, they are added to the filter program.

v) Develop an outreach program to notify customers of their eligibility for free filters, including at a minimum, a letter or bill insert

PWSA sent a letter to all CAP customers (at that time) on February 1, 2019 and is notifying any new CAP participants on a monthly basis of their eligibility for this program.

vi) Develop and implement a plan for prioritizing lead service line replacements where curb box inspections are completed in designated neighborhoods

PWSA worked with CLRAC to develop a prioritization strategy and applied it to areas where additional 2019 LSLR work may occur depending on availability of PENNVEST funding. This was completed at the April meeting.

vii) Maintain the current outreach procedures for obtaining customer consent, and the current post-partial lead service line replacement sampling and filter-provision measures.

PWSA is maintaining its outreach procedures for customer consent and the current post-partial lead service line replacement sampling and filter-provision measures. This task is on-going.

viii) Consult with the CLRAC regarding whether and how to seek authorization from the City of Pittsburgh to compel private-side lead service line replacements when a property owner who does not reside at the property declines a free private-side lead service line replacement.

This issue was discussed at the January 8 and June 3, 2019 CLRAC meetings, and discussion is ongoing.

ix) Consult with the CLRAC regarding whether to ask the City of Pittsburgh to establish a process through which partial lead service line replacements conducted by PWSA are documented in the property record for the relevant address

This issue was discussed at the January 8 and June 3, 2019 CLRAC meetings, and discussion is ongoing.

x) Record and make publicly available on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders.

PWSA recorded and made publicly available (at the beginning of January 2019) on its website mapping the locations of all service line replacements conducted by PWSA to date and planned for the work orders. PWSA's web map has been and will continue to be updated on a monthly basis by the first of each month.

xi) Continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.

PWSA will continue replacing private-side lead service lines (assuming customer consent is provided) at no cost to customers when replacing public-side lead service lines.

xii) Continue to make a good-faith effort to secure an agreement with PennVEST enabling it to obtain customer consent for private-side lead service line replacements at any point before PWSA completes lead service line replacements for the work order covering the customer's property.

At the first CLRAC meeting, PWSA reported that it was successful in securing an agreement with PENNVEST.

xiii) Continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost

PWSA will continue to provide residents who have had their service lines replaced with water testing kits and NSF-certified filters and six months of replacement cartridges at no cost immediately after replacement.

b. Compliance Plan Requirements

The Compliance Plan requirements associated with PWSA's lead remediation program were addressed through the Tariff and Compliance Plan Settlement document.

4. Infrastructure

Infrastructure activities are those that involve capital planning, investment, and installation/renewal in the water, wastewater and stormwater systems. This includes distribution system master planning, meter installations, capital project cost/projection effectiveness, record keeping, pressure assurance, and design/construction standards updates.

a. Master List of Stipulation Requirements

The Master List of Stipulation Requirements was developed in July 2019 to respond to feedback from the Parties, and to codify additional reporting requirements for PWSA. Table 8 highlights these additional reporting requirements.

Table 8: Infrastructure Requirements from the Master List of Stipulations

Task	Timeline (if specified in the Master List of Stipulations)	Progress to Date
Construction Project Tracking and Evaluation	Next rate case	PWSA has developed and is in the process of validating a list of proposed metrics
Selection Processes and Existing Contractors	Annually	On-Target
Projected Expenditures	Quarterly	On-Target
LTIIP – Materials, Valves, Prioritization	Quarterly	PWSA is in the process of updating its GIS to facilitate reporting on this data
LTIIP – Customer Owned Lead Service Lines		On-Target
LTIIP – Workforce Development		On-Target
LTIIP – Construction Coordination with Other Utilities and Municipalities		On-Target
LTIIP – Distribution System Improvement Charge (DSIC)	Next base rate case	On-Target

i) Construction Project Tracking and Evaluation

PWSA has a sophisticated performance management system and monitors more than 50 metrics through its Headwaters tracking database, as well as additional capital information through its eBuilder system. PWSA is in the process of expanding the number of metrics tracked in these systems, based on the last rate case settlement, Compliance Plan, and Compliance Plan Settlement. As data for these metrics is available, PWSA will begin to provide periodic updates of construction-related performance metrics related to capital project cost effectiveness. PWSA is preparing to provide I&E with a list of proposed metrics within 60 days of entering into the Settlement and Stipulation and will track any mutually agreed upon metrics with updates in the Compliance Plan Progress Reports.

ii) Selection Processes and Existing Contractors

PWSA will continue to follow the requirements of the Municipal Authorities Act (MAA) regarding competitive bidding, which typically requires that all projects with values above $20,600 be competitively bid. PWSA has committed to providing a list of each construction contract in the prior year that was awarded without competitive bidding, as well as an analysis of how those contracts compare to the total number of construction contracts awarded. PWSA will

provide this information, as well as updated design engineer and company affiliation for each project in future Compliance Plan Progress Reports.

iii) Projected Expenditures

PWSA will update its testimony to provide the project operations for open and active projects, as of the date of the supplemental testimony, and will provide updated details about the funding sources that it plans to use in each project in future Compliance Plan Progress Reports.

iv) LTIIP – Materials Report, Valves, Prioritization

As the data becomes available and PWSA's GIS is updated, PWSA will provide a comprehensive materials report and updated information regarding types and sizes of valves in future Compliance Plan Progress Reports. PWSA will also provide additional information regarding the prioritization of valve and main replacements and will notify the parties its Computerized Maintenance Management System (CMMS) project is implemented.

v) Customer Owned Lead Service Lines

At an appropriate time, PWSA will file a Petition to Amend its Long-term Infrastructure Improvement Plan to include estimates on the number of customer-owned (i.e. private side) lead service lines, and the expected expenditures for replacement, to the extent that the Commission has authorized or directed PWSA to replace these facilities. PWSA is on track to file this petition.

vi) Workforce Development

PWSA has agreed to update its existing LTIIP to include the additional information set forth in PWSA St. C-1R at 70-72, in addition to more current information regarding workforce challenges related to the LTIIP schedule and how PWSA will build a workforce to meet the needs of its increased capital spending. This information will include how headcount projections were quantified and an estimate of the number of required contractors.

vii) Construction Coordination with Other Utilities and Municipalities

PWSA has also agreed to update its existing LTIIP to include the additional information set forth in PWSA St. C-1R at 72, as well as any other more current information regarding how PWSA will meet the need for increased coordination with local utilities and governments. This will include adopting a plan with the City to ensure that additional engineering staff will improve coordination efforts, or that other necessary actions to improve such efforts are taken.

viii) Distribution System Improvement Charge

In its next base rate case, PWSA is authorized to seek Commission approval of a DSIC, with a to-be-determined cap in excess of 5%, and waivers of Act 11 so as to permit PWSA to use an annual, levelized charge as the basis for the DSIC (subject to subsequent true-up for PWSA's actual experience).

b. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including development of a distribution system master plan, a district metering program, the Highland Membrane Filtration Plant (HMFP)/Highland No. 1 Reservoir, and the cost effectiveness of PWSA's projections, as shown in Table 9. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area.

Table 9: Compliance Plan Supplement Requirements - Infrastructure

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Develop a Water Distribution System Master Plan, to address master metering, non-revenue water, and include an AWWA Water Audit based on available data.	2019-2020	PWSA's Board of Directors has approved this project during the February 22, 2019 Regular Meeting (Resolution No. 29) and it is in progress, with anticipated completion late 2019-mid-2020.
Develop and implement district metering program.	2020	On-Target
Provide a detailed cost breakdown of actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP.	Starting within 30 days of the signature date of the Settlement and quarterly thereafter	On-Target, first provided on January 23, 2019.
A cost/benefit analysis comparing continuing to operate the HMFP instead of covering and placing a physical barrier around Highland No. 1 Reservoir.	With the next base rate filing	On-Target
Develop a plan to track cost effectiveness and cost reporting relative to projections.	With future filings	PWSA has begun monitoring several metrics related to the effectiveness of its cost projections through its eBuilder project management software.

i) Develop a Water Distribution System Master Plan, to address master metering, non-revenue water, and include an AWWA Water Audit based on available data.

PWSA's Board of Directors has approved the Water Distribution System Master Plan, with a targeted completion date of late 2019 to mid-2020. This plan will include a detailed process to clearly identify needed improvements to the distribution system, to evaluate and rank candidate water mains for renewal, present an assessment of expected growth in the system, assess vertical assets, and recommend capital improvement. The Master Plan will address master metering and non-revenue water and will include a water audit that follows AWWA guidance using available data. This plan will also recommend locations for implementation of the district metering program, which is discussed in the next section.

ii) Develop and implement district metering program.

PWSA's plan includes metering devices at each of its intakes on the Allegheny River, and at two of the main pump stations serving the City (the Aspinwall and Bruecken Pump Stations). In addition, the plan includes master meter

locations recommended by the Water Distribution System Master Plan at key locations within the distribution system. This is on schedule to be completed in 2020.

iii) Provide a detailed cost breakdown of actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP

PWSA shared the following cost breakdown with all settlement parties on January 23, 2019:

- Actual and projected operating and capital costs to date incurred and estimated to be incurred as a result of the October 25, 2017 Department of Environmental Protection Administrative Order with regard to the HMFP; and
- Actual and projected operating and capital costs on a calendar year basis incurred and estimated to be incurred to operate the HMFP.

PWSA will continue to make these cost breakdowns available quarterly, as well as upon completion of repairs to the HMFP.

iv) A cost/benefit analysis comparing continuing to operate the HMFP instead of covering and placing a physical barrier around Highland No. 1 Reservoir

PWSA is on schedule to provide a cost/benefit analysis of the relevant legal, technical, and policy considerations, as well as a cost comparison, of operating the HMFP instead of covering and placing a physical barrier around the Highland No. 1 Reservoir in the next base rate case. Note that the HMFP is still not fully operational and operating under DEP consent, so operations and maintenance cost projections cannot be verified until the system is fully on line (anticipated completion date is August 28, 2019).

v) Develop a plan to track cost effectiveness and cost reporting relative to projections

PWSA has begun to monitor several metrics related to cost effectiveness and cost reporting relative to its projected capital spending. It is using the eBuilder project management software to track project costs and progress, which allows advanced calculation of performance metrics. Currently, PWSA is tracking project total costs and cash flow relative to budget. PWSA working on defining additional metrics such as Estimated Cost at Completion (ECAC), schedule variance, change order volume and percentage of total project, etc., and has scheduled a preliminary internal review to receive, review, and address comments. A list of metrics being considered for tracking, as was requested by the PUC and other interested parties is contained in Appendix F.

c. Compliance Plan Requirements

For PWSA's infrastructure area, the Compliance Plan addresses topics including records management, meeting pressure requirements, metering municipal and flat rate customers, metering all sources of supply, ensuring appropriately sized mains and operable valves, and incorporating the PUC's design requirements into a formalized design manual (Table 10). Compliance tasks associated with PUC Section 65.8 (Meters – Change-outs) and 65.17 (Standards of Design – Flushing Program) have already been addressed in the Compliance Plan Supplement Requirements. As such, this section lays out each of the remaining infrastructure requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 10: Compliance Plan Requirements – Infrastructure

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.4 Develop a series of SOPs for records filing, records updates in GIS, and records retrieval.	Within 6 months	On-Target
65.4 Update GIS with main installation date and material.	by 2021	On-Target
65.4 Update GIS with hydrant and valve status.		On-Target
65.4 Organize, store, and input current records backlog into GIS.		On-Target
65.6 Install additional monitoring stations for areas of low pressure.	by 2020	On-Target, to be addressed by Master Plan.
65.6 Develop an SOP to address areas of high pressure.	by the end of 2019	On-Target, to be addressed by Master Plan.
65.7 Secure a contractor to assist with inspection, sizing, and installation of meters and associated equipment for municipal buildings and flat rate customers.	2024	Site inspections have started, and PWSA's Board of Directors approved a consulting contract on April 26. 2019.
65.14 Reestablish operability of meters at each source of supply and install an additional meter at Fox Chapel Station.	2019	Complete
65.17 Continue to work on replacing all 4" water mains.		On-Target, to be addressed by Master Plan.
65.17 Incorporate the PUC's design requirements, specifications, and standard details into a formalized design manual.	2019 and 2020	On-Target
65.18 Complete the development of a comprehensive flushing program.	Starts in 2018	On-Target
65.18 Review the existing system to ensure ample valves.	Starts in 2018	On-Target, to be addressed by Master Plan.
65.18 Increase the number of valves inspected and operated per year.	2019	On-Target, to be addressed by Master Plan.

i) 65.4 - Records

Section 65.4 of Chapter 65 stipulates that utilities must keep complete maps, plans, or records of their entire distribution systems that show the size, character, and location of each main, street valve, and service line. To address these requirements, PWSA is committed to developing SOPs for records filing, updates, and retrieval; updating its GIS system with main installation dates and materials; updating its GIS system with hydrant and valve status; and organizing, storing, and inputting the current records backlog into GIS. This effort is currently underway but may move slowly due to other high-priority activities. Associated metrics and progress data (as available) are shown in Appendix C.

ii) 65.6 - Pressures

PWSA is aware of locations within its system where pressure falls below 25 psi. In accordance with Part 4 of the PA DEP October 25, 2017 Administrative Order, PWSA has installed 24 pressure monitoring stations, which monitor and record pressures every 15 minutes, and report on low or loss of pressure by text and email alert. PWSA is also aware of areas where pressure exceeds 150 psi and is in the process of developing an SOP to address this issue. Capital projects associated with areas of high and low pressure will be addressed in the Distribution System Master Plan, and PWSA is on-target to meet the projected timeframes.

iii) 65.7 - Secure a contractor to assist with inspection, sizing, and installation of meters and associated equipment for municipal buildings and flat rate customers

PWSA has committed to partnering with a contractor to inspect, size, and install meters for municipal and other unmetered accounts (PWSA estimates 200-400 of these accounts in its service area) within the next five years. PWSA developed and released an RFP for these services and has begun inspecting facilities for meter installations. PWSA's Board of Directors approved a consulting contract with the selected vendor, Buchart Horn, on April 26. 2019. More discussion of this initiative is included in the Operations section of this Quarterly Report.

iv) 65.14 - Reestablish operability of meters at each source of supply and install an additional meter at Fox Chapel Station

PWSA has installed meters at each source of supply and the Fox Chapel Station and has tested these meters to ensure accuracy, thus completing this task. Further capital projects related to meter operability will be addressed in the Master Plan. This includes additional master meter facilities at the Aspinwall Water Treatment Facility to monitor the total flows into the distribution system.

v) 65.17 – Standards of Design

In accordance with the PUC's standards of design, PWSA is focused on continuing to replace all 4" water mains, which will be addressed in the Master Plan, and incorporating the PUC's design requirements, specifications, and standard details into a formalized design manual. PWSA is on target to address these issues within the specified timeline.

vi) 65.18 – Standards of Construction

As discussed in the Operations section, PWSA is in the process of developing and implementing a comprehensive flushing program and increasing the number of valves inspected and operated each year. PWSA will also be analyzing the existing system to ensure ample valves through its Master Planning process. The Authority is on target to have these issues addressed within the specified timeframes.

5. Finance, Contractual, and Other Issues

PWSA has already made considerable effort to ensure compliance regarding financial, contractual, and other issues, and many of the initiatives agreed to in the Tariff Settlement, Compliance Plan or the Compliance Plan Supplement have already been completed. The following sections focus on identifying the remaining requirements and highlighting PWSA's progress in each of these areas.

a. Master List of Stipulation Requirements

The Master List of Stipulation Requirements was developed in July 2019 to respond to feedback from the Parties, and to codify additional reporting requirements for PWSA. Table 11 highlights these additional reporting requirements.

Table 11: Finance, Contractual, and Other Issues Requirements from the Master List of Stipulations

Task	Timeline (if specified in the Master List of Stipulations)	Progress to Date
Residential Fire Protection and Standby Charges	Next Base Rate Case	Residential customers who have been charged private fire protection have been identified and will be credited for those payments.
Ownership of Wastewater Laterals		PWSA is initiating a study on this issue

i) Residential Fire Protection and Standby Charges

PWSA has identified 49 current customers that are being charged a separate private fire protection charge, pursuant to PWSA's tariff. These customer accounts have been reviewed, and four accounts have been identified as residential. These four customers will no longer be assessed the private fire protection charges (charges assessed since April 1, 2018 will be retroactively removed, and customers will receive a credit on their bill or a one-time payment in lieu of credit). PWSA plans to update its tariff language and will report on this issue in subsequent Compliance Plan Progress Reports.

ii) Ownership of Wastewater Laterals

PWSA will conduct a study to investigate the legal, economic, and operational feasibility of owning and/or maintaining (now privately owned) wastewater laterals within public easements. The report will include the cost, feasibility, and appropriateness of alternatives such as facilitating the provision of private line insurance rather than PWSA owning and/or maintaining the wastewater laterals.

b. Compliance Plan Supplement Requirements

The Compliance Plan Supplement addresses topics including negotiations with the City of Pittsburgh and ALCOSAN, rates for public fire hydrant service, flat rates for unmetered customers, the discount for Pennsylvania American Water customers, as shown in Table 12. This section lays out each of the requirements that PWSA has committed to meeting, as well as a progress update and/or plan for achieving the PUC's standards. Below the table is a narrative discussion of each area. Tasks that were completed and reported on in previous updates have been moved to Appendix A.

Table 12: Compliance Plan Supplement Requirements – Finance, Contractual, and Other Issues

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Renegotiate the Cooperation Agreement with the City of Pittsburgh.	Quarterly Updates, beginning 4/30	PWSA's Board of Directors approved the cooperation agreement on June 28, 2019.
Formally notify the City of Pittsburgh of the record and outcome of this case, that the Cooperation Agreement is being reviewed by the PUC in the Compliance Filing proceeding, and that PWSA's LTIIP Filing is pending with the Commission.		Complete
Serve the City with a copy of Final Commission Orders and file a certificate of service with the Commission verifying that such service was made.	Issued in this matter within 10 days of their issuance	Complete
Consider the timeframe for developing a separate rate for public fire hydrant service.	Next Base Rate Case	On Target
Consider assessing the City of Pittsburgh a separate rate for public fire hydrant service.	Next Base Rate Case	On Target
Consider the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties or buildings served by PWSA.	Next Base Rate Case	On Target
Analyze the feasibility of assessing a flat rate to the unmetered customers.	Next Base Rate Case	On Target
Investigate the allocation of flows to ALCOSAN and other municipalities to determine the feasibility of measuring stormwater separately from wastewater.		On Target
Propose a plan or method for developing separate cost of service studies for wastewater and stormwater for the development of stormwater rates.		On Target
Evaluate the potential ways to address PWSA's contract with ALCOSAN, including renegotiation of the contract.		On Target
Investigate the City of Pittsburgh discount for PAWC water customers as originated under the terms of the 1973 Agreement between the City of Pittsburgh and Western Pennsylvania Water Company.	Next Base Rate Case	The analysis has been completed and the subsidy will be eliminated 120 days after the Commission's final order.

i) Renegotiate the Cooperation Agreement with the City of Pittsburgh

PWSA is in the process of renegotiating the Cooperation Agreement with the City of Pittsburgh and plans to begin providing quarterly updates to the parties on April 30, 2019. Note that PWSA has given notice that it is terminating the existing Cooperation Agreement within the timeframes specific in the agreement. Even though PWSA has given termination notice to the City, the Authority's Board of Directors extended the Cooperation Agreement by two months on April 26, 2019. Prior to agreement on a new Cooperation Agreement fees for any service provided to or received

from the City will be done on an actual cost basis. PWSA's Board of Directors approved the cooperation agreement on June 28, 2019.

ii) Notify all parties to the Settlement proceeding if the City of Pittsburgh and PWSA reach an agreement for an Amended Cooperation Agreement, and provide each with a copy of the renegotiated Cooperation Agreement

PWSA plans to notify all parties to the Settlement proceeding if the City of Pittsburgh and PWSA reach an agreement for an Amended Cooperation Agreement, and to provide each with a copy of the renegotiated Cooperation Agreement.

iii) Consider the timeframe for developing a separate rate for public fire hydrant service

PWSA has committed to developing a separate, cost-justified rate for public fire hydrant service, to be presented as part of the next base rate case filing. The billing plan for these hydrants will be part of the Cooperation Agreement. This process is underway, and a formal rate will be proposed in the next base rate case, which will show an allocation of 25% of all public fire hydrant costs to the City. PWSA reserves the right to propose an appropriate phase-in period at that time. Starting in 2020, PWSA will use the PAWC public fire hydrant rate as a proxy until Commission approval of a PWSA public fire hydrant rate.

iv) Consider assessing the City of Pittsburgh a separate rate for public fire hydrant service

PWSA plans to assess the City of Pittsburgh with a separate rate for public fire hydrant service. Implementation timing and approach regarding this rate will be in the context of, and dependent on, larger negotiations with the City. Starting in 2020, PWSA will use the PAWC public fire hydrant rate as a proxy until Commission approval of a PWSA public fire hydrant rate.

v) Consider the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties or buildings served by PWSA

PWSA has begun its consideration of the proposal for a flat rate for both water and wastewater for all unmetered and unbilled municipal and government properties/buildings served by PWSA but wants to be sure that any methodology applied is defensible and equitable. Beginning on 1/1/2020, PWSA plans to implement water and wastewater rates for unmetered and/or unbilled properties on a "phased-in" and "stepped" 20-40-60-80-100 percentage basis, assuming PUC approval. "Phasing" means installing meters over time at City locations, and "stepping" means fully billing metered properties over a period of time.

vi) Analyze the feasibility of assessing a flat rate to the unmetered customers

The Authority has every intention of assessing water consumption and sewer demand charges to unmetered customers. However, the majority of the unmetered customers are non-residential, which complicates development and assessment of a flat rate, because the buildings are not homogeneous and water line size is not necessarily indicative of use. As such, assessing a flat rate will be dependent on the Authority's ability to accurately capture use and avoid assessing an inequitable charge. The Authority plans to conduct its analysis before the next rate case.

vii) Investigate the allocation of flows to ALCOSAN and other municipalities to determine the feasibility of measuring stormwater separately from wastewater

Approximately 70% of PWSA's collection system is combined, which prevents the Authority from accurately measuring stormwater and wastewater separately. However, PWSA is investigating the allocation of flows to ALCOSAN and studying the value, maintenance requirements, and use ratios for its shared conveyance system.

viii) Propose a plan or method for developing separate cost of service studies for wastewater and stormwater for the development of stormwater rates

PWSA has initiated the development of separate cost of service studies for wastewater and stormwater, with the goal of proposing stormwater rates. This effort will be completed by the next rate case filing.

ix) Evaluate the potential ways to address PWSA's contract with ALCOSAN, including renegotiation of the contract

PWSA has initiated evaluation of its contract with ALCOSAN and is in the process of identifying opportunities to address existing issues.

x) Investigate the City of Pittsburgh discount for PAWC water customers as originated under the terms of the 1973 Agreement between the City of Pittsburgh and Western Pennsylvania Water Company

PWSA is in the process of investigating the City of Pittsburgh discount for PAWC water customers, in light of rate changes for both organizations, and in the context of PWSA's negotiations with the City of Pittsburgh. Based on the May 2019 billing data, over 80% of residential customers are receiving a subsidy of $1 or less, over one-third of the residential customers are receiving no subsidy; and the average subsidy customers are receiving is less than $.50 per month. Therefore, the subsidy shall be eliminated 120 days after the entry of the Commission's final order adjudicating this settlement. PAWC will provide notice to customers before the subsidy is eliminated, over the course of two billing cycles.

c. Compliance Plan Requirements

For PWSA's financial, contractual, and other areas, the Compliance Plan addresses topics including the system of accounts, annual financial reporting requirements, a workforce diversity policy, and emergency response planning and self-certification requirements, as shown in Table 13. This section lays out each of the remaining financial, contractual, and other requirements for PWSA, as well as a progress update and/or plan for achieving the PUC's standards.

Table 13: Compliance Plan Requirements – Finance, Contractual, and Other Issues

Task	Timeline (if specified in the Compliance Plan)	Progress to Date
65.16 System of Accounts	FY 2021	On-Target
65.19 Filing of Annual Financial Reports	2019	On-Target
69.801 Develop a formal policy to improve diversity in the workforce.	By the end of 2019	On-Target
69.16 Update emergency response plan with updated SOPs.	March, 2019	Anticipated October 2019
73.3 Annual Depreciation Reports	April 1, 2022	On-Target, Partial reports beginning 2020
73.5 Service Life Study Report	April 1, 2022	On-Target
73.7 Capital Investment Plan Report	2020	On-Target

101.3 Plan Requirements	March, 2019	Anticipated October 2019
101.4 File a Self-Certification Form	April 30, 2019	Anticipated October 2019
Capital Lease Agreement	2025	On-Target
Bulk Water: Sales for Resale	Within 120 days of the Final Commission Order	On-Target
Bulk Wastewater Conveyance Agreements	Within 120 days of the Final Commission Order	On-Target

i) 65.16 - System of Accounts

Section 65.16 mandates that a public utility, having an annual operating revenue of $750,000 or more shall keep its accounts in conformity with the most recent Uniform System of Accounts for Class A Water Utilities, as prescribed by the National Association of Regulatory Utility Commissioners (NARUC). PWSA has completed its effort to map its current chart of accounts to the NARUC chart of accounts in order to identify existing gaps. Future reporting will include the date when a Request for Proposals is issued for an Enterprise Resource Planning (ERP) contract, the notice of selection of an ERP contractor, the contractor-projected ERP system cost, and a detailed implementation schedule. PWSA is prepared to file all required reports in 2019, and complete installation of an ERP system will occur by December 2021.

ii) 65.19 - Filing of Annual Financial Reports

PWSA understands the importance of filing annual financial reports and has filed its first with the Commission in 2019.

iii) 69.801 - Develop a formal policy to improve diversity in the workforce

PWSA is in the process of developing a formal policy to improve diversity in the workforce. A policy has been drafted and has been sent to the Board of Directors for review.

iv) 69.16 - Update emergency response plan with updated SOPs

PWSA is in the process of updating its emergency response plan to better adhere to the National Incident Management System's public information system and including updated standard operating procedures. This effort has an anticipated completion date of 10/31/2019.

v) 73.3 - Annual Depreciation Reports

PWSA operates on the cash basis and does not use depreciation in its ratemaking methodology. PWSA acknowledges the importance of keeping accurate fixed asset records and plans to comply with the requirements listed in Section 73.3 and file its first annual depreciation report with the Bureau of Fixed Utility Services by 2024 and partial reports until that time, detailing known and newly constructed plant additions and retirements. PWSA will also solicit the services of a vendor familiar with this type of work and will collaborate with the vendor to hone the current asset list and allow for full reporting by 2024.

vi) 73.5 - Service Life Study Report

Section 73.5 stipulates that public utilities with intrastate gross revenues in excess of $20 million per year shall file a service life study report with the Office of Special Assistants every five years. PWSA plans to meet this requirement and file a service life study report by April 1, 2022.

vii) 73.7 – Capital Investment Plan Report

PWSA will file the Capital Investment Plan Reports pursuant to 52 Pa. Code 73.7 and 73.8 starting in 2020, and plans to file every five years thereafter.

viii) 101.3 – Plan Requirements

PWSA is in the process of developing a physical security plan, based on its recently completed security assessment. Similarly, a cyber security assessment was completed in 2018, and PWSA has begun to develop a cyber security plan. PWSA is also working to update its emergency response plan to comply with the Commission's requirements, as well as to incorporate feedback from the Allegheny County Health Department and the PA Department of Environmental Protection. Specific estimated completion dates are:

- Physical security plan: 12/31/2019
- Cyber security plan: draft completed by staff on 4/30/2019, pending review and approval
- Emergency response plan – 10/31/2019
- Business continuity plan – 10/31/2019

ix) 101.4 - File a Self-Certification Form

PWSA anticipates filing a self-certification form once it meets the plan requirements. Note that under 101.3 PWSA indicates that it is working on the plan and there is an estimated completion date of October 2019. PWSA plans to file its self-certification form by February 28, 2020 and will provide a status report by October 31, 2019 regarding the Authority's efforts to achieve the targeted dates referenced in 101.3.

x) Capital Lease Agreement

PWSA plans to purchase the system for $1 when eligible in 2025, unless a new arrangement is negotiated and approved by the Commission in advance of that timeline.

xi) Bulk Water: Sales for Resale

Within 120 days of the final Commission Order in this proceeding, PWSA will file a separate docket including all bulk water sales contracts entered into with municipalities and other public utilities, and will file all future contracts with the Commission, as required by Sections 507 and 508. In its next rate case, PWSA will propose a retail rate or rates that will be included in the tariff and charged to new bulk water sales. PWSA will provide costs of providing these wholesale services as part of the cost of service study performed for the next rate case and seek to update rates to reflect the current cost of service.

xii) Bulk Wastewater Conveyance Agreements

Within 120 days of the final Commission Order in this proceeding, PWSA will file with the Commission a separate docket with all bulk wastewater conveyance agreements with municipalities and other public utilities, and will file all future contracts with the Commission, as required by Sections 507 and 508. In its next rate case, PWSA will propose a retail rate or rates that will be included in the tariff and charged to new bulk wastewater conveyance arrangements. PWSA will provide costs of providing these wholesale services as part of the cost of service study performed for the next rate case and seek to update rates to reflect the current cost of service.

Appendix A – Completed Compliance Plan Supplement Requirements

Task	Timeline (if specified in the Compliance Plan Supplement)	Progress to Date
Operations		
Install a new meter test station for testing 5/8" to 2" meters.	April 2019	Complete
Hire a private contractor to test meters that are 3" and above on site or at their facility.		The PWSA Board of Directors awarded this contract to Vanguard on April 26, 2019.
Billing/Customer Service		
Conduct a regular review of informal complaint information to determine complaint trends and whether there is a need to implement additional or new internal training policies.		PWSA is regularly reviewing informal complaints to determine trends and the need for further training.
Track whether customer complaints are related to water, sewer, or stormwater.	Monthly	Complete
Suspend the use of Jordan Tax Service, Inc.	With the Commission's final order approving the Settlement	Complete
Track the following metrics: Abandon %, ACD handling time, average speed of answer, CSR attendance, Customer satisfaction, service level % (Appendix E).	Monthly	Completed
Collect and report on requested billing data (Appendix E).		Q2 data appears in Appendix E of this report.
Provide interested parties and the Commission's Bureau of Consumer Services with a draft of the bill changes for feedback and recommendations.		The bill draft was provided on March 29, 2019. Responses were provided in April 2019 by OCA, I&E, and Pittsburgh UNITED.
Inform customers of the payment arrangement terms, based on the consumer's ability to pay upon contact with the customer, and offer payment arrangements as permitted by Chapter 14.		Informal practices in this area have been formalized to demonstrate compliance.
Form a Low Income Assistance Advisory Committee.	Meetings should occur at least quarterly	Completed
Revise Bill Discount Program rate to provide for a 75% discount on the minimum water and/or wastewater charge for customers with income at or below 150% of the federal poverty level.		Completed, and effective as of March 1, 2019.
Lead		
Form a Community Lead Response Advisory Committee (CLRAC).	Initiated within 30 days of Settlement Agreement	The first quarterly meeting was held January 8, 2019, and subsequent meetings occurred on February 6,

		2019, March 4, 2019, April 24, 2019, and June 3, 2019.
Develop and implement a plan to encourage greater participation in the lead line replacement program.	Plan developed within 90 days of effective date of rates; customer participation reported quarterly	The Community Outreach and Communication Plan was presented to CLRAC for input and is currently being implemented. Updates are provided at each meeting.
Make best efforts to send a letter notifying the resident and property owner of the results of a curb box inspection.	Within 90 days of the completion of the inspection, but no later than 120 days	Complete.
Develop and implement a plan to encourage greater participation in the lead sampling program.	Within 90 days of effective date of rates	The Community Outreach and Communication Plan was presented to CLRAC for input and is currently being implemented. Updates are provided at each meeting.
Make all historical service line records available for public viewing on website.	Within 90 days of effective date of rates	This was completed in early January 2019.
Analyze per-line costs for replacing lead service lines.	Within 90 days of effective date of rates	This information was presented to CLRAC on April 24, 2019.
Analyze the feasibility of including all lead service lines, including private-side-only lead service lines, in PWSA's 2019 lead service line replacement program and 2020 - 2026 small diameter water main replacement program.	Within 90 days of effective date of rates	This information was presented to CLRAC on March 4, 2019.
Develop an outreach program to notify customers of their eligibility for free filters, including at a minimum, a letter or bill insert.	Within 90 days of effective date of rates	Letters sent to all CAP customers in February 2019 with update in April and every month hereafter.
Finance, Contractual, and Other Issues		
Formally notify the City of Pittsburgh of the record and outcome of this case, that the Cooperation Agreement is being reviewed by the PUC in the Compliance Filing proceeding, and that PWSA's LTIIP Filing is pending with the Commission.		Complete
Serve the City with a copy of Final Commission Orders and file a certificate of service with the Commission verifying that such service was made.	Issued in this matter within 10 days of their issuance	Complete

Appendix B – Title 52 Sections where PWSA Believes it is Currently in Compliance

Section	Subchapter	Currently in Compliance
56.1	Preliminary Provisions for Utilities and Customers Subject to Chapter 14 of the Public Utility Code	X
56.31 – 56.58	Credit and Deposits Standards Policy (Water)	X
56.71 – 56.72	Interruption and Discontinuance of Service (Water)	X
56.81-56.118	Include information in Spanish directing Spanish-speaking customers to numbers for translation assistance for shut-offs (Water)	X
56.14 – 56.174	Disputes; Termination Disputes; Informal and Formal Complaints (Water)	X
56.191	Restoration of Service (Water)	X
56.251 – 56.252	Provisions for Wastewater, Steam Heat and Small Natural Gas Distribution Utilities and Victims of Domestic Violence with a Protection from Abuse Order	X
56.281 – 56.307	Credit and Deposits Standards Policy (Wastewater)	X
56.311 – 56.312	Interruption and Discontinuance of Service (Wastewater)	X
56.371 – 56.411	Disputes; Termination Disputes; Informal and Formal Complaints (Wastewater)	X
56.321-56.358	Include information in Spanish directing Spanish-speaking customers to numbers for translation assistance for shut-offs (Wastewater)	X
56.421 – 56.422	Restoration of Service (Wastewater)	X
56.441	Informal Complaints (Wastewater)	X
65.3.	Complaints.	X
65.5.	Interruptions of service.	X
65.9.	Adjustment of bills for meter error.	X
65.10.	Disputed bills.	X
65.12.	Notice of desire to have service discontinued.	X
65.13.	Temporary service.	X
65.14.	Reestablish operability of meters at each source of supply and install an additional meter at Fox Chapel Station.	X
65.15.	Refusal to serve applicants.	X
69.51 – 69.85	Inclusion of State Taxes and Gross Receipts Taxes in Base Rates	X
69.169	Policy Statement Interpreting Terms Included In 66 Pa.C.S. § 1326	X
69.261 – 69.267	Policy Statement On Customer Assistance Programs	X
69.351	Implementation Of SFAS 106	X
73.7.	Capital investment plan report	X
121.3.	LTIIP.	X
121.4.	Filing and Commission review procedures.	X

Appendix C – 20 Operating Metrics Identified in I&E St. No. 4, p. 5

Metric	July 2019
Pipeline Materials (% of pipe segments with materials listed in GIS)	Water: 23% (15,254 out of 67,048 water mains have material populated) Sewer: 76% (34,049 out of 44,922 sewer mains have material populated)
Pipeline Age (% of pipe segments with age listed in GIS)	Water and Sewer: Not a field in GIS at this time, but can be calculated using installation date, so same % as below could be provided
Leak History per Mile (number of leaks per 100 miles of pipe per year)*	TBD
Pipeline Pressures (distribution pressure devices recording pressure outside minimum and maximum for more than 10 minutes)	TBD
Installation Year (% of pipe segments with installation year listed in GIS)	Water: 21% (14,143 out of 67,048 water mains have date installed populated) Sewer: 14% (6,275 out of 44,922 sewer mains have a date installed populated)
Pipeline Diameter (% of pipe segments with pipeline diameter listed in GIS)	Water: 100% (67,046 out of 67,048 water mains have a diameter populated) Sewer: 100% of active sewer mains have a diameter populated (includes some assumed inlet lateral diameters);
Pipeline Mileage (miles of active and retired pipe in the distribution system)	Water: Active Water Mains: 961.7 miles; Abandoned Water Mains: 155.2 miles mapped in GIS (includes abandoned water mains layer originally exported from CAD prior to GIS conversion) Active Sewer Mains: 1,217.8 miles; Abandoned Sewer Mains: 59.1 miles mapped in GIS
Addition/Retirements of Plant (GIS or CMMS field denoting active or inactive assets)	TBD
Materials and Supplies (Value of materials and supplies on-hand)	TBD
Leak Repair (number of leaks repaired – distribution main)	TBD
Leak Repair (number of leaks repaired – service line)	TBD
Pipeline Damages from Excavation (GIS or CMMS field denoting suspected cause of leak)	TBD
Plant in Service (Asset inventory)	TBD

Corrosion Protection Programs (pipe segments protected by cathodic protection)	TBD
Lead Levels (Lead and copper action level, current period)	TBD
Miles of Lead Pipeline	TBD
Cost of Lead Pipeline Replacement for PWSA Work Crews (average pipeline replacement cost per period)	TBD
Cost of Lead Pipeline Replacement for PWSA Contractors (average pipeline replacement cost per period)	TBD
Sanitary Flow Reduction (Number of reportable SSOs per year)	TBD
Sanitary Flow Reduction (Volume of reportable SSOs per year)	TBD
Miles of Combined Sewer Separation (per year)	TBD
Unaccounted for Water (% of finished water that is unaccounted for)	TBD
Non-revenue Water (% of finished water that is non-revenue)	TBD

*Leaks will be geotagged to the segments in which they occur

Appendix D – Low Income Customer Billing Metrics

Billing Metrics	July 2019	October 2019	January 2020
Billed revenue	$60,228,203		
Receipts actually collected	$57,694,798		
Number of accounts in arrears	27,717		
Dollars of arrears	$13,390,625		
Number of accounts disconnected for nonpayment	711		
Number of accounts receiving a notice of disconnection for nonpayment	12,097		
Number of bill discount participants who entered the bill discount program with unpaid account balances	129		
Dollars of unpaid account balances for bill discount program participants at the time those participants entered the bill discount program	$88,189.63		
Number of bill discount participants by agreed-upon poverty ranges	15206 1.15% 15210 3.72% 15235 5.59% 15206 6.01% 15220 18.73% 15219 19.69% 15214 19.69% 15216 20.43% 15206 22.49% 15212 22.67% 15212 22.67% 15203 23.42% 15206 23.42% 15212 23.42% 15201 24.39% 15214 25.80% 15207 31.81% 15213 37.56% 15211 44.77% 15212 44.81% 15206 48.03% 15206 48.38% 15219 53.22% 15210 54.71%		

	15214	55.73%		
	15211	55.95%		
	15212	56.27%		
	15210	58.00%		
	15212	59.02%		
	15201	59.75%		
	15208	60.75%		
	15204	64.07%		
	15208	65.90%		
	15206	66.42%		
	15206	69.26%		
	15206	70.82%		
	15213	72.81%		
	15224	73.23%		
	15201	73.69%		
	15210	74.07%		
	15206	77.77%		
	15210	77.91%		
	15212	77.91%		
	15220	78.14%		
	15210	78.69%		
	15217	80.47%		
	15211	81.21%		
	15214	83.01%		
	15207	83.38%		
	15217	83.44%		
	15208	83.68%		
	15208	83.77%		
	15220	83.87%		
	15212	84.09%		
	15208	85.00%		
	15219	86.36%		
	15208	89.35%		
	15213	91.24%		
	15212	91.42%		
	15214	94.64%		
	15212	95.02%		
	15219	95.98%		
	15212	96.07%		
	15211	96.31%		
	15106	102.75%		
	15219	103.57%		
	15208	107.41%		

	15204 108.95% 15224 109.21% 15212 112.69% 15219 115.38% 15208 115.96% 15212 116.97% 15219 117.98% 15208 120.19% 15213 123.90% 15206 125.77% 15208 127.87% 15211 128.58% 15201 130.47% 15210 130.47% 15212 131.77% 15211 132.77% 15210 133.12% 15208 134.31% 15210 135.99% 15212 136.14% 15214 138.85% 15212 140.68% 15221 142.72% 15206 146.13% 15201 147.19%		
Average usage	4,000 gallons		
Average bill including ALCOSAN charges	$128.28		
Number of PWSA customers receiving a PWSA hardship grant	83		
Average amount of PWSA hardship grants	$271.38		
Average arrearage of PWSA customers receiving a PWSA hardship grant.	$749.89		

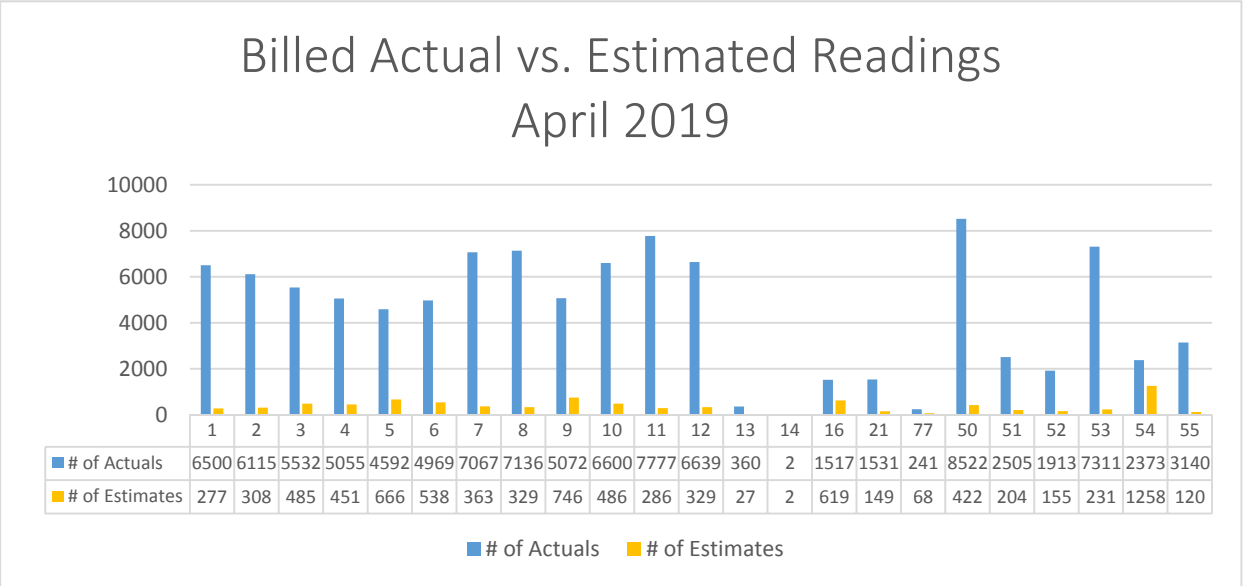
Appendix E – Call Center Metrics and Customer Service Monthly Reports

Metric	April, 2019	May, 2019	June, 2019
Abandoned Calls (% of total calls)	2.2%	3.7%	3.7%
Automatic Call Distributor (ACD) Handling Time (minutes)	4:34	4:26	4:26
Average Speed of Answer (minutes)	0:59	1:42	1:34
Customer Service Representative Staffing (FTE – Full Time Equivalents)	11 FTEs	10 FTEs	16 FTEs
Customer Satisfaction (customer survey)	98.6%	99.4%	99.0%
Service Level %	83.6%	69.5%	70.9%

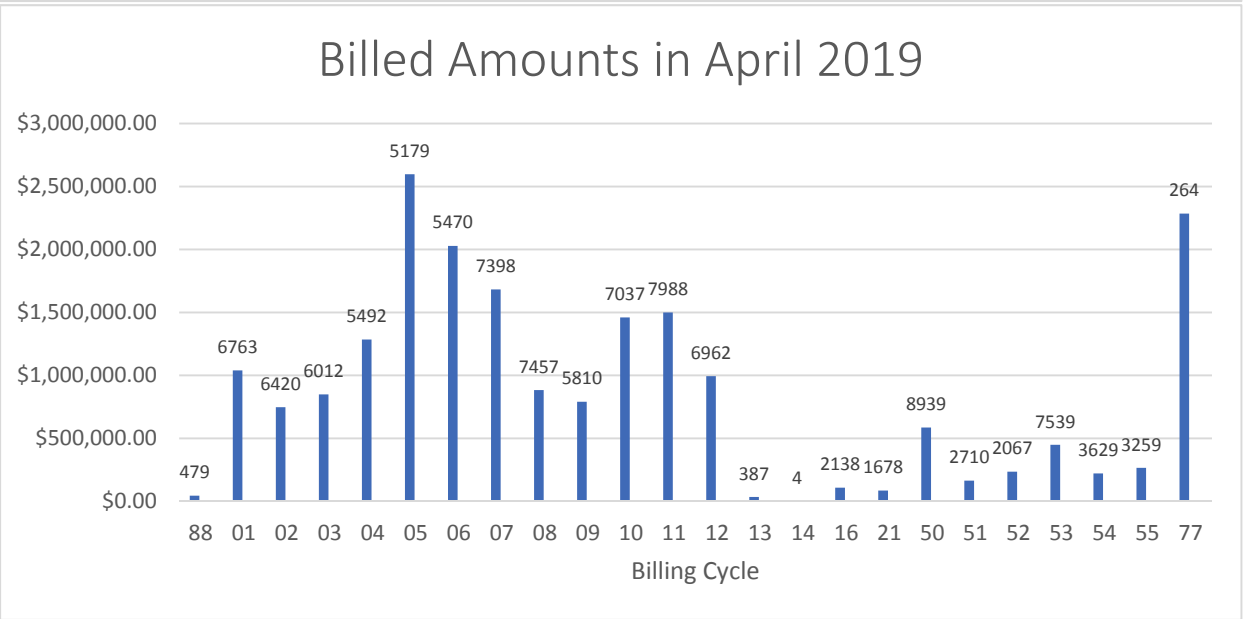
CUSTOMER SERVICE MONTHLY REPORT

AMI and BILLING – APRIL 2019

A Non-Access Campaign continued to address the 996 aged actual meter readings and 3,690 estimated meter readings. Under the PA PUC Compliance Plan, customers are continuing to be notified via letters and posting notices to make appointments for a meter upgrade. PWSA successfully upgraded 817 meters in April 2019. Additionally, 999 letters were issued, 176 properties were posted, and 21 accounts were shut for non-access. Billing received 432 final bill requests and processed them within 7 days. Billing totals for the month of April 2019 were 111,081 bills produced in the amount of $20,341,841.65.



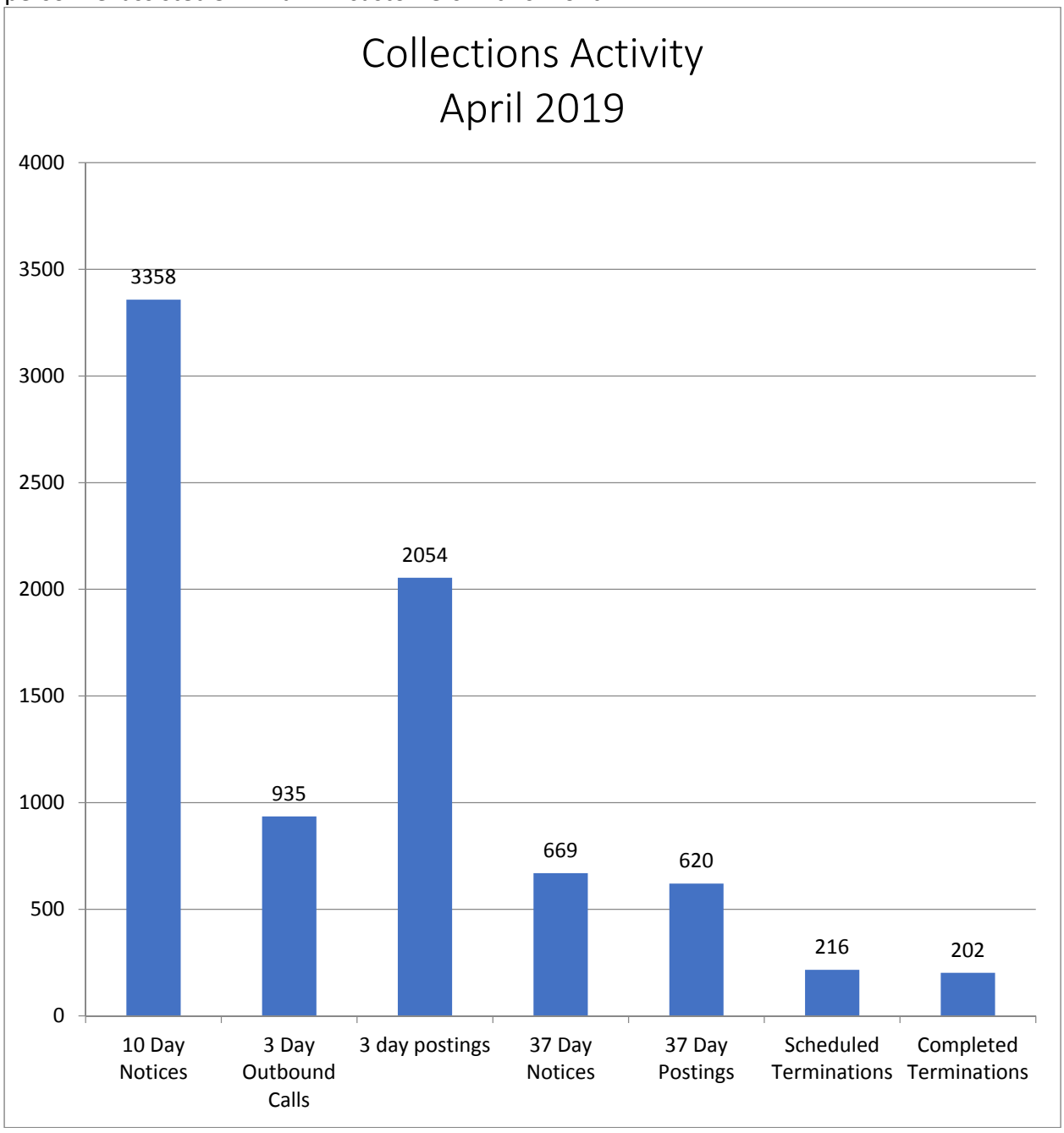
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	21	77	50	51	52	53	54	55
# of Actuals	6500	6115	5532	5055	4592	4969	7067	7136	5072	6600	7777	6639	360	2	1517	1531	241	8522	2505	1913	7311	2373	3140
# of Estimates	277	308	485	451	666	538	363	329	746	486	286	329	27	2	619	149	68	422	204	155	231	1258	120



CUSTOMER SERVICE MONTHLY REPORT

COLLECTIONS – APRIL 2019

In April 2019, the total Collections were $20,384,205, which was $1.3M more than what was billed in March 2019. This increase was likely due to collection activities following the end of the Winter Moratorium. Out of a total of 1,083 customer inquiries to info@pgh2o.com, Collections personnel responded to 1,022 inquiries, most within 48 hours. Collections personnel assisted 977 walk-in customers in this month.



CUSTOMER SERVICE MONTHLY REPORT

CONTACT CENTER – APRIL 2019

There were 21 business days in the month of April 2019. Customer calls continued to be monitored and assessed by the Customer Service Training Coordinator. Corrective actions continued to be taken to address any employee performance issues. The Customer Service Coordinator overseeing the Contact Center continued to promote a positive work environment through rewards, celebrations, and mentoring. The attendance rate changed to 10 full time employees and 2 part time employees. Of the 14,676 calls handled in the month of April 2019, the Customer Service Representatives were able to report a 98.6% customer satisfaction rate.

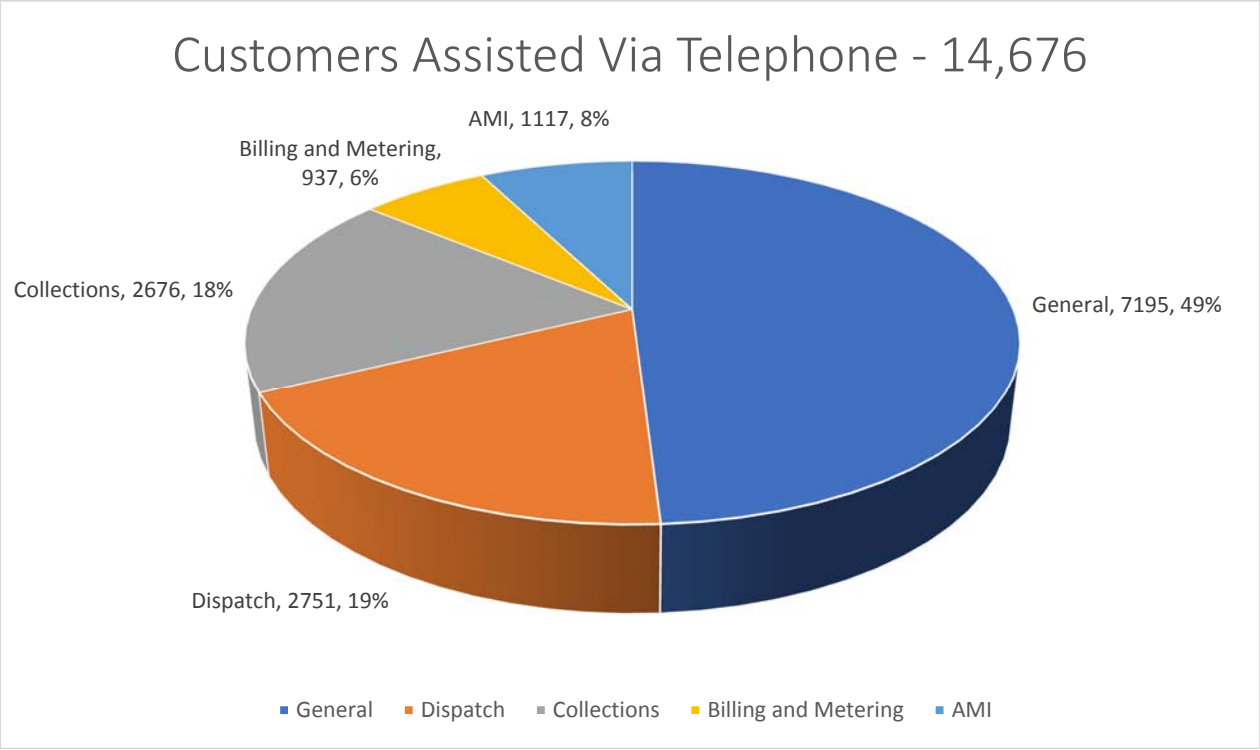
Queue Group Performance by Queue

1 - All Queues

4/1/2019 - 4/30/2019 - 00:00 - 24:00

Created on 5/1/2019 8:46:17 AM by TishlaJones

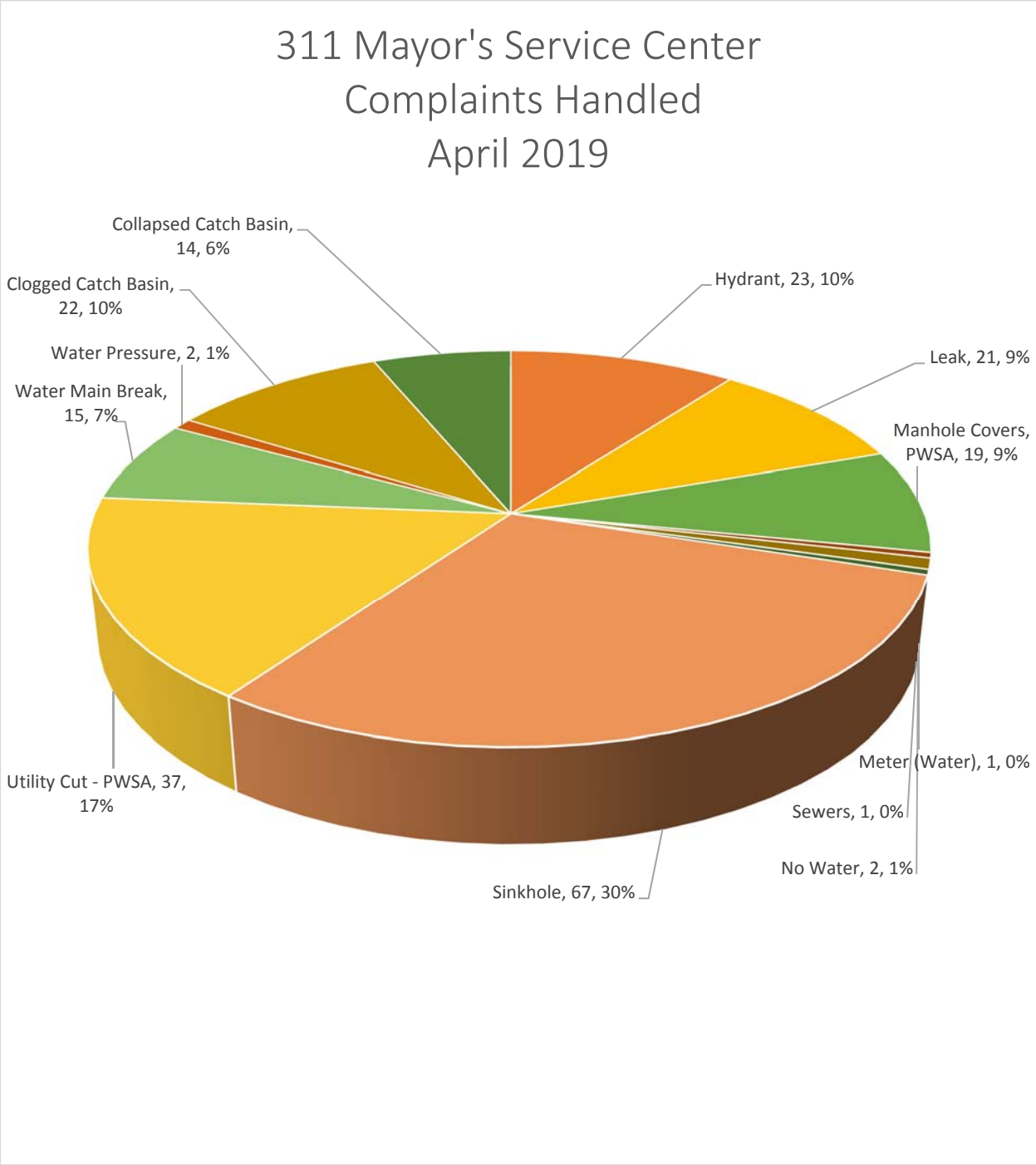
ACD queue	ACD queue name	ACD calls offered	ACD calls handled	Average speed of answer (hh:mm:ss)	Average ACD handling time (hh:mm:ss)	Abandon %	Service level %	Answer %
P001	GENERAL	7393	7195	00:01:15	00:05:08	2.7%	77.9%	97.3%
P004	DISPATCH	2793	2751	00:00:13	00:01:56	1.5%	98.3%	98.5%
P002	COLLECTIONS	2742	2676	00:01:18	00:06:09	2.4%	76.4%	97.6%
P003	BILLING AND METERING	955	937	00:01:08	00:04:31	1.9%	79.5%	98.1%
P006	AMI 8920	1434	912	00:00:05	00:03:33	0.3%	100.0%	63.6%
P005	AMI	210	205	00:01:01	00:03:47	2.4%	87.1%	97.6%
Totals		**15527**	**14676**	**00:00:59**	**00:04:34**	**2.2%**	**83.6%**	**94.5%**



CUSTOMER SERVICE MONTHLY REPORT

DISPATCH – APRIL 2019

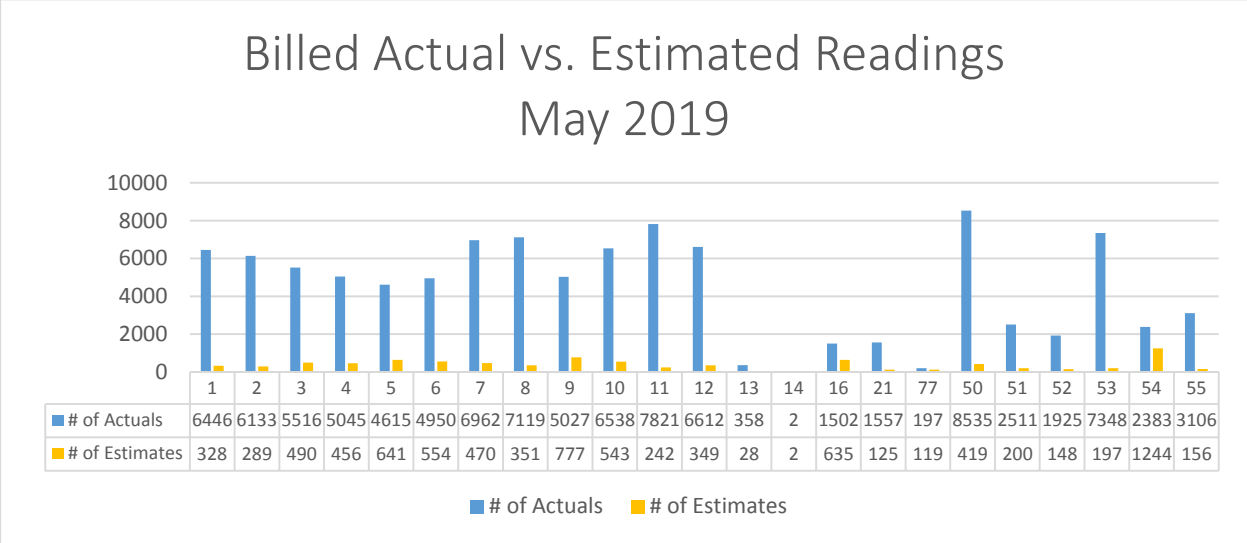
Dispatch responded to 2,751 calls for emergency service in April 2019. In this month, the Dispatchers issued 96 Interruptions of Service and facilitated 203 dig requests to Pennsylvania One Call.



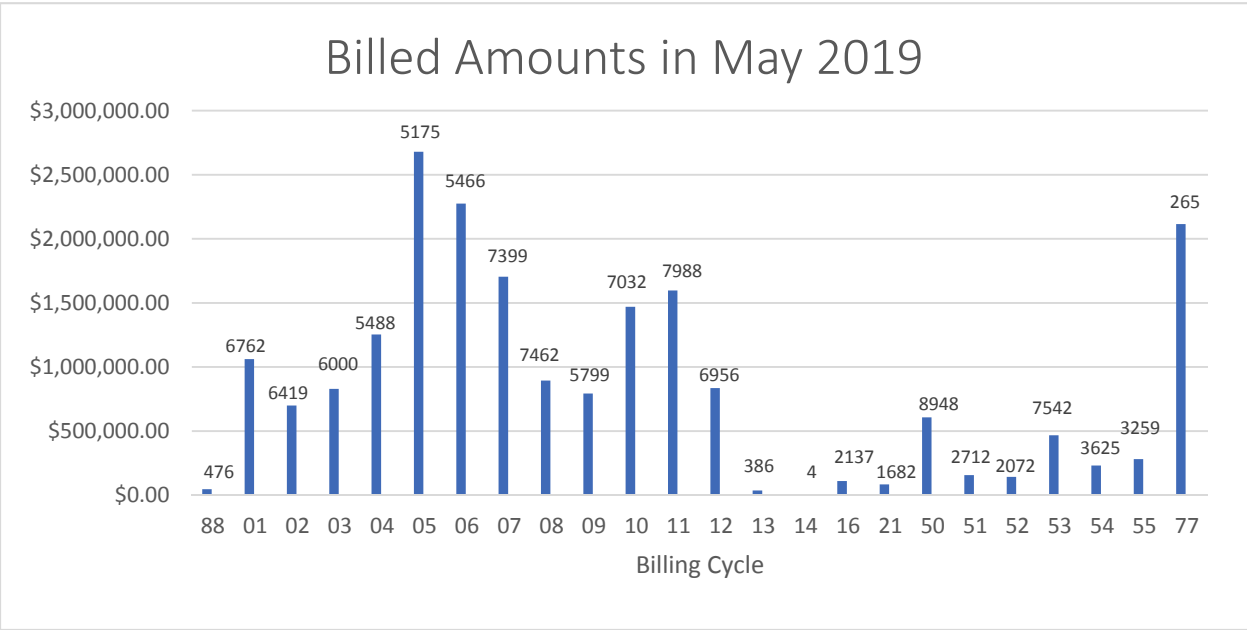
CUSTOMER SERVICE MONTHLY REPORT

AMI and BILLING – MAY 2019

A Non-Access Campaign continued to address the 1,076 aged actual meter readings and 3,580 estimated meter readings. Under the PA PUC Compliance Plan, customers are continuing to be notified via letters and posting notices to make appointments for a meter upgrade. PWSA successfully upgraded 801 meters in May 2019. Additionally, 916 letters were issued, 367 properties were posted, and 19 accounts were shut for non-access. Billing received 375 final bill requests and processed them within 7 days. Billing totals for the month of May 2019 were 111,054 bills produced in the amount of $20,370,418.68.



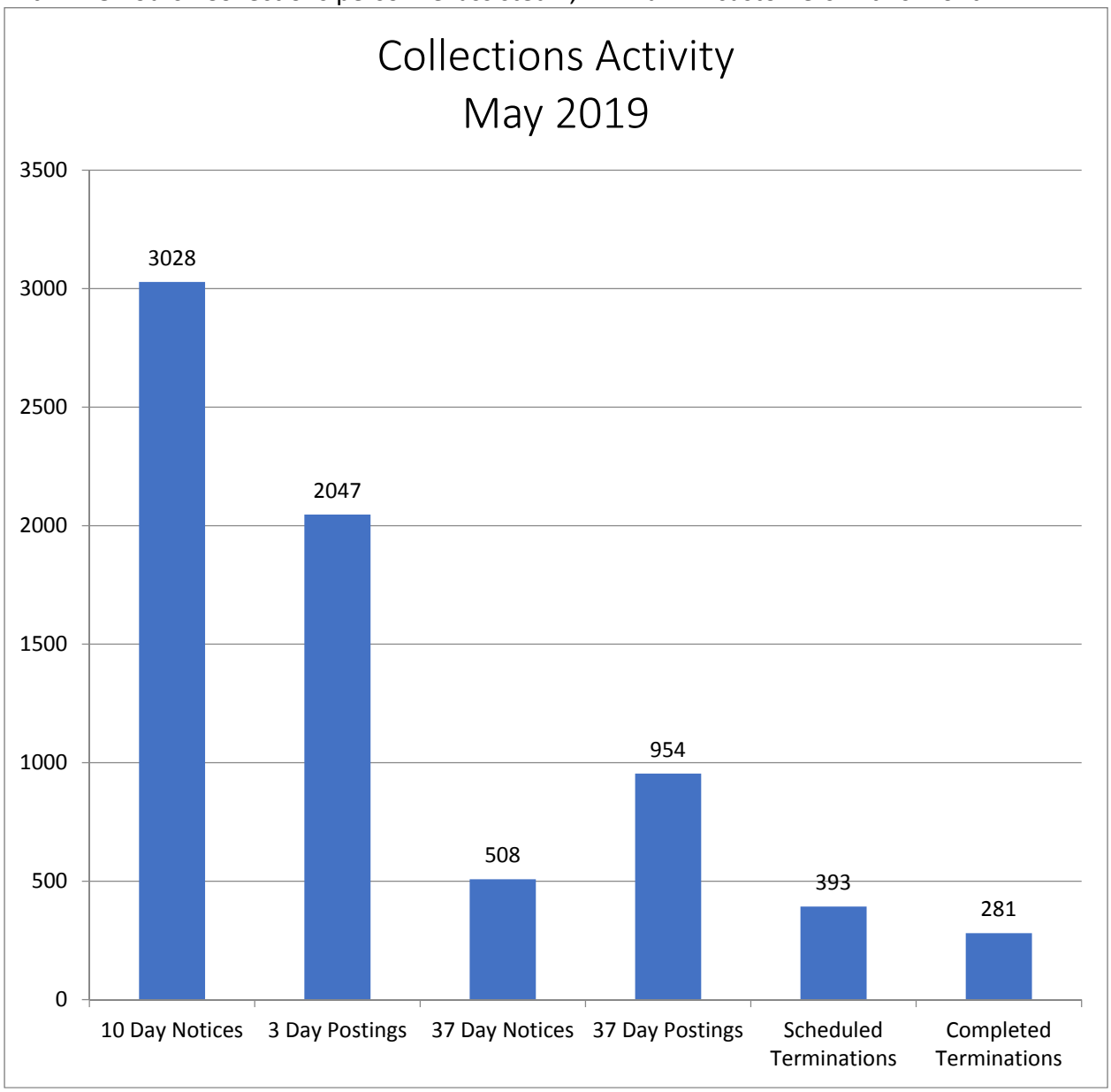
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	21	77	50	51	52	53	54	55
# of Actuals	6446	6133	5516	5045	4615	4950	6962	7119	5027	6538	7821	6612	358	2	1502	1557	197	8535	2511	1925	7348	2383	3106
# of Estimates	328	289	490	456	641	554	470	351	777	543	242	349	28	2	635	125	119	419	200	148	197	1244	156



CUSTOMER SERVICE MONTHLY REPORT

COLLECTIONS – MAY 2019

In May 2019, the total Collections were $21,205,276, which was $863K more than what was billed in April 2019. This better than expected collection total was due to an audit of the Collections process by the Customer Service Manager. Following up on failed automated outbound calls for planned and emergency outages in this month, 214 letters were mailed to customers, requesting that they update their contact information with PWSA. Out of a total of 748 customer inquiries to info@pgh2o.com, Collections personnel responded to 731, most within 48 hours. Collections personnel assisted 1,174 walk-in customers in this month.



CUSTOMER SERVICE MONTHLY REPORT

CONTACT CENTER – MAY 2019

There were 23 business days in the month of May 2019. Customer calls continued to be monitored and assessed by the Customer Service Training Coordinator. Corrective actions continued to be taken to address any employee performance issues. The Customer Service Coordinator overseeing the Contact Center continued to promote a positive work environment through rewards, celebrations, and mentoring. The attendance rate changed to 9 full time employees and 2 part time employees. Of the 15,510 calls handled in the month of May 2019, the Customer Service Representatives were able to report a 99.4% customer satisfaction rate.

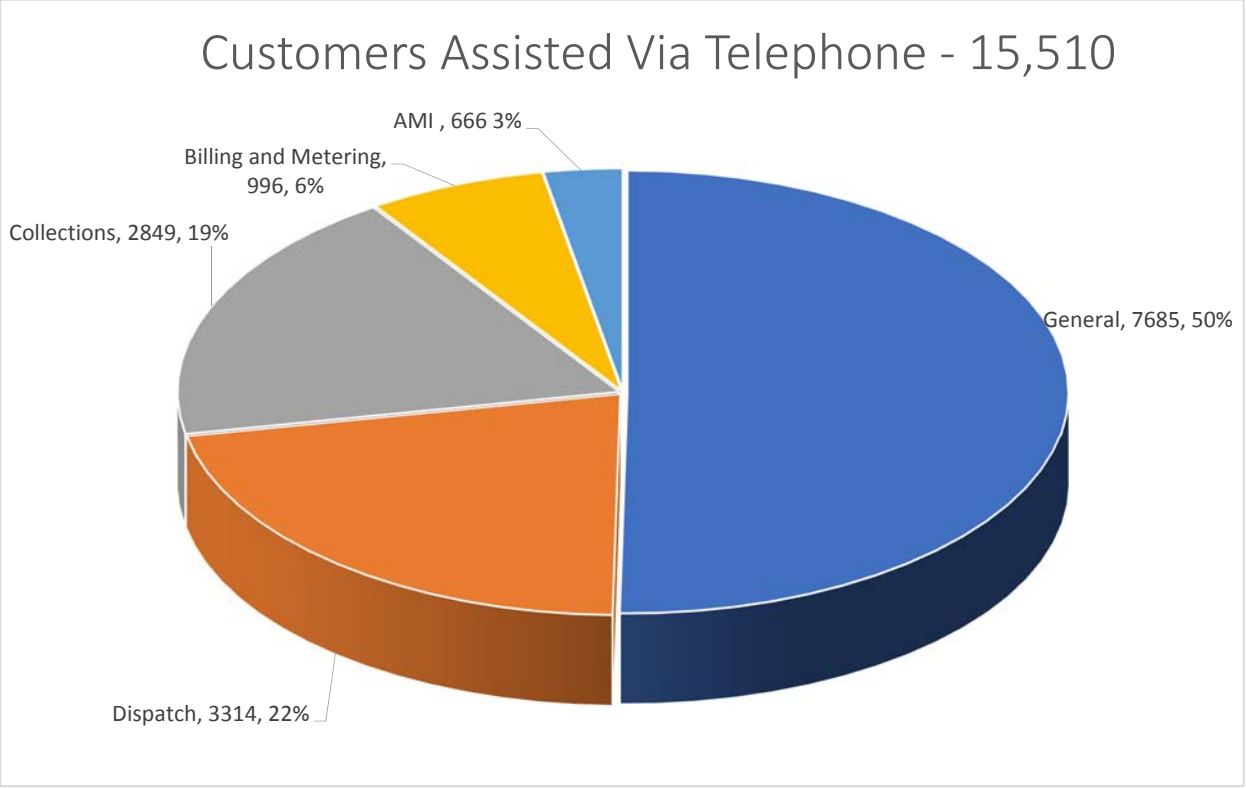
Queue Group Performance by Queue

1 - All Queues

5/1/2019 - 5/31/2019 - 00:00 - 24:00

Created on 6/3/2019 8:19:13 AM by TishlaJones

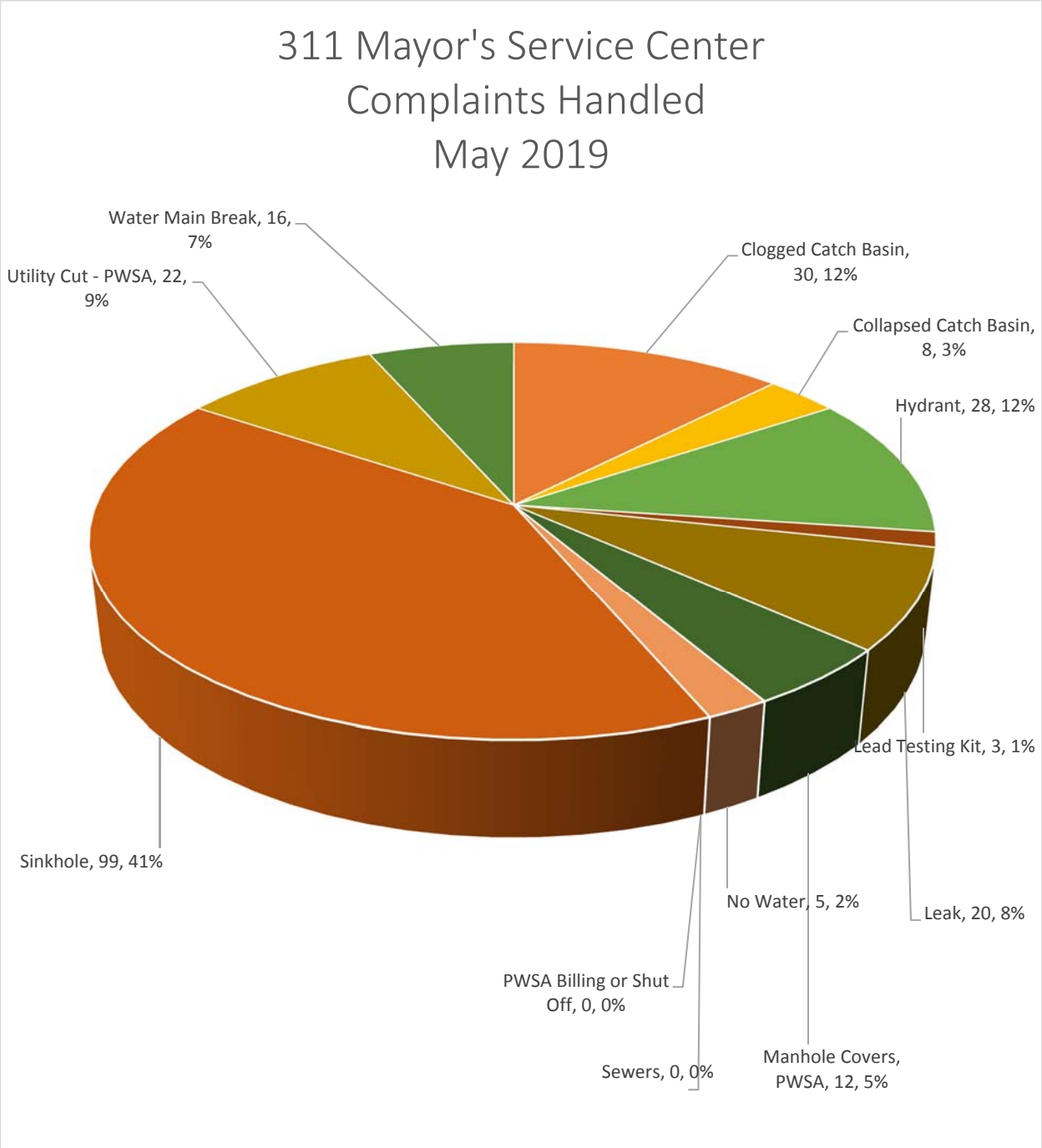
ACD queue	ACD queue name	ACD calls offered	ACD calls handled	Average speed of answer (hh:mm:ss)	Average ACD handling time (hh:mm:ss)	Abandon %	Service level %	Answer %
P001	GENERAL	8029	7685	00:02:06	00:05:03	4.3%	61.3%	95.7%
P004	DISPATCH	3404	3314	00:00:21	00:01:53	2.6%	96.3%	97.4%
P002	COLLECTIONS	2972	2849	00:02:22	00:05:42	4.1%	55.8%	95.9%
P003	BILLING AND METERING	1043	996	00:02:03	00:04:53	4.5%	61.8%	95.5%
P006	AMI 8920	612	441	00:00:07	00:03:54	0.2%	99.8%	72.1%
P005	AMI	228	225	00:00:39	00:03:39	1.3%	92.1%	98.7%
Totals		**16288**	**15510**	**00:01:42**	**00:04:26**	**3.7%**	**69.5%**	**95.2%**



CUSTOMER SERVICE MONTHLY REPORT

DISPATCH – MAY 2019

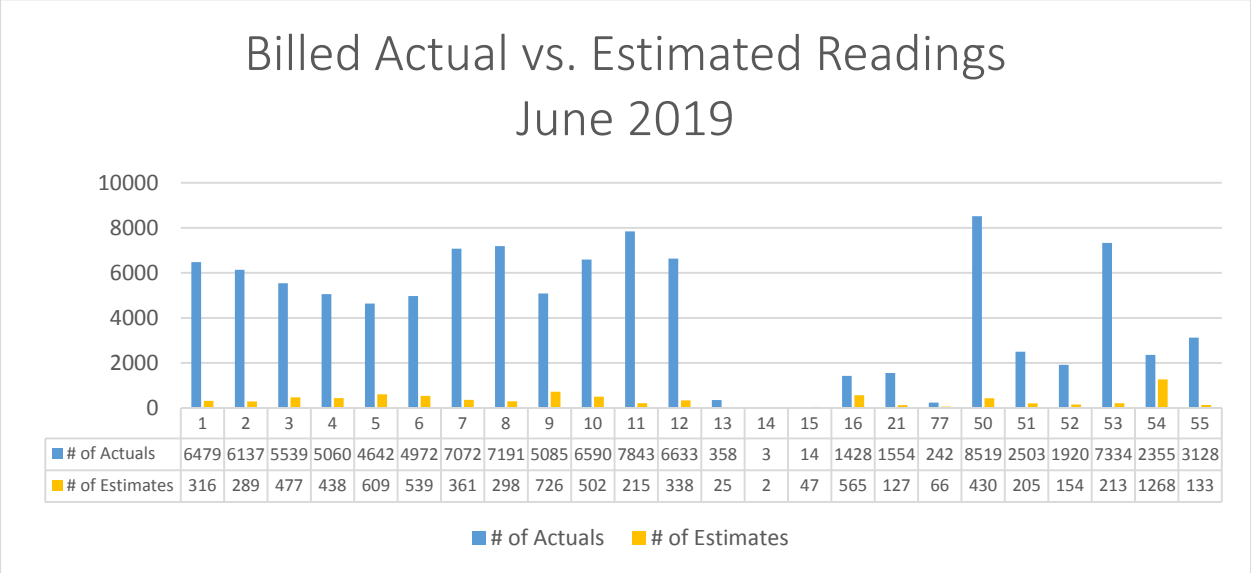
Dispatch responded to 3,314 calls for emergency service in May 2019. In this month, the Dispatchers issued 124 Interruptions of Service and facilitated 196 dig requests to Pennsylvania One Call.



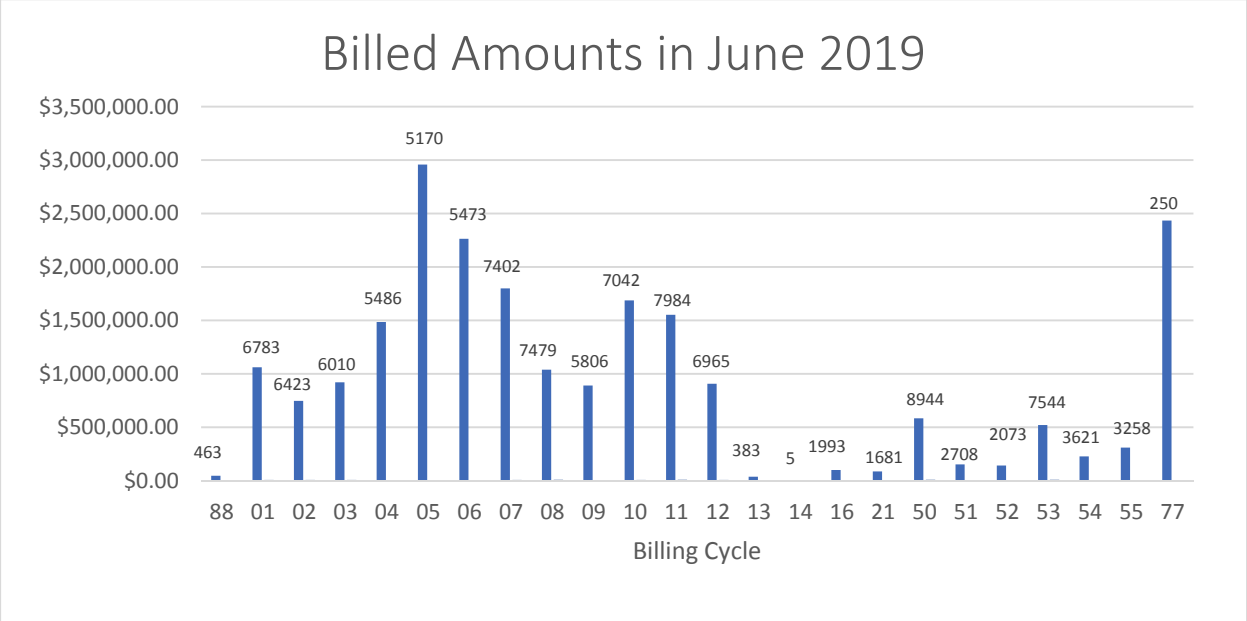
CUSTOMER SERVICE MONTHLY REPORT

AMI and BILLING – JUNE 2019

A Non-Access Campaign continued to address the 1,121 aged actual meter readings and 3,503 estimated meter readings. Under the PA PUC Compliance Plan, customers are continuing to be notified via letters and posting notices to make appointments for a meter upgrade. PWSA successfully upgraded 654 meters in June 2019. Additionally, 724 letters were issued, 34 properties were posted, and 30 accounts were shut for non-access. Billing received 425 final bill requests and processed them within 7 days. Billing totals for the month of June 2019 were 110,946 bills produced in the amount of $21,937,867.44.



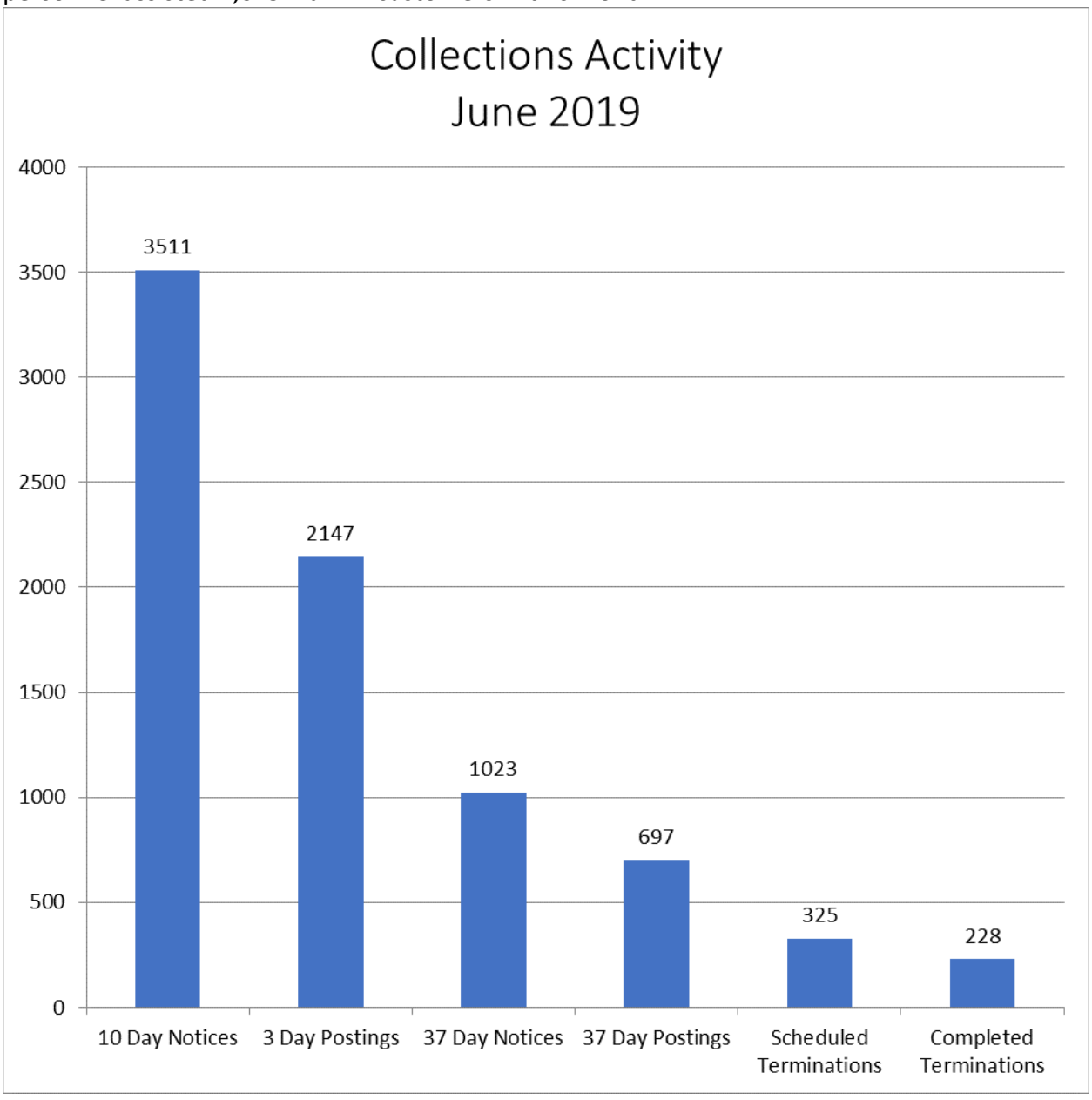
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	21	77	50	51	52	53	54	55
# of Actuals	6479	6137	5539	5060	4642	4972	7072	7191	5085	6590	7843	6633	358	3	14	1428	1554	242	8519	2503	1920	7334	2355	3128
# of Estimates	316	289	477	438	609	539	361	298	726	502	215	338	25	2	47	565	127	66	430	205	154	213	1268	133



CUSTOMER SERVICE MONTHLY REPORT

COLLECTIONS – JUNE 2019

In June 2019, the total Collections were $16,105,317, which was $4.2M less than what was billed in May 2019. The number of business days and calendar configuration this month contributed to this shortfall. Following up on failed automated outbound calls for planned and emergency outages in this month, 259 letters were mailed to customers, requesting that they update their contact information with PWSA. Out of a total of 1,110 customer inquiries to info@pgh2o.com, Collections personnel responded to 1,098, most within 48 hours. Collections personnel assisted 1,049 walk-in customers in this month.



CUSTOMER SERVICE MONTHLY REPORT

CONTACT CENTER – JUNE 2019

There were 20 business days in the month of June 2019. Customer calls continued to be monitored and assessed by the Customer Service Training Coordinator. Corrective actions continued to be taken to address any employee performance issues. The Customer Service Coordinator overseeing the Contact Center continued to promote a positive work environment through rewards, celebrations, and mentoring. The attendance rate increased to 15 full time employees and 2 part time employees. Of the 14,434 calls handled in the month of June 2019, the Customer Service Representatives were able to report a 99.0% customer satisfaction rate.

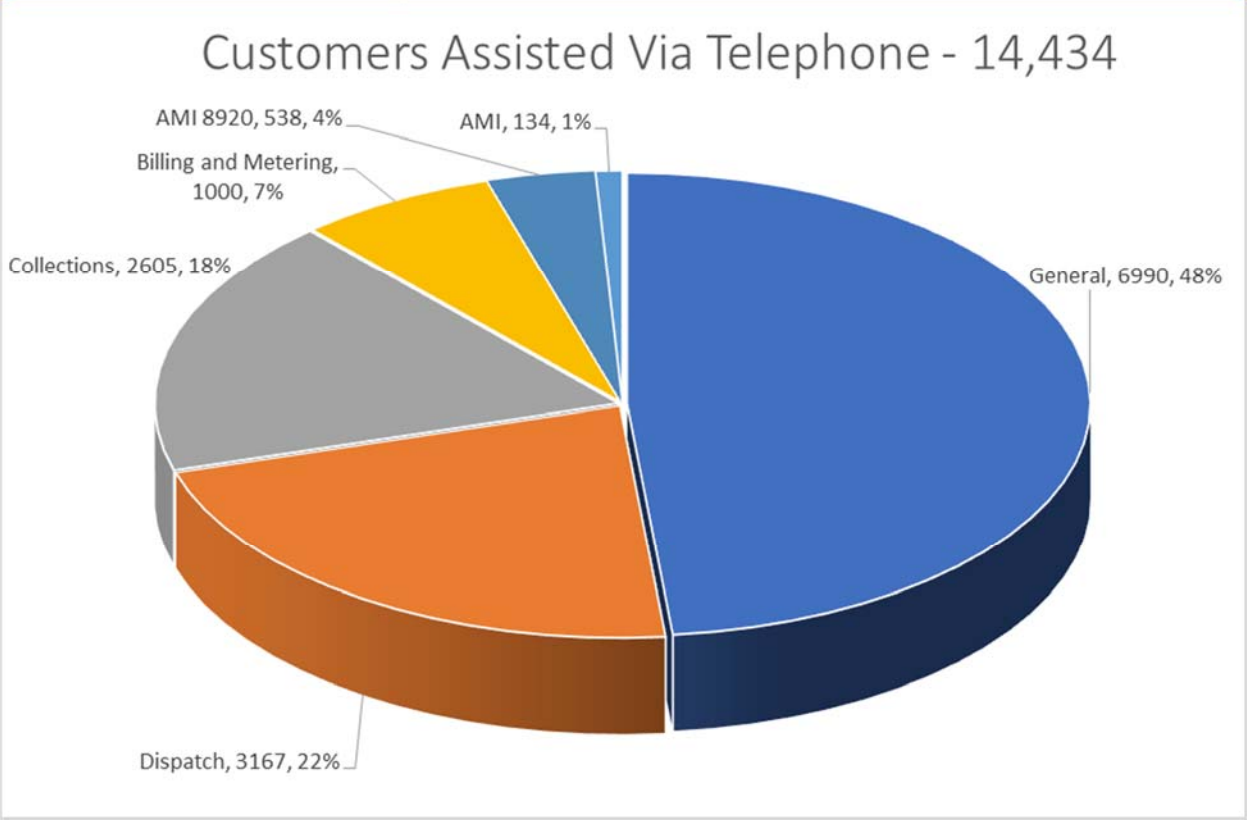
Queue Group Performance by Queue

1 - All Queues

6/1/2019 - 6/30/2019 - 00:00 - 24:00

Created on 7/2/2019 12:15:08 PM by TishlaJones

ACD queue	ACD queue name	ACD calls offered	ACD calls handled	Average speed of answer (hh:mm:ss)	Average ACD handling time (hh:mm:ss)	Abandon %	Service level %	Answer %
P001	General	7287	6990	00:01:58	00:05:07	4.1%	62.2%	95.9%
P004	Dispatch	3261	3167	00:00:17	00:01:53	2.9%	96.7%	97.1%
P002	Collections	2731	2605	00:02:13	00:05:45	4.6%	57.2%	95.4%
P003	Billing and Metering	1039	1000	00:02:02	00:04:46	3.8%	61.9%	96.2%
P006	AMI 8920	796	538	00:00:06	00:03:49	0.3%	100.0%	67.6%
P005	AMI	137	134	00:00:06	00:03:49	0.3%	100.0%	67.6%
Totals		**15251**	**14434**	**00:01:34**	**00:04:26**	**3.7%**	**70.9%**	**94.6%**



CUSTOMER SERVICE MONTHLY REPORT

DISPATCH – JUNE 2019

Dispatch responded to 3,167 calls for emergency service in June 2019. In this month, the Dispatchers issued 87 Interruptions of Service and facilitated 192 dig requests to Pennsylvania One Call.

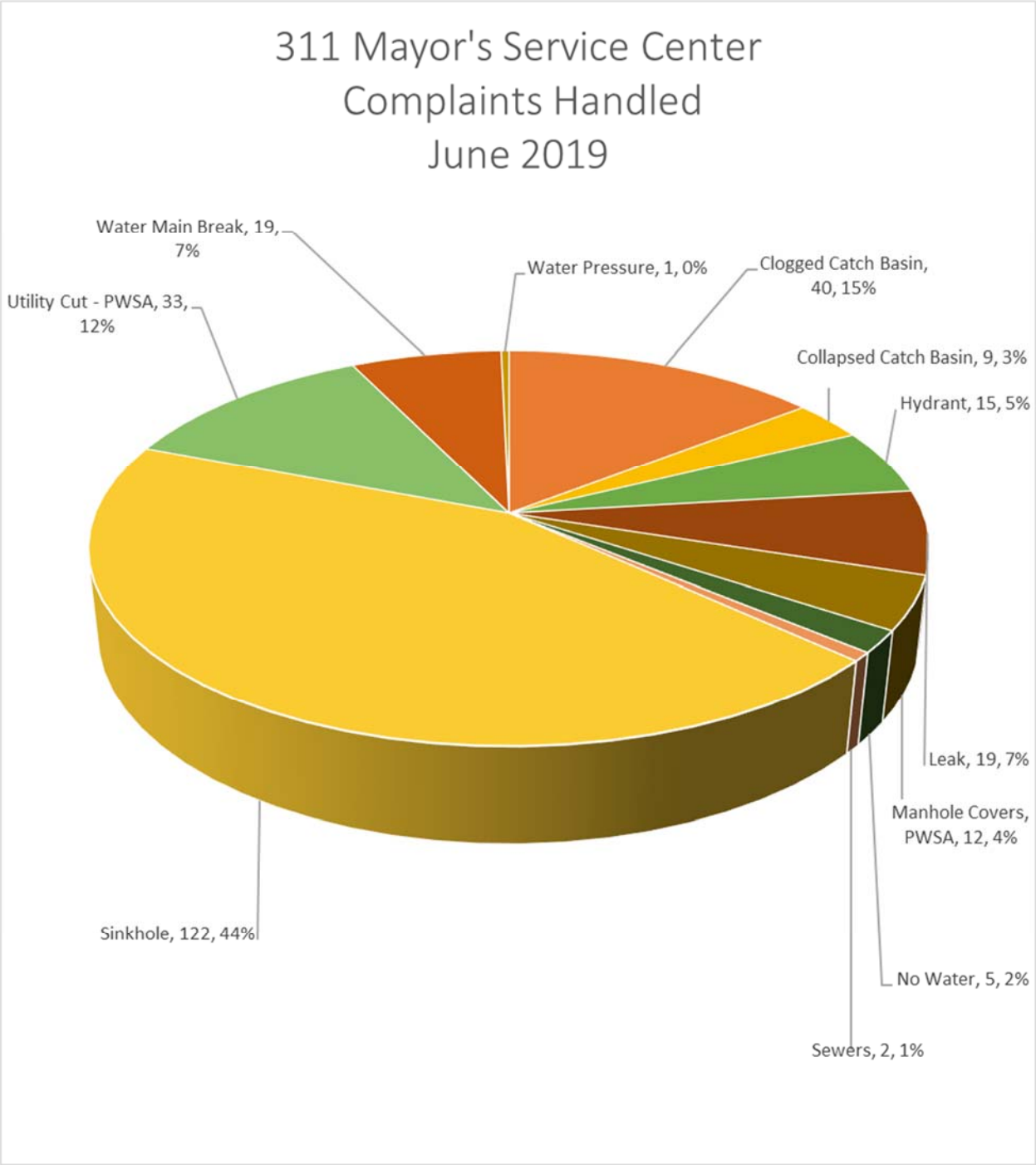


Exhibit RAW/C-33

Pittsburgh Water & Sewer Authority

Alan Eichler
Program Manager
Pennsylvania Department of Environmental Protection
Safe Drinking Water Program
500 Waterfront Drive
Pittsburgh, PA 15222-4745

RE: PWSA Response to Administrative Order dated October 25, 2017
Proposed Emergency Response Plan Schedules

Dear Mr. Eichler:

Pittsburgh Water and Sewer Authority (PWSA) recognizes the tenuous condition of its water supply, treatment and distribution systems. As experienced during this past year, equipment failures have led to water quality concerns, insufficient supply (unacceptably lowered system water pressures), and PADEP Administrative Orders (AO). PADEP's October 25, 2017 AO mandates several actions which are essential to PWSA system operations. Without these actions, PWSA will continue to experience water quality and pressure problems, which could lead to future Boil Water Advisories. Note that the recent Boil Water Advisories resulted in PWSA emergency operations expenditures of $300,000 to $500,000 per event to ensure that the public's needs are met. On this basis, PWSA proposes the following "Emergency Response Plan" to minimize future risks of water quality violations or other water system failures.

Pittsburgh Water and Sewer Authority (PWSA) has reviewed the specific tasks and associated deadlines set forth in the Pennsylvania Department of Environmental Protection's (PADEP's) Administrative Order dated October 25, 2017. We recognize and accept the PADEP approvals that are required, but request that PWSA be given the latitude to purchase long lead time equipment and materials without formal PADEP approvals. We understand that PADEP will mandate that PWSA comply with all current State and Federal rules and regulations. We also recognize that any materials and equipment purchase or other work performed to expedite these projects to minimize water system risks to the public will be subject to PADEP's review and full compliance with PADEP and USEPA regulations.

1. **Highland 1 Reservoir and Membrane Filtration Plant (MFP)**: PWSA recognizes the PADEP rationale for covering the existing Highland No. 1 Reservoir is based upon the Federal mandate to cover all treated water to prevent recontamination. While we understand the ultimate value of covering the reservoir, PWSA believes that installation of a cover of the Highland No. 1 Reservoir may not be in the immediate best interests of PWSA, or the City. Recent studies suggest that any future reservoir construction for this service area should establish a higher overflow elevation, which may require moving the reservoir from its present location. Therefore, PWSA has chosen to pursue the reactivation of the Highland 1 Reservoir by completing the activities associated with the reinstatement of the

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Pittsburgh PA 15222

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F 412.255.2475

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Customer Service /
Emergencies:
412.255.2423

Highland MFP identified under Administrative Order Subparagraphs 1.a.i through 1.a.viii., while studying the future reservoir locations.

In response to the deadlines stipulated by PADEP's AO for these activities, PWSA offers the following response:

a. Subparagraphs 1.a.i.(a) through (d): PWSA proposes to submit a preliminary permit application to the PADEP on or before the stated deadline of November 30, 2017. This preliminary application will be presumed to be "technically sufficient" to proceed with the essential steps to restore the supply to service. As such, PWSA intends to procure the equipment, materials and construction services prior to receipt of a formal PADEP approval.

b. The Preliminary Permit Application will include the Basis of Design Report and Schematic Design Documents. For the basis of scheduling, it was assumed that the PADEP will require approx. 4 weeks to review and approve the selected UV Reactor, which would coincide with December 29, 2017. A Final Permit Application will include Final Plans and Specifications, and provide complete design details for the proposed improvements, and will be submitted as soon as possible. For the basis of scheduling, it was assumed that the PADEP will issue a temporary facilities construction permit by no later than February 1, 2018.

c. As confirmation, the temporary construction permit will be based upon the Preliminary Permit Application which would provide basic equipment design criteria and specifications for the following: :
    i. The replacement of both the in-line membrane strainers and membrane filtration modules [subparagraphs (a) and (b)],
    ii. The addition of an ultraviolet (UV) disinfection unit [subparagraph (c)] that is:
        1. Capable of inactivation of Giardia, Cryptosporidium, and viruses through UV treatment in conjunction with the existing chlorination system
        2. Compliant with the US EPA Ultraviolet Disinfection Guidance Manual
        3. Validated via an EPA approved 3rd party, and
    iii. The identification of all modifications to the MFP recommended by the membrane filter manufacturer, Pall Corporation.

d. Subparagraphs 1.a.ii and iii: PWSA proposes to have Pall Corporation staff replace all the in-line membrane filtration strainers and the 4 membrane racks of filtration modules in accordance with their (the manufacturer's) standards within a 90-day timeframe *[requested modification from stipulated 60-day timeframe]*, as determined from the actual date that the PADEP issues the amended construction permit. The

reason for the 30-day extension is due to a contingency in the actual date that the Pall staff will be available to begin this work, as they cannot schedule their staff until after they have received the Notice to Proceed from PWSA, which cannot be given until a temporary facilities construction permit is issued by PADEP.

e. Subparagraph 1.a.iv: PWSA will submit a schedule for replacing the remaining membrane racks filtration modules within the 60-day timeframe stipulated from the actual date that the PADEP issues a temporary facilities construction permit. *[No requested modification]*

f. Subparagraph 1.a.v: PWSA will submit documentation to the PADEP on or before November 30, 2017 confirming that the Kinney Strainers are functioning in accordance with manufacturer standards. *[No requested modification]*

g. Subparagraph 1.a.vi: PWSA proposes to install the UV disinfection unit as approved within 150 days of the date the Department issues the temporary construction permit. *[Requested modification from stipulated 90 days]* This modification is requested based on the actual timeframes necessary for the UV System manufacture and installation durations. This coincides with a project construction completion and startup date of June 30, 2018.

h. Subparagraph 1.a.vii: PWSA will notify the Department at least 48 hours prior to start-up of the Highland MFP and will request a pre-operational site visit by the PADEP to verify that PWSA has properly completed the stated tasks. *[No requested modification]*

i. Subparagraph 1.a.viii: PWSA will submit, each day by 9 am, all information contained in the Monthly Daily Integrity Pressure Decay Testing Report form and will continue to provide daily reports until directed otherwise in writing by the PADEP following start-up of the Highland MFP. *[No requested modification]*

j. Subparagraph 1.b. Within 150 days of the date the PADEP issues an amended final construction permit, PWSA will provide adequate security with a physical barrier at the Highland 1 Reservoir. *[No requested modification]*

2. **Lanpher Reservoir**: PWSA will complete all emergency response actions necessary to restore the Lanpher Reservoir to service. PWSA proposes to accelerate the work for these activities to the greatest extent possible to ensure that the public water supply quality and availability is maintained. We propose the following modifications to the PADEP schedule as previously specified:

a. On November 15, 2017, PWSA completed repairs to the cover of the Lanpher Reservoir East Cell and returned the East Cell to service. *[Complete]*

b. On or before November 30, 2017, PWSA will submit a complete permit application to the PADEP for an amended construction permit to replace the cover and liner on both cells of the Lanpher Reservoir. *[No requested modification]* For purposes of scheduling, PWSA has assumed PADEP will require 30 days to review, approve, and issue the amended construction permit, estimated to be January 2, 2018.

c. Within 150 days of the date the PADEP issues an amended construction permit, estimated to be June 27, 2018, PWSA shall complete replacement of the West Cell cover and liner, and apply for an operation permit for the West Cell. PWSA shall return the West Cell to service immediately upon issuance of an operation permit by the PADEP. Note: Weather and adverse temperatures may cause delays that cannot be controlled by PWSA. Additionally, a new electrical service is required at the site to power the SCADA and chlorination facilities. PWSA is dependent upon the scheduling proposed by the power company to finalize our schedule. *[No requested modification at this time]*

d. Within 150 days of returning the West Cell to service, estimated to be November 23, 2018, PWSA shall replace the East Cell cover and liner, and apply for an operation permit for the East Cell. PWSA shall return the East Cell to service immediately upon issuance of an operation permit by the PADEP. Note: Weather and adverse temperatures may cause delays that cannot be controlled by PWSA. Additionally, a new electrical service is required at the site to power the SCADA and chlorination facilities. PWSA is dependent upon the scheduling proposed by the power company to finalize our schedule. *[No requested modification at this time]*

3. **Bruecken Pump Station**: Please see Attachment C for the Project Schedule and associated documentation that was prepared to support the development of a detailed and realistic schedule associated with Bruecken Pump Station tasks and actions. In response to the deadlines stipulated by PADEP for these activities, please note the following PWSA replies:
   a. Subparagraph 3a: On or before November 30, 2017, PWSA will submit a complete application for an amended construction permit (associated with the ongoing Bruecken Pump Station Valve Vault Project) to install an interim backup water pump system at the Bruecken Pump Station. The interim pumping solution consists of the installation of three Xylem Godwin Dri-Prime automatic self-priming water pumps to provide the desired variable speed backup pumping capabilities to support the demands of the Highland Reservoir #1 Service Area. These pumps will be immediately purchased and installed to backup both the existing pumps and the

electrical system and power supply. *[No requested date modification; approach revised]*

i. Concurrently, on or before January 31, 2018, PWSA will submit a complete application for another amendment to the open construction permit (associated with the ongoing Bruecken Pump Station Valve Vault Project) to install a permanent backup variable speed pump at the Bruecken Pump Station, replacing the three dri-prime automatic self-priming water pumps. *[Requested date modification requested ;approach modification suggested]*

b. Subparagraph 3b: Within 60 days of the date the PADEP issues an amended construction permit, PWSA shall obtain the three backup Godwin Dri-Prime automatic self-priming water pumps and submit to the Department a standard operating procedure (SOP) describing the circumstances and specific mechanism as to how it will be brought into service if needed. Assuming a 30-day permit review cycle by PADEP, the interim pumping solution will be installed on or before February 28, 2018 to support the demands of the Highland Reservoir #1 Service Area. *[No requested date modification; approach revised]*

i. Concurrently, PWSA shall obtain the final design package for the backup variable speed pump, on or before February 28, 2018. Upon PADEP issuing the amended construction permit, bidding and negotiations are estimated to require 30-days, to be complete on or before March 30, 2018. Equipment Procurement has been estimated to be a 12-month duration, per the pump manufacturer, coinciding with a completion date on or before March 30, 2019. Concurrently, construction has been estimated to be a 14-month duration, per the engineer and contractors, coinciding with a permanent facility in service date of May 31, 2019. Submit to the Department a standard operating procedure (SOP) describing the circumstances and specific mechanism as to how it will be brought into service if needed.

c. Subparagraph 3c: On or before December 31, 2017, PWSA will provide complete inspection, maintenance, and testing service of the two existing trailer mounted emergency backup power generators for the Bruecken Pump Station and shall submit to the Department the details of the backup power system and a copy of the SOP that will be added to PWSA'S Emergency Response Plan for use of the backup power system. These two generators currently provide backup power to operate one pump (Pump No. 2, Pump 3 [28 MGD each to Highland Reservoir No. 1], or Pump No. 6 [24 MGD to Highland Reservoir No. 2]). *[No requested date modification; approach modification suggested]*

i. On or before July 31, 2018, PWSA will provide a third interim trailer mounted emergency backup power generator for the Bruecken Pump Station and shall submit to the Department the details of the backup power system and a copy of the SOP that will be added to PWSA'S Emergency Response Plan for use of the backup power system. This third generator will provide backup power to Pump No. 7 [24 MGD to Highland Reservoir No. 2], *[Requested date modification; approach modification suggested]*

ii. On or before December 31, 2017, PWSA will provide emergency backup power for the Bruecken Pump Station and shall submit to the Department the details of the backup power system and a copy of the SOP that will be added to PWSA'S Emergency Response Plan for use of the backup power system.

iii. On or before May 31, 2019, PWSA will provide three permanent emergency backup/stand-by power generators for the Bruecken Pump Station and shall submit to the Department the details of the backup power system and a copy of the SOP that will be added to PWSA'S Emergency Response Plan for use of the backup power system. These three generators will replace the interim trailer mounted generators, providing backup power to run any of the 7 pumps [Pumps No. 1, 2, 3, and 4 to Highland Reservoir No. 1; and Pumps No. 6 and 7 to Highland Reservoir No. 2] *[Requested date modification; approach modification suggested]*

4. Pressure Sensors

a. Subparagraph 4b: Within 90 days of the Department's approval of PWSA's submission, PWSA shall install pressure sensors at each of these locations capable of reporting pressure data to PWSA in real time, which assumes a 30-day permit review cycle by PADEP. Suppliers of the Fluid Conservation Systems (FCS) MultiLog LX2 pressure loggers have stipulated a 4 week lead time on the equipment. Additionally, prior to installation PWSA must install manholes at the proposed monitoring locations, which may involve utility relocation. [*Requested date modification requested.]*

Alan Eichler

PWSA Response to Administrative Order dated October 25, 2017
Proposed Emergency Response Plan Schedules

PWSA sincerely appreciates the advice and assistance provided by PADEP over the past year.

We look forward to working closely with you and the PADEP Team to address the above Emergency Response Plan to provide immediate resilience and backup systems to alleviate our risk of future water system failures.

Our ultimate objective is to restore PWSA's water works to a "best in class" system of which we can all be proud.

Please contact me directly should you have any questions or comments.

Sincerely
Pittsburgh Water and Sewer Authority

Robert A. Weimar
Interim Executive Director

cc:
Ronald Schwartz, PADEP
Renee Diehl, PADEP
Tim McClelland, PADEP
Robin Shaw, ACHD
Barb Grosch, ACHD

PWSA cc:
Faith Wydra, Environmental Compliance Manager
Barry King, Interim Director of Engineering and Construction
Kate Mechler, PWSA Capital Program Manager
Dennis Graham, Project Manager

Exhibit RAW/C-34

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
2	HMM 23-06 Maryland Street Flooding Investigation	2013-930-223-6	MOTT MACDONALD (Capital)	23-06	Other Services	Maryland Street Flooding Investigation
3	HMM 23-08 Forbes Avenue Sewer Extension Feasibilty Study	2013-930-223-8	MOTT MACDONALD (Capital)	23-08	Planning and Design Related	Forbes Avenue Sewer Extension Feasibilty Study
4	Eastside 3 Development	2013-OPS-107-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO00268	Other Services	CONSTRUCTION INSPECTION
5	Bruecken PS Valve Vault Upgrade - Electrical	2013-323-175-2	LANCO ELECTRIC, INC.	PO00631	General Contractor	Bruecken PS Valve Vault Upgrade - Electrical
6	Filter Rehabilitation Project - HVAC	2013-322-176-3	WAYNE CROUSE	PO00655	General Contractor	Filter Rehabilitation Project-HVAC
7	Filter Rehabilitation Project - Electrical	2013-322-176-2	BRONDER TECHNICAL SERVICES (Capital)	PO00862	General Contractor	Filter Rehabilitation Project - Electrical
8	2015 Water Emergency/Relay - Zottola	2013-325-176-0	FRANK J ZOTTOLA CONSTRUCTION, INC. (Capital)	PO01861	General Contractor	Awarded Contractor Bid
9	2015 Pump and Motor Service Contract	2013-OPS-208-0	TOTAL EQUIPMENT COMPANY (Ops)	PO01864	General Contractor	Awarded Contractor Bid
10	e-Builder Implementation Management	2013-930-222-0	E-BUILDER, INC.	PO02106	Other Services	eB additional license
11	2015 Water Emergency/Relay - Zottola	2013-325-176-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO02280	Program Mgt/CM Related	Approved TO value
12	Bruecken PS Valve Vault Upgrade - General	2013-323-175-1	WAYNE CROUSE	PO03092	General Contractor	General Contractor for Bruecken PS
13	Filter Rehabilitation Project - General and Mechanical	2013-322-176-1	WAYNE CROUSE	PO03093	General Contractor	Filter Rehabilitation Project-GC
14	e-Builder Implementation Management	2013-930-222-0	E-BUILDER, INC.	PO03873	Other Services	EB Implementation
15	Centre Ave Storm Sewer Phase 1A	SSI6-424-215-0	A. MERANTE CONTRACTING, INC. (PennVest)	PO04053	General Contractor	LHR Centre Ave Storm Sewer
16	Centre Ave Storm Sewer Phase 1A	SSI6-424-215-0	HATCH ASSOCIATES CONSULTANTS, INC. (PennVest)	PO04054	Program Mgt/CM Related	LHR Centre Ave Storm Sewer-CM
17	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	KTA-TATOR, INC	PO04067	Planning and Design Related	Designer
18	Bruecken PS Valve Vault Upgrade - General	2013-323-175-1	PRINTSCAPE IMAGING & GRAPHICS	PO04363	Other Services	Prints of Specs and Plans
19	Filter Rehabilitation Project - General and Mechanical	2013-322-176-1	PRINTSCAPE IMAGING & GRAPHICS	PO04364	Other Services	Printing of Specs and Plans
20	e-Builder Implementation Management	2013-930-222-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO04671	Program Mgt/CM Related	CIP Management e-Builder
21	Motor and Pump Service Contract	2008-323-42-0	TOTAL EQUIPMENT (Capital)	PO05164	General Contractor	Motor & Pump Services
22	Modifications to the Filter Backwash Recycle System at WTP	2013-322-196-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO09429	Program Mgt/CM Related	CDM Modification Project
23	Filter Rehabilitation Project - Consultant	2013-322-176-0	CDM (Capital)	PO09609	Planning and Design Related	Filter Rehab Project-CDM
24	Filter Rehabilitation Project - Consultant	2013-322-176-0	KTA-TATOR, INC	PO10183	Planning and Design Related	Filter Rehab Project-Design Paint
25	Motor and Pump Service Contract	2008-323-42-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO11630	Program Mgt/CM Related	Motor & Pump Service-CM
26	z_Sandbox - Giuseppe Sciulli	90	MOTT MACDONALD (Capital)	PO12345	Program Mgt/CM Related	TEST COMMITMENT

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
27	2015 Water Emergency/Relay - Zottola	2013-325-176-0	MOTT MACDONALD (Capital)	PO14262	Other Services	HMM23-31_Waterline Relay Surveys
28	Filter Rehabilitation Project - Consultant	2013-322-176-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO14744	Other Services	CE27-58 Embedded Staff Project Manager
29	Route 51 and Route 88 Intersection Improvements	2013-424-162-0	PENNDOT-OFFICE OF CONTROLLER OPS (Capital)	PO15005	General Contractor	PennDot Cost Share - PWSA Portion
30	Red Oak/Hayson GI Demonstration Project	2016-GI-101-0	MOTT MACDONALD (Capital)	PO16123	Other Services	HMM23-58 GI Flow Monitoring
31	Melwood and Finland GI Design and Construction	2016-GI-105-1	MOTT MACDONALD (Capital)	PO16124	Other Services	HMM23-58 flow monitoring at various locations to obtain field data and understanding of pre-GI construction conditions
32	Centre and Herron	2016-GI-104-0	MOTT MACDONALD (Capital)	PO16125	Other Services	HMM23-58 flow monitoring at various locations to obtain field data and understanding of pre-GI construction conditions
33	Hillcrest	2016-GI-103-0	MOTT MACDONALD (Capital)	PO16211	Other Services	HMM23-58 GI Flow Monitoring
34	Negley Run ACOE Design	2016-GI-102-0	US ARMY CORPS OF ENGINEERS	PO16440	Other Services	ACOE Cost Share Agreement
35	Red Oak/Hayson GI Demonstration Project	2016-GI-101-0	INDEPENDENT ENTERPRISES INC (Capital)	PO16772	General Contractor	Awarded Contract Amount
36	2016 Catch Basin Replacement	2016-424-105-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO17015	Program Mgt/CM Related	CE27-75 CM/CI Services
37	HMM 23-01.01 Project Manager Support Services	2013-930-223-1.1	MOTT MACDONALD (Ops)	PO17251	Other Services	HMM23-01.01 PM SUPPORT SERVICES
38	GI Initiative	PWSAGI00	Carnegie Library	PO17291	Other Services	Matching Grant
39	Centre Ave Storm Sewer Phase 1A	SSI6-424-215-0	SPORTS & EXHIBITION AUTHORITY OF ALLEGHENY COUNTY (PennVest)	PO17318	Planning and Design Related	SEA payment through Michael Baker Inc.
40	2016-17 Pump and Motor Service Contract	2016-OPS-115-0	TOTAL EQUIPMENT COMPANY (Ops)	PO19196	General Contractor	Awarded Contract Value
41	GI Initiative	PWSAGI00	STUDENT CONSERVATION ASSOCIATION, INC.	PO19742	Other Services	SCA Intern March 2017 - March 2018
42	2017 Surface Restoration	2017-OPS-105-0	A. FOLINO CONSTRUCTION, INC. (OPS)	PO19744	General Contractor	Awarded Contract Value
43	Clearwell Emergency Response Project	2017-323-100-0	GAI CONSULTANTS INC. (Capital)	PO19875	Planning and Design Related	GAI28-05 TO APPROVED VALUE
44	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	GAI CONSULTANTS INC. (Capital)	PO19876	Planning and Design Related	GAI28-06 TO AWARDED VALUE
45	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	ARCADIS US, INC. (Capital)	PO19879	Planning and Design Related	ARC28-09 APPROVED TO VALUE
46	Hillcrest	2016-GI-103-0	URS CORPORATION (capital)	PO19975	Program Mgt/CM Related	URS27-21/27-13 APPROVED TO VALUE
47	2016-17 Pump and Motor Service Contract	2016-OPS-115-0	URS CORPORATION (OPS)	PO19976	Program Mgt/CM Related	URS27-16 APPROVED TO VALUE
48	2017 Manhole and Point Repair Contract	2016-OPS-119-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO19977	Program Mgt/CM Related	CE27-79 APPROVED TO VALUE
49	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO19982	Program Mgt/CM Related	CE27-82 APPROVED TO VALUE

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
50	Aspinwall Water Treatment Plant Electrical and Backup Power Improvements	2017-322-100-0	WOOD ENVIRONMENTAL & INFRASTRUCTURE, INC. (Capital)	PO20012	Planning and Design Related	AMEC28-14 APPROVED TO VALUE
51	MS4 NPDES Renewal	2016-OPS-118-0	MOTT MACDONALD (Ops)	PO20142	Planning and Design Related	MM23-89 2017 MS4 Plans TO Value
52	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	URS CORPORATION (capital)	PO20299	Planning and Design Related	URS27-18 TO VALUE PM SERVICES
53	Centre Ave Storm Sewer Phase 1A	SSI6-424-215-0	SPORTS & EXHIBITION AUTHORITY OF ALLEGHENY COUNTY (PennVest)	PO20318	Planning and Design Related	SEA payment through Michael Baker Inc. Remaining Disbursement
54	Hillcrest	2016-GI-103-0	MOTT MACDONALD (Capital)	PO20456	Other Services	MM23-82 PM SUPPORT TO VALUE
55	Centre and Herron	2016-GI-104-0	MOTT MACDONALD (Capital)	PO20459	Other Services	MM23-83 PM SUPPORT TO VALUE
56	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO20466	Program Mgt/CM Related	CE27-90 CM/CI TO VALUE
57	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	ARCADIS US, INC. (Capital)	PO20513	Planning and Design Related	ARC28-10 AWARDED TO VALUE
58	Highland Park Membrane Filtration Plant Transformer Repair and UPS Replacement	2017-322-103-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO20611	Planning and Design Related	CE27-91 ENGINEERING SUPPORT AWARDED TO VALUE
59	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO20627	General Contractor	MFP EQUIPMENT AND PARTS
60	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO20629	General Contractor	MFP STARTUP TRAINING
61	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO20630	General Contractor	MFP STARTUP SERVICES
62	Highland Park Membrane Filtration Module Replacement Program	2017-322-105-0	PALL CORPORATION	PO20632	General Contractor	MEMBRANE MODULES
63	31st Ward Sewer System	2017-424-100-0	MOTT MACDONALD (Capital)	PO20775	Other Services	MM23-93 AWARDED TO VALUE PM SUPPORT
64	Lawn and Ophelia Green Infrastructure Project	2017-424-104-0	Sci-Tek Consultants, Inc.	PO20875	Planning and Design Related	Topographic and Utility Survey
65	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	DAMAN-SUPERIOR, LLC	PO20944	Other Services	PROMINENT METERING PUMPS
66	2017 Surface Restoration	2017-OPS-105-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO21070/24039	Program Mgt/CM Related	CM/CI CE27-89 AWARDED TO VALUE
67	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO21071	Planning and Design Related	CE27-99 MFP DESIGN AWARDED TO VALUE
68	EPA 308 PWSA/City of Pittsburgh Source Reduction Response	2017-424-106-0	MOTT MACDONALD (Capital)	PO21115	Program Mgt/CM Related	MM23-97 EPA 308 RESPONSE TO VALUE

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
69	2017 Hydrant Replacement	2017-325-102-0	INDEPENDENT ENTERPRISES INC (Capital)	PO21130	General Contractor	Awarded Contract Value-IEI
70	2017 Valve Replacement	2017-325-104-0	INDEPENDENT ENTERPRISES INC (Capital)	PO21135	General Contractor	Awarded Contract Value-IEI
71	2017 Catch Basin and Inlet Replacement - Facchiano	2017-424-102-0	MICHAEL FACCHIANO CONTRACTING	PO21138	General Contractor	Awarded Contract Value
72	Highland Park Membrane Filtration Plant Transformer Repair and UPS Replacement	2017-322-103-0	FRANKL ELECTRIC, INC. (Capital)	PO21139	General Contractor	Awarded Contract Value-Frankl Electric
73	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO21186	General Contractor	Membrane Rack Strainers
74	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO21310	Other Services	CE27-103 On-Site Facility Improvements Support
75	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO21448	Other Services	CE27-102 PM SUPPORT (GRAHAM) APPROVED TO VALUE
76	2015 Pump and Motor Service Contract	2013-OPS-208-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO21491	Other Services	CE27-119 PM SUPPORT (D. GRAHAM)
77	Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	2017-322-102-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO21492	Other Services	CE27-92 PM SUPPORT (D. GRAHAM) & DESIGN APPROVED TO VALUE
78	Filter Rehabilitation Project - Consultant	2013-322-176-0	URS CORPORATION (capital)	PO21584	Program Mgt/CM Related	URS27-23 CM AWARDED TO VALUE
79	2017 Catch Basin and Inlet Replacement - Facchiano	2017-424-102-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO21588	Program Mgt/CM Related	CE27-117 CM/CI AWARDED TO VALUE
80	2018 Raftelis Professional Services	2018-OPS-104-0	RAFTELIS FINANCIAL CONSULTANTS (Ops)	PO21741	Other Services	PROFESSIONAL SERVICE AGREEMENT
81	Melwood and Finland GI Design and Construction	2016-GI-105-1	A. FOLINO CONSTRUCTION, INC. (Capital)	PO21749	General Contractor	A. FOLINO-AWARDED CONTRACT VALUE
82	Larimer-East Liberty Redevelopment Phase 2	2017-OPS-109-0	URS CORPORATION (OPS)	PO21752	Program Mgt/CM Related	URS27-30 CM/CI AWARDED TO VALUE
83	Locust Street 8 Waterline Relocation	2017-OPS-118-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO21769	Program Mgt/CM Related	CE27-118 CM/CI AWARDED TO VALUE
84	Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	2017-322-102-0	ADVANCED FIBERGLASS SERVICES (Capital)	PO21868	Other Services	4 FRP Tanks Inspections
85	Panther Hollow Lake Flood Mitigation	2017-OPS-100-0	OptiRTC, Inc.	PO21878	Other Services	GI MONITORING
86	Filter Rehabilitation Project - Consultant	2013-322-176-0	MOTT MACDONALD (Capital)	PO22086	Planning and Design Related	MM23-99 AWARDED TO VALUE
87	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	URS CORPORATION (capital)	PO22093	Program Mgt/CM Related	URS27-25 CM SRVCS AWARDED TO VALUE
88	Melwood and Finland GI Design and Construction	2016-GI-105-1	URS CORPORATION (capital)	PO22166	Program Mgt/CM Related	URS27-26 CM/CI AWARDED TO VALUE
89	SMR Intergrated Watershed Management Watershed Plan-Phase I & II	2013-930-223-11	MOTT MACDONALD (Ops)	PO22595	Other Services	MM23-102 SMR IWM PH. 2 AWARDED TO VALUE

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
90	2016 Water System Hydraulic Model	2016-325-103-0	MOTT MACDONALD (Ops)	PO22597	Planning and Design Related	MM23-103 AWARDED TO VALUE
91	McKinley Park - Chicken Hill	2017-424-112-0	PITTSBURGH PARKS CONSERVANCY (Capital)	PO22607	Planning and Design Related	IMPLEMENT STORMWATER MGMT COMPONENTS
92	Lanpher Reservoir Improvements	2017-323-105-0	ARCADIS US, INC. (Capital)	PO22608	Planning and Design Related	ARC28-13 DESIGN AWARDED TO VALUE
93	Centre and Herron	2016-GI-104-0	WOOD ENVIRONMENTAL & INFRASTRUCTURE, INC. (Capital)	PO22630	Planning and Design Related	AMEC28-16 DESIGN AWARDED TO VALUE
94	Melwood and Finland GI Design and Construction	2016-GI-105-1	ARCADIS US, INC. (Capital)	PO22631	Planning and Design Related	ARC28-11 DESIGN AWARDED TO VALUE
95	Lanpher Rising Main Repair	2017-323-103-0	GRAINGER (Ops)	PO22759	Other Services	COMPRESSOR PARTS
96	Lanpher Reservoir Improvements	2017-323-105-0	Univar USA, Inc. (Ops)	PO22788	Other Services	SODIUM HYPOCHLORITE & BISULFITE
97	2018 Sewer Reconstruction	2017-424-111-0	MOTT MACDONALD (Capital)	PO22789	Other Services	MM23-104 PM SRVCS-KYLE HOOD
98	2016-17 Pump and Motor Service Contract	2016-OPS-115-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO22802	Other Services	CE27-125 PM SRVCS AWARDED TO VALUE-GRAHAM
99	Lanpher Reservoir Improvements	2017-323-105-0	Mr. John (Ops)	PO22810	Other Services	Mr. John Rentals
100	Filter Rehabilitation Project - Consultant	2013-322-176-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO22936	Program Mgt/CM Related	CE27-127 PM SUPPORT AWARDED TO VALUE
101	2018 Manhole and Point Repair	2017-424-114-0	FRANK J. ZOTTOLA CONSTRUCTION, INC. (OPS)	PO22954	General Contractor	AWARDED CONTRACT VALUE
102	Smallman Street Reconstruction	2017-424-113-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO23096	Program Mgt/CM Related	CE27-126 AWARDED TO VALUE
103	Aspinwall and MFP Fiberglass Reinforced Plastic Chemical Tank Inspections and Repairs/Replacement	2017-322-102-0	ADVANCED FIBERGLASS SERVICES (Capital)	PO23143	Other Services	LINER INSTALL AND INTERIOR SURFACE INSTALL
104	Larimer Avenue Sewer and 28th Street Slope Stabilization	2016-424-102-0	WOOD ENVIRONMENTAL & INFRASTRUCTURE, INC. (Capital)	PO23172	Planning and Design Related	AMEC28-18 AWARDED TO VALUE (DESIGN)
105	Red Oak/Hayson GI Demonstration Project	2016-GI-101-0	MOTT MACDONALD (Ops)	PO23247	Other Services	MM23-98 POST MONITORING AWARDED TO VALUE
106	Woods Run Stream Inflow - Mairdale Avenue	2017-424-108-0	Civil & Environmental Consultants, Inc. (Capital)	PO23405	Planning and Design Related	CEC00-01 DESIGN SERVICES AWARDED
107	2018 Sewer Reconstruction	2017-424-111-0	G. Stephens, Inc. (Capital)	PO23406	Program Mgt/CM Related	GSI00-01 CM/CI AWARDED TO VALUE
108	Maryland Avenue Green Infrastructure Project	2017-424-101-0	G. Stephens, Inc. (Capital)	PO23454	Program Mgt/CM Related	GSI00-06 CONST REVIEW AWARDED TO VALUE
109	Lanpher Reservoir Improvements	2017-323-105-0	MOTT MACDONALD (Capital)	PO23497	Program Mgt/CM Related	MM23-105 PM SUPPORT AWARDED TO VALUE
110	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO23536	Planning and Design Related	JMT00-01 DESIGN AWARDED TO VALUE
111	PWSA00 G. Stephens, Inc. CM Core Team	2017-OPS-125-0	G. Stephens, Inc. (Ops)	PO23544	Program Mgt/CM Related	GSI00-02 CM OVERSIGHT AWARDED TO VALUE
112	PWSA27 AECOM/URS CM Core Team	2016-OPS-121-0	URS CORPORATION (OPS)	PO23547	Program Mgt/CM Related	URS27-33 2018 CM OVERSIGHT AWARDED TO VALUE
113	PWSA23 MM Embedded Staff	2016-OPS-120-1	MOTT MACDONALD (Ops)	PO23589	Program Mgt/CM Related	MM23-108 2018 EOR AWARDED TO VALUE

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
114	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO23590	Program Mgt/CM Related	CE27-128 CM/CI SRVCS AWARDED TO VALUE
115	2018 Raftelis Professional Services	2018-OPS-104-0	RAFTELIS FINANCIAL CONSULTANTS (Ops)	PO23669	Other Services	PERFORMANCE IMPROVEMENT
116	Operation Engineering	2016-OPS-109-0	MOTT MACDONALD (Ops)	PO23718	Other Services	MM23-107 2018 INT. DIR OF ENGINEERING- KING
117	2018 Manhole and Point Repair	2017-424-114-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO23790	Program Mgt/CM Related	CE27-131 CM/CI AWARDED TO VALUE
118	Lanpher Reservoir Improvements	2017-323-105-0	URS CORPORATION (OPS)	PO23897	Program Mgt/CM Related	URS27-28 CM/CI AWARDED TO VALUE
119	2018 Curb Box Inspection Contract	2017-325-106-0	URS CORPORATION (capital)	PO23967	Other Services	URS27-32 PM SPPT AWARDED TO VALUE
120	Permits and Compliance Reports	2016-OPS-110-0	MOTT MACDONALD (Ops)	PO23975	Program Mgt/CM Related	MM23-111 TO VALUE PERMITTING SUPPORT
121	Lanpher Reservoir Improvements	2017-323-105-0	MOTT MACDONALD (Capital)	PO24021	Planning and Design Related	MM23-113 PM SPPT- G. HORN AWARDED TO VALUE
122	Lanpher Reservoir Improvements - Retaining Wall and Parapet Wall Improvements	2017-323-105-1	FRANK J ZOTTOLA CONSTRUCTION, INC. (Capital)	PO24026	General Contractor	AWARDED CONTRACT VALUE
123	Clearwell Emergency Response Project	2017-323-100-0	MOTT MACDONALD (Capital)	PO24125	Other Services	MM23-112 PM SUPPORT AWARDED TO VALUE
124	2015 Pump and Motor Service Contract	2013-OPS-208-0	URS CORPORATION (OPS)	PO24135	Program Mgt/CM Related	URS27-22 CM/CI AWARDED TO VALUE
125	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	MOTT MACDONALD (Capital)	PO24138	Other Services	MM23-114 PM SPPT AWARDED TO VALUE
126	Lanpher Reservoir Improvements - West and East Cell Cover and Liner Replacement	2017-323-105-2	Layfield USA Corp. (Capital)	PO24171	General Contractor	AWARDED CONTRACT VALUE
127	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	KROHNE (Capital)	PO24188	Other Services	Krohne Converter and Flowtube
128	Centre and Herron	2016-GI-104-0	WOOD ENVIRONMENTAL & INFRASTRUCTURE, INC. (Capital)	PO24278	Planning and Design Related	AMEC28-20 DESIGN BUDGET INCREASE
129	Aspinwall Water Treatment Plant Electrical and Backup Power Improvements	2017-322-100-0	MOTT MACDONALD (Capital)	PO24347	Program Mgt/CM Related	MM23-116 PM SRVCS AWARDED TO VALUE
130	Lanpher Reservoir Improvements - West and East Cell Cover and Liner Replacement	2017-323-105-2	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO24409	Program Mgt/CM Related	CE27-140 CM/CI AWARDED TO VALUE
131	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	F.N. Cuthbert, Inc. (Capital)	PO24415	Other Services	TANK HEATER
132	Wightman Park GI Project	2017-424-105-0	ethos collaborative (capital)	PO24416	Planning and Design Related	EC00-01 DSGN SRVCS AWARDED TO VALUE
133	2018 Lead Service Line Replacement Program	2018-325-100-0	120 Water Audit, LLC (Capital)	PO24629	Other Services	LEAD SAMPLE TESTING CONTRACT
134	2018 Lead Service Line Replacement Program	2018-325-100-0	MOTT MACDONALD (Capital)	PO24665	Program Mgt/CM Related	MM23-117 LEAD INVENTORY SRVCS AWARDED TO VALUE

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
135	2018 Lead Service Line Replacement Program	2018-325-100-0	MOTT MACDONALD (Capital)	PO24666	Program Mgt/CM Related	MM23-118 2018 LEAD PROG SPPT AWARDED TO VALUE
136	Smallman Street Reconstruction	2017-424-113-0	Independence Excavating, Inc. (Capital)	PO24708	General Contractor	AWARDED CONTRACT VALUE
137	Stormwater Program Implementation	2018-GI-100-0	MICHAEL BAKER, INC. (Ops)	PO24711	Planning and Design Related	MBI00-02 SW IMPLEMENTATION AWARDED TO VALUE
138	2018 Sewers Under Structures	2017-424-110-0	MICHAEL BAKER, INC. (Capital)	PO24785	Planning and Design Related	MBI00-03 ENG SRVCS AWARDED TO VALUE
139	2018 Curb Box Inspection Contract	2017-325-106-0	MICHAEL BAKER, INC. (Capital)	PO24792	Other Services	MBI00-01 GPS AWARDED TO VALUE
140	2018 Curb Box Inspection Contract	2017-325-106-0	L/B WATER SERVICE, INC.	PO24828	Other Services	B & T REPLACEMENT LIDS
141	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	FLOWNETWORX, INC/dba 540 TECHNOLOGIES (Capital)	PO24844	Other Services	PRESSURE LOGGERS
142	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	Vepo Metering, LLC. (Capital)	PO24867	Other Services	PRESSURE SENSORS
143	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	L/B WATER SERVICE, INC.	PO24868/PO26318	Other Services	WATER METER CROCK
144	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	Civil & Environmental Consultants, Inc. (Capital)	PO24953	Planning and Design Related	DESIGN AWARDED CONTRACT VALUE PH. 1
145	2018 Lead Service Line Replacement Program	2018-325-100-0	East Woods Consultants. LLC (Capital)	PO24966	Program Mgt/CM Related	2018 LEAD PRGM MANAGER CONSULTING SRVCS CT
146	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	MOTT MACDONALD (Capital)	PO24970	Program Mgt/CM Related	MM23-119 PM SRVCS CONT. - BOLENBAUGH
147	2018 Urgent Water Repair - A. Folino	2018-OPS-100-0	A. FOLINO CONSTRUCTION, INC. (OPS)	PO24983	General Contractor	AWARDED CONTRACT VALUE
148	2018 Urgent Water Repair - Zottola	2018-OPS-100-1	FRANK J. ZOTTOLA CONSTRUCTION, INC. (OPS)	PO24984	General Contractor	AWARDED CONTRACT VALUE
149	2018 Lead Service Line Replacement Program	2018-325-100-0	Compliance Management International (Capital)	PO24988	Other Services	PWSA77- ADDITIONAL WORK SAFETY SUPPORT
150	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	CDM SMITH, INC.	PO25104	Planning and Design Related	CDM00-02 DESIGN AWARDED TO VALUE
151	Smallman Street Reconstruction	2017-424-113-0	PRINTSCAPE IMAGING & GRAPHICS	PO25173	Other Services	SIGNAGE
152	2017 Surface Restoration	2017-OPS-105-0	PARKING LOT PAINTING COMPANY (OPS)	PO25176	Other Services	Line Painting (Non-CD) Piggyback 5/14/18-12/31/18
153	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	Air Technologies (Capital)	PO25192	Other Services	AIR COMPRESSOR/MOTOR REBUILD AND INSTALL
154	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	CDE/Mosbach Electric (Capital)	PO25206	Other Services	ROCKWELL SCADA SYSTEMS
155	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	GAI CONSULTANTS INC. (Capital)	PO25283	Planning and Design Related	GAI28-09 FINAL DESIGN AWARDED TO VALUE
156	2017 Surface Restoration	2017-OPS-105-0	PARKING LOT PAINTING COMPANY (OPS)	PO25289	Other Services	Line Painting (CD) Piggyback 5/14/18-12/31/18

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
157	2018 Lead Service Line Replacement Program	2018-325-100-0	G. Stephens, Inc. (Capital)	PO25337	Program Mgt/CM Related	GSI00-05 PRJ CNTRLS AWARDED TO VALUE
158	Aspinwall Pump Station to Lanpher Reservoir Rising Main	2018-323-100-0	ARCADIS US, INC. (Capital)	PO25338	Other Services	ARC28-15 RFP PREP AWARDED TO VALUE
159	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	MOTT MACDONALD (Capital)	PO25340	Planning and Design Related	MM23-120 ENG SRVCS AWARDED TO VALUE
160	Clearwell Emergency Response Project	2017-323-100-0	ARCADIS US, INC. (Capital)	PO25363	Other Services	ARC28-14 MODELING AWARDED TO VALUE
161	Panther Hollow Lake Flood Mitigation	2017-OPS-100-0	Jase Construction Services, LLC (Ops)	PO25376	Other Services	RETROFIT INSTALLATION
162	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	XYLEM DEWATERING SOLUTIONS, INC.	PO25386	Other Services	PUMPS PURCHASE AND ACCESSORIES
163	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	Primary Flow Signal, Inc. (Capital)	PO25417	Other Services	VENTURI FLOW METERS INSPECTIONS
164	2018 Lead Service Line Replacement Program	2018-325-100-0	Cintas Corporation (Capital)	PO25431	Other Services	BOOTS-D. MATRANO
165	Aspinwall Rail Spur Replacement	2018-OPS-103-0	MOTT MACDONALD (Ops)	PO25465	Program Mgt/CM Related	MM23-122 PM SUPPORT AWARDED TO VALUE
166	Smallman Street Reconstruction	2017-424-113-0	ABC Transit Inc. (Capital)	PO25473	Other Services	SHUTTLE SERVICE TO/FROM PRKING LOT
167	Aspinwall Rail Spur Replacement	2018-OPS-103-0	MOTT MACDONALD (Ops)	PO25479	Planning and Design Related	MM23-123 DSDC AWARDED TO VALUE
168	2018 Lead Service Line Replacement Program - A. Merante	2018-325-100-5	A. MERANTE CONTRACTING, INC. (Capital)	PO25494	General Contractor	AWARDED CONTRACT VALUE
169	Maryland Avenue Green Infrastructure Project	2017-424-101-0	BUCHART HORN, INC. (Capital)	PO25508	Planning and Design Related	BH28-08 FINAL DESIGN SRVCS TO VALUE
170	Smallman Street Reconstruction	2017-424-113-0	PRINTSCAPE IMAGING & GRAPHICS	PO25553	Other Services	SHUTTLE SIGN INSERTS
171	2018 Lead Service Line Replacement Program	2018-325-100-0	120 Water Audit, LLC (Capital)	PO25562	Other Services	PWSA99 IFB AWARD FOR FILTERS/PITCHERS
172	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	CDW GOVERNMENT	PO25596	Other Services	WIRELESS AIRLINK AND VPN ROUTER
173	2018 Urgent Sewer Repair - Independent	2018-OPS-102-0	INDEPENDENT ENTERPRISES, INC. (OPS)	PO25605	General Contractor	CONTRACT AWARD
174	2018 Urgent Sewer Repair - A. Folino	2018-OPS-102-1	A. FOLINO CONSTRUCTION, INC. (OPS)	PO25606	General Contractor	CONTRACT AWARD
175	2018 Urgent Water Repair - Zottola	2018-OPS-100-1	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO25615	Program Mgt/CM Related	CE27-144 CM/CI AWARDED TO VALUE
176	2018 Urgent Water Repair - A. Folino	2018-OPS-100-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO25618	Program Mgt/CM Related	CE27-143 CM/CI AWARDED TO VALUE
177	2017 Surface Restoration	2017-OPS-105-0	LINDY PAVING, INC.	PO25619	Other Services	MATERIALS PIGGYBACK JUN 2018-FEB 2019
178	2018 Lead Service Line Replacement Program - A. Merante	2018-325-100-5	URS CORPORATION (capital)	PO25623	Program Mgt/CM Related	URS27-43 CM/CI AWARDED TO VALUE
179	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	WAYNE CROUSE	PO25641	General Contractor	CONTRACT AWARD
180	2018 Catch Basin Replacement - Independent	2018-424-101-0	INDEPENDENT ENTERPRISES INC (Capital)	PO25672	General Contractor	CONTRACT AWARD

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
181	2018 Catch Basin Replacement - A. Folino	2018-424-101-1	A. FOLINO CONSTRUCTION, INC. (Capital)	PO25673	General Contractor	CONTRACT AWARD
182	Lanpher Reservoir Improvements	2017-323-105-0	United Rentals (Capital)	PO25725	Other Services	STANDBY GENERATOR AT ASPINWALL PS
183	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO25742	Planning and Design Related	JMT00-04 DSGN 2 AWARDED TO VALUE
184	2018 Lead Service Line Replacement Program	2018-325-100-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO25793	Program Mgt/CM Related	CE27-145 GPS AWARDED TO VALUE
185	Wightman Park GI Project	2017-424-105-0	ethos collaborative (capital)	PO25794	Planning and Design Related	EC00-03 FINAL DESIGN AWARDED TO VALUE
186	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	TOTAL EQUIPMENT (Capital)	PO25881	General Contractor	ORTHO PHOSPHATE LONG LEAD ITEMS
187	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO25900	Planning and Design Related	JMT00-05 CONSTRUCT REVIEW AWARDED TO VALUE
188	Lawn and Ophelia Green Infrastructure Project	2017-424-104-0	ethos collaborative (capital)	PO25901	Planning and Design Related	EC00-02 DESIGN AWARDED TO VALUE
189	Permits and Compliance Reports	2016-OPS-110-0	URS CORPORATION (OPS)	PO25970	Other Services	URS27-42 PERFORMANCE EVAL AWARDED TO VALUE
190	Aspinwall Rail Spur Replacement	2018-OPS-103-0	Rhinehart Railroad Construction, Inc. (Ops)	PO26021	General Contractor	CONTRACT AWARD-PIGGYBACK
191	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	Hach Company (Capital)	PO26022	Other Services	USB + POWER MODULE & CALIBRATION KIT
192	2018 Water Relay	2018-325-101-0	MICHAEL FACCHIANO CONTRACTING	PO26033	General Contractor	CONTRACT AWARD
193	2018 Catch Basin Replacement - Independent	2018-424-101-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO26075	Program Mgt/CM Related	JMT00-06 CM/CI/GPS AWARDED TO VALUE
194	2018 Catch Basin Replacement - A. Folino	2018-424-101-1	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO26076	Program Mgt/CM Related	JMT00-07 CM/CI/GPS AWARDED TO VALUE
195	2018 Small Diameter Sewer Rehabilitation (IDIQ)	2018-424-100-0	INSITUFORM TECHNOLOGIES	PO26083	General Contractor	CONTRACT AWARD
196	PWSA23 Program Management Core Team	2016-OPS-120-0	MOTT MACDONALD (Ops)	PO26084	Program Mgt/CM Related	Program Management Core Team-Option Year 2 FINAL
197	2018 Urgent Sewer Repair - Independent	2018-OPS-102-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO26148	Program Mgt/CM Related	CE27-146 CM/CI AWARDED TO VALUE
198	2018 Urgent Sewer Repair - A. Folino	2018-OPS-102-1	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO26149	Program Mgt/CM Related	CE27-147 CM/CI AWARDED TO VALUE
199	PWSA Development of the PUC-Required Long-Term Infrastructure Improvement Plan (LTIIP)	2018-325-102-0	MOTT MACDONALD (Capital)	PO26343	Program Mgt/CM Related	MM23-127 PRG MGMT SRVCS AWARDED TO VALUE
200	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO26391	Program Mgt/CM Related	CE27-149 CM/CI AWARDED TO VALUE
201	Smallman Street Reconstruction	2017-424-113-0	THE BUNCHER COMPANY	PO26415	Other Services	REMOVAL OF OUTDOOR ADVERTISEMENT
202	Smallman Street Reconstruction	2017-424-113-0	COMMONWEALTH OF PENNSYLVANIA C/O DEP (DEPT.ENVIRONMENTAL PROTEC.	PO26441	Other Services	WQM PERMIT-SEWAGE (DEP)
203	Lanpher Reservoir Improvements	2017-323-105-0	Univar USA, Inc. (Capital)	PO26485	Other Services	SODIUM BISULFITE
204	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO26493	Program Mgt/CM Related	CE27-151 PM SRVCS AWARDED TO VALUE

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
205	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO26495	Other Services	CE27-152 PM SRVCS AWARDED TO VALUE
206	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	MOTT MACDONALD (Capital)	PO26498	Program Mgt/CM Related	MM23-121 TREAT-ABILITY STUDIES AWARDED TO VALUE
207	Aspinwall Rail Spur Replacement	2018-OPS-103-0	G. Stephens, Inc. (Ops)	PO26525	Program Mgt/CM Related	GSI00-07 CM/CI AWARDED TO VALUE
208	2018 Small Diameter Sewer Rehabilitation (IDIQ)	2018-424-100-0	G. Stephens, Inc. (Capital)	PO26551	Program Mgt/CM Related	GSI00-08 CM/CI AWARDED TO VALUE
209	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO26559	Other Services	CE27-150 PM SERVICES AWARDED TO VALUE 2/1/18-3/8/19
210	PWSA Program Management Service	2018-325-103-0	MOTT MACDONALD (Capital)	PO26595	Program Mgt/CM Related	MM23-126 PWSA PROGRAM MGMT SERVICES
211	2018 Water Relay	2018-325-101-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO26597	Program Mgt/CM Related	CE27-153 CM/CI AWARDED TO VALUE
212	Forbes Avenue (SR 2108/2308) Betterment Project	2018-WS-100-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO26648	Program Mgt/CM Related	JMT00-08 CM/CI/GPS AWARDED TO VALUE
213	2018 Sewer Reconstruction	2017-424-111-0	Columbia Gas of PA (Capital)	PO26684	Other Services	COLUMBIA GAS COST SHARE FOR SURFACE RESTORATION
214	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	COMMONWEALTH OF PENNSYLVANIA C/O DEP (DEPT.ENVIRONMENTAL PROTEC.	PO26717	Other Services	PERMIT APP FEE/DEP
215	PWSA27 Chester CM Core Team	2017-OPS-103-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO26775	Program Mgt/CM Related	CE27-157 OUTSTANDING INVOICES RECONCILE
216	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	ARCADIS US, INC. (Capital)	PO26784	Planning and Design Related	ARC28-18 DESGN SRVCS & CARBON SYSTEM IMPROVEMENTS
217	Covode Place Slope	2018-OPS-106-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO26786	Other Services	CE27-156 RESTORE SRVCS AWARDED TO VALUE
218	Lanpher Reservoir Improvements - Electrical for Rainwater Removal Pumps	2017-323-105-3	FRANKL ELECTRIC, INC. (Capital)	PO26850	General Contractor	CONTRACT AWARD
219	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	ARCADIS US, INC. (Capital)	PO26914	Planning and Design Related	ARC28-16 DESIGN AWARDED TO VALUE
220	Water Treatment Plant Roof Replacement	2018-322-101-0	URS CORPORATION (capital)	PO26928	Program Mgt/CM Related	URS27-44 CM/CI AWARDED TO VALUE
221	Ross Pump Station	2018-323-101-0	ARCADIS US, INC. (Capital)	PO26975	Planning and Design Related	ARC28-20 CONDITION ASSESSMENT AWARDED TO VALUE
222	Almono Mill Street Project	2017-OPS-106-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO26986	Program Mgt/CM Related	CE27-155 CM/CI AWARDED TO VALUE
223	Thomas and McPherson Green Infrastructure	2018-GI-106-0	Wade Trim, Inc. (Capital)	PO26989	Planning and Design Related	WT00-02 DESIGN AWARDED TO VALUE
224	2018 Lead Service Line Replacement Program	2018-325-100-0	Cintas Corporation (Capital)	PO27085	Other Services	BOOTS FOR ERNY AND BERGH
225	Lanpher Reservoir Improvements - Electrical for Rainwater Removal Pumps	2017-323-105-3	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO27185	Program Mgt/CM Related	CE27-162 CM/CI AWARDED TO VALUE
226	2016 Forbes/Darlington	2016-424-107-0	GAI CONSULTANTS INC. (Capital)	PO27215	Planning and Design Related	GAI28-10 DESIGN SRVCS AWARDED TO VALUE

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
227	Aspinwall Pump Station to Lanpher Reservoir Rising Main	2018-323-100-0	MOTT MACDONALD (Capital)	PO27216	Program Mgt/CM Related	MM23-125 PM SERVICES AWARDED TO VALUE
228	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	G. Stephens, Inc. (Capital)	PO27219	Other Services	GSI00-09 PM SUPPORT AWARDED TO VALUE
229	Volunteer's Field Green Infrastructure	2018-GI-104-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO27223	Planning and Design Related	JMT00-12 DESIGN AWARDED TO VALUE
230	SMR Streambank Stabilization Project	2018-GI-107-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO27225	Planning and Design Related	JMT00-11 DESIGN AWARDED TO VALUE
231	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO27299	Other Services	CE27-160 CONSTRUCTABILITY REVIEW AWARDED TO VALUE
232	PennDOT SR0837-A42 E Carson St	2018-WS-103-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO27300	Program Mgt/CM Related	JMT00-10 CM/CI/GPS AWARDED TO VALUE
233	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	Alphagraphics (Capital)	PO27304	Other Services	POST CARDS FOR COMMUNITY MEETING ON 11/4
234	Hillcrest	2016-GI-103-0	Vigliotti Landscape & Construction, Inc.	PO27314	Other Services	CONCRETE REPAIRS
235	2018 Individual Lead Service Line Replacement Contract - Independent	2018-325-100-7	INDEPENDENT ENTERPRISES INC (Capital)	PO27329	General Contractor	CONTRACT AWARD
236	Stormwater Program Implementation	2018-GI-100-0	MICHAEL BAKER, INC. (Ops)	PO27333	Other Services	SURFACE MAPPING CONTRACT AWARD
237	Lanpher Reservoir Improvements	2017-323-105-0	MARION HILL ASSOCIATES, INC.	PO27344	Other Services	CONCRETE PATCHING
238	Bruecken Pump Station Upgrade - Consultant	2013-323-175-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO27428	Planning and Design Related	CE27-163 DSDC AWARDED TO VALUE
239	M-29 Outfall Improvements	2018-424-103-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO27457	Planning and Design Related	JMT00-13 DESIGN SRVCS AWARDED TO VALUE
240	Woods Run Stream Inflow - Mairdale Avenue	2017-424-108-0	Civil & Environmental Consultants, Inc. (Capital)	PO27494	Planning and Design Related	CEC00-03 FINAL DESIGN AWARDED TO VALUE
241	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	MICHAEL BAKER, INC. (Capital)	PO27508	Planning and Design Related	MBI00-05 3RD PTY RVW AWARDED TO VALUE
242	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	ARCADIS US, INC. (Capital)	PO27509	Planning and Design Related	ARC28-17 DESIGN SRVCS AWARDED TO VALUE
243	Highland Reservoir Pump Station and Rising Main	2017-323-101-0	CDM (Capital)	PO27510	Planning and Design Related	CDM00-03 PRELIM DESIGN AWARDED TO VALUE
244	Aspinwall WTP Raw Water Intakes	2018-322-100-0	ARCADIS US, INC. (Capital)	PO27515	Planning and Design Related	ARC28-19 DESIGN SRVCS AWARDED TO VALUE
245	Hillcrest	2016-GI-103-0	Atlantic Construction Fabrics, Inc. (Capital)	PO27562	Other Services	BEEHIVE OVERFLOW FILTERS AND BAGS
246	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO27644	Program Mgt/CM Related	CE27-165 CM/CI AWARDED TO VALUE
247	Woodland Drive Green Infrastructure	2018-GI-108-0	Civil & Environmental Consultants, Inc. (Capital)	PO27648	Planning and Design Related	CEC00-02 DESIGN SRVCS AWARDED TO VALUE
248	M-29 Outfall Improvements	2018-424-103-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO27654	Planning and Design Related	JMT00-14 FINAL DESIGN AWARDED TO VALUE
249	Maryland Avenue Green Infrastructure Project	2017-424-101-0	MS CONSULTANTS, INC.	PO27670	Planning and Design Related	THIRD PARTY REVIEW
250	Maryland Avenue Green Infrastructure Project	2017-424-101-0	eDesign Dynamics, LLC (Capital)	PO27680	Planning and Design Related	THIRD PARTY REVIEW

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
251	31st Ward Sewer System	2017-424-100-0	BUCHART HORN, INC. (Capital)	PO27747	Planning and Design Related	BH28-10 FINAL DESIGN AWARDED TO VALUE
252	Filter Rehabilitation Project - Consultant	2013-322-176-0	MOTT MACDONALD (Capital)	PO27751	Other Services	MM23-131 VIBRATION EVALUATION AWARDED TO VALUE
253	Maryland Avenue Green Infrastructure Project	2017-424-101-0	Alphagraphics (Capital)	PO27820	Other Services	Print and Mailing supplies for updated project
254	Maryland Avenue Green Infrastructure Project	2017-424-101-0	MICHAEL BAKER, INC. (Capital)	PO27888	Planning and Design Related	MBI00-06 3RD PTY REVIEW AWARDED TO VALUE
255	Maytide Storm and Sanitary Sewer Improvements	2017-424-109-0	Wade Trim, Inc. (Capital)	PO27947	Planning and Design Related	WT00-03 FINAL DESIGN AWARDED TO VALUE
256	Smallman Street Reconstruction	2017-424-113-0	COMMONWEALTH OF PENNSYLVANIA C/O DEP (DEPT.ENVIRONMENTAL PROTEC.	PO27961	Other Services	WQM Permit- Sewage (DEP)
257	Highland Reservoir Pump Station and Rising Main	2017-323-101-0	MOTT MACDONALD (Capital)	PO28030	Planning and Design Related	MM23-129 DESIGN SERVICES
258	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	ARCADIS US, INC. (Capital)	PO28105	Planning and Design Related	ARC28-21 Clarifier No 2 and No 4 for Improvements/Design Services
259	2019 Small Diameter Sewer Rehabilitation (Defined Sites)	2019-424-100-0	MOTT MACDONALD (Capital)	PO28116	Planning and Design Related	MM23-133 PM Services
260	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	TOTAL EQUIPMENT (Capital)	PO28207	General Contractor	ORTHO PHOSPHATE CONSTRUCTION CONTRACT
261	PWSA23 MM Embedded Staff	2016-OPS-120-1	MOTT MACDONALD (Ops)	PO28217	Program Mgt/CM Related	MM23-134 MM EMBEDDED STAFF 2019 (T BATRONEY)
262	Aspinwall WTP Raw Water Intakes	2018-322-100-0	MOTT MACDONALD (Capital)	PO28218	Program Mgt/CM Related	MM23-136 PM SERVICES
263	Ross Pump Station	2018-323-101-0	MOTT MACDONALD (Capital)	PO28235	Program Mgt/CM Related	MM23-135 PM SERVICES FOR ROSS PUMP STATION
264	2019 Lead Service Line Replacement Program	WSI9-325-100-0	MOTT MACDONALD (PennVest)	PO28238	Program Mgt/CM Related	MM23-141 PROGRAM MANAGEMENT SERVICES
265	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO28289	Other Services	FIELD SERVICES
266	2019 Lead Service Line Replacement Program	WSI9-325-100-0	Compliance Management International (Penn Vest)	PO28294	Other Services	SAFETY AUDITS
267	2019 Lead Service Line Replacement Program	WSI9-325-100-0	East Woods Consultants. LLC (Penn Vest)	PO28297	Program Mgt/CM Related	2019 Lead Service Line Replacement Professional Services
268	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO28333	Program Mgt/CM Related	CE27-166 Constructability Review /Cost Estimate
269	2019 Lead Service Line Replacement Program	WSI9-325-100-0	G. Stephens, Inc. (Penn Vest)	PO28334	Program Mgt/CM Related	GSI00-10 CONSULTING SERVICES FOR 2019 LSLR PROGRAM
270	2019 Lead Service Line Replacement Program	WSI9-325-100-0	Koryak Consulting, Inc. (Penn Vest)	PO28366	Program Mgt/CM Related	Maintenance and Support for the lead service line replacement
271	St. Johns Stormwater Management Project	2019-424-101-0	ethos collaborative (capital)	PO28469	Planning and Design Related	EC00-05 Preliminary Design for St. John's Project
272	2019 Lead Service Line Replacement Program	WSI9-325-100-0	AECOM TECHNICAL SERVICES, INC. (Penn Vest)	PO28480	Program Mgt/CM Related	URS27-47 Arc-GIS Data Collector App Maintenance

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
273	2019 Lead Service Line Replacement Program	WSI9-325-100-0	AECOM TECHNICAL SERVICES, INC. (Penn Vest)	PO28487	Program Mgt/CM Related	URS27-48 CM Services
274	2019 Lead Service Line Replacement Program (Petrakis) -2	WSI9-325-100-2	AECOM TECHNICAL SERVICES, INC. (Penn Vest)	PO28495	Program Mgt/CM Related	URS27-49 CM/CI Services for 2019 LSLR Program
275	2019 Lead Service Line Replacement Program (Zottola) -3	WSI9-325-100-3	AECOM TECHNICAL SERVICES, INC. (Penn Vest)	PO28496	Program Mgt/CM Related	URS27-50 CI Services for 2019 LSLR Program
276	2019 Lead Service Line Replacement Program (Independent)-1	WSI9-325-100-1	AECOM TECHNICAL SERVICES, INC. (Penn Vest)	PO28497	Program Mgt/CM Related	URS27-51 CI Services for 2019 LSLR Program
277	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	Burns Industrial Equipment, Inc.	PO28537	Other Services	Purchase of Hyster W45ZHD lift truck
278	2019 Surface Restoration Contract	2019-325-106-0 (IEI)	INDEPENDENT ENTERPRISES INC (Capital)	PO28552	General Contractor	Contract Award
279	2019 Small Diameter Sewer Rehabilitation (Defined Sites)	2019-424-100-0	Wade Trim, Inc. (Capital)	PO28558	Planning and Design Related	WT00-05 Design and Design Services During Construction
280	Woods Run Stream Inflow - Mairdale Avenue	2017-424-108-0	MOTT MACDONALD (Capital)	PO28568	Program Mgt/CM Related	MM23-137 PM Services -T. Batroney
281	Lawn and Ophelia Green Infrastructure Project	2017-424-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO28581	Program Mgt/CM Related	Constructability Review- Hatch
282	2019 Surface Restoration Contract -1	2019-OPS-100-1(A.F)	A. FOLINO CONSTRUCTION, INC. (OPS)	PO28644	General Contractor	Awarded Contract
283	2019 Surface Restoration Contract -1	2019-OPS-100-1(A.F)	A. FOLINO CONSTRUCTION, INC. (Capital)	PO28667	General Contractor	Awarded Contract
284	2019 Surface Restoration Contract -2	2019-OPS-100-2 (M.M)	Mele & Mele & Sons, Inc (OPS)	PO28677	General Contractor	AWARDED CONTRACT
285	2019 Surface Restoration Contract -2	2019-OPS-100-2 (M.M)	MELE & MELE & SONS, INC. (Capital)	PO28679	General Contractor	AWARDED CONTRACT
286	2019 Hydrant Replacement	2018-325-104-0	INDEPENDENT ENTERPRISES INC (Capital)	PO28681	General Contractor	Contract Award Independent Enterprises, Inc.
287	2019 Valve Replacement	2018-325-105-0	INDEPENDENT ENTERPRISES INC (Capital)	PO28689	General Contractor	Contract Award Independent Enterprises, Inc.
288	Woods Run Stream Inflow - Mairdale Avenue	2017-424-108-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO28761	Program Mgt/CM Related	JMT00-17 Third Party Constructability Review
289	PWSA27 AECOM/URS CM Core Team	2016-OPS-121-0	URS CORPORATION (OPS)	PO28794	Program Mgt/CM Related	URS27-46 Engineering Support Services - T. Warner
290	2018 Small Diameter Sewer Rehabilitation (IDIQ)	2018-424-100-0	MOTT MACDONALD (Capital)	PO28797	Program Mgt/CM Related	MM23-142 Design Support
291	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	Hach Company (Capital)	PO28912	Other Services	Purchase of rr 2100Q Portable Turbidimeter
292	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	Surveillance Group inc (Capital)	PO28923	Other Services	Installation of Video softtware
293	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	COMMONWEALTH OF PENNSYLVANIA C/O DEP (DEPT.ENVIRONMENTAL PROTEC.	PO28947	Other Services	Permit fee for DEP
294	Southside Green / Stormwater	2019-GI-100-0	ethos collaborative (capital)	PO29033	Planning and Design Related	EC00-04 Southside Green / Stormwater Preliminary Design

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
295	Southside Green / Stormwater	2019-GI-100-0	AMG Environmental LTD (Capital)	PO29148/29148	Other Services	FLOW MONITORING EQUIPMENT
296	Thomas and McPherson Green Infrastructure	2018-GI-106-0	AMG Environmental LTD (Capital)	PO29148/29148	Other Services	FLOW MONITORING EQUIPMENT
297	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	EPlus Technology, Inc (Capital)	PO29183	General Contractor	TECHNOLOGY SERVICES AS NEEDED
298	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	PALL CORPORATION	PO29185	General Contractor	REPLACING EXISTING AMIAD TWIN BRUSH
299	Lawn and Ophelia Green Infrastructure Project	2017-424-104-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO29190	Other Services	JMT00-18 Constructability Review
300	2019 Sewer Reconstruction	2019-424-102-0	INDEPENDENT ENTERPRISES INC (Capital)	PO29201	General Contractor	AWARDED CONTRACT
301	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	FRANK J ZOTTOLA CONSTRUCTION, INC. (Capital)	PO29202	General Contractor	AWARDED CONTRACT
302	2019 Manhole and Point Repair	2019-OPS-101-0	INDEPENDENT ENTERPRISES, INC. (OPS)	PO29205	General Contractor	AWARDED CONTRACT
303	SMR Streambank Stabilization Project	2018-GI-107-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29281	Planning and Design Related	CE27-172 3rd Party Constructability Review
304	Volunteer's Field Green Infrastructure	2018-GI-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29288	Planning and Design Related	CE27-173 3rd Party Constructability Review
305	Emergency Clarifier Repairs - Clarifiers No. 1, 2 & 4	2017-322-101-6	WAYNE CROUSE	PO29311	General Contractor	Material and Equipment
306	2018 Lead Service Line Replacement Program	2018-325-100-0	120 Water Audit, LLC (Capital)	PO29323	Other Services	Contract Award PWSA99 for filters and pitchers 1 yr extension
307	2018 Lead Service Line Replacement Program	2018-325-100-0	Precision Laser & Instrument, Inc. (Capital)	PO29336	Other Services	GPS Equipment
308	2019 Lead Service Line Replacement Program (Zottola) -3	WSI9-325-100-3	FRANK J ZOTTOLA CONSTRUCTION, INC. (PennVest)	PO29341	General Contractor	Awarded Contract of Replacement lead service lines
309	2019 Lead Service Line Replacement Program (Independent)-1	WSI9-325-100-1	INDEPENDENT ENTERPRISES INC (PennVest)	PO29354	General Contractor	Awarded Contract to replace service lines
310	2019 Lead Service Line Replacement Program (Petrakis) - 2	WSI9-325-100-2	W. A. Petrakis Contracting & Landscaping Co. (Penn Vest)	PO29355	General Contractor	Awarded Contract to replace service lines
311	Aspinwall Pump Station to Lanpher Reservoir Rising Main	2018-323-100-0	MICHAEL BAKER, INC. (Capital)	PO29372	Planning and Design Related	Professional Services for Design
312	Almono Mill Street Project	2017-OPS-106-0	Almono LP (OPS)	PO29394	Other Services	MEMO inspection
313	2018 Sewer Reconstruction	2017-424-111-0	MICHAEL BAKER, INC. (Capital)	PO29407	Planning and Design Related	MBI00-07 Design Services
314	Water Distribution System Master Plan	2019-325-100-0	MOTT MACDONALD (Capital)	PO29408	Program Mgt/CM Related	MM23-144 PM Services
315	M-29 Outfall Improvements	2018-424-103-0	MOTT MACDONALD (Capital)	PO29410	Program Mgt/CM Related	MM23-145 Project Management and Support Services
316	2018 Lead Service Line Replacement Program	2018-325-100-0	120 Water Audit, LLC (Capital)	PO29446	Other Services	Lead Service Line Replacement
317	Maytide Storm and Sanitary Sewer Improvements	2017-424-109-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29463	Program Mgt/CM Related	Constructability Review for Maytide Storm and Sanitary Sewer Improvements
318	2018 Small Diameter Water Main Replacement Project - Zotolla	2017-325-103-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29465	Program Mgt/CM Related	CM/CI/GPS Services for 2018 SDWMR

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
319	Maryland Avenue Green Infrastructure Project	2017-424-101-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO29467	Program Mgt/CM Related	Constructability Review for Maryland Avenue Green Infrastructure
320	Emergency Clarifier Repairs - Clarifiers No. 1, 2 & 4	2017-322-101-6	AECOM TECHNICAL SERVICES, INC.	PO29468	Program Mgt/CM Related	CM/CI Services for Emergency Clarifier Repair
321	Lanpher Supply Main Leak Assessment and Repair	2019-OPS-108-0	MOTT MACDONALD (Ops)	PO29470	Program Mgt/CM Related	MM23-155 Professional Services for Lanpher Supply Main Leak Assessment and Repair
322	Maryland Avenue Green Infrastructure Project	2017-424-101-0	Wade Trim, Inc. (Capital)	PO29472	Planning and Design Related	Third Party Technical Review for Maryland Avenue GI Project
323	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	ALEM Consulting	PO29476	Other Services	Alem Consulting contract to engage a professional project manager for engineering projects
324	CSO Flow Montoring Equipment	2016-424-101-0	ADS Environmental Service (OPS)	PO29482	Other Services	Awarded Contract for CSO Flow Monitoring
325	2020 Small Diameter Water Main Replacement - Contract B	2019-325-102-2	GAI CONSULTANTS INC. (Capital)	PO29503	Planning and Design Related	Design Services Agreement for 2020 SDWMR - Contract B
326	2020 Small Diameter Water Main Replacement - Contract A	2019-325-102-1	BUCHART HORN, INC. (Capital)	PO29511	Planning and Design Related	2020 A - Design Services - Buchart Horn
327	2019 Small Diameter Water Main Replacement	2019-325-101-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO29515	Planning and Design Related	2019 SDWR - JMT
328	31st Ward Sewer System	2017-424-100-0	American General Services Corporation (Capital)	PO29570	Other Services	Closing of land purchase
329	Corrosion Control Chemical Storage & Feed Systems	2017-322-107-0	Surveillance Group inc (Capital)	PO29683	Other Services	Surveillance Installation
330	2019 Hydrant Replacement	2018-325-104-0	G. Stephens, Inc. (Capital)	PO29692	Program Mgt/CM Related	GSI00-11 - ICM/CI/GPS Services for 2019 Hydrant Replacement Contract
331	2019 Surface Restoration Contract -1	2019-OPS-100-1(A.F)	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO29716	Program Mgt/CM Related	CE27-178 - CM/CI Services for 2019 Surface Restoration -1 -OPS
332	2019 Surface Restoration Contract	2019-325-106-0 (IEI)	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29720	Program Mgt/CM Related	CE27-170 CM/CI - All Capital
333	Maytide Storm and Sanitary Sewer Improvements	2017-424-109-0	MOTT MACDONALD (Capital)	PO29729	Planning and Design Related	MM23-147 - Third Party Technical Review
334	2016 Forbes/Darlington	2016-424-107-0	MOTT MACDONALD (Ops)	PO29730	Program Mgt/CM Related	MM23-154 - Forbes Darlington Sewer
335	2017 Hydrant Replacement	2017-325-102-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29731	Program Mgt/CM Related	CE27-176 - Construction Management and Construction Inspection Services Task Order Request
336	2019 Sewer Reconstruction	2019-424-102-0	MOTT MACDONALD (Capital)	PO29734	Program Mgt/CM Related	MM23-148 - Project Management Services for 2019 Sewer Reconstruction
337	2019 Surface Restoration Contract -2	2019-OPS-100-2 (M.M)	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO29736	Program Mgt/CM Related	CE27-180 - CM/CI OPS
338	2017 Valve Replacement	2017-325-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29737	Program Mgt/CM Related	CE27-177 - Construction Management and Construction Inspection Services Task Order Request

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
339	Powdered Activated Carbon System Improvements - General/Mechanical	2017-322-101-2	AECOM TECHNICAL SERVICES, INC.	PO29741	Program Mgt/CM Related	URS27-54 - CM/CI for PAC System Improvements
340	2019 Surface Restoration Contract -2	2019-OPS-100-2 (M.M)	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29756/29756	Program Mgt/CM Related	CE27-181 - CM/CI Capital
341	2019 Surface Restoration Contract -1	2019-OPS-100-1(A.F)	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29759	Program Mgt/CM Related	CE27-179 - CM/CI Capital
342	2019 Large Diameter Water Main Improvements (Rising Main 3 & 4)	2019-325-103-0	MOTT MACDONALD (Capital)	PO29777	Program Mgt/CM Related	MM23-143 - Rising Main 3 & 4 Rehabilitation Feeding Study
343	2014 COA Storm Sewer Separation	SSI5-424-178-0	INDEPENDENT ENTERPRISES INC (Capital)	PO29845	General Contractor	Purchase Order for Release of Retainage - Originally PennVest
344	Bausman & Bernd Green Infrastructure	2018-GI-101-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO29846	Other Services	Bausman and Bernd green infrastructure project
345	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	PITTSBURGH PARKS CONSERVANCY (Capital)	PO29851	Planning and Design Related	IMPLEMENT STORMWATER MGMT COMPONENTS
346	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	CDM (Capital)	PO29860	Other Services	CDM00-04 - Pretreatment & Chemical Process Improvements BODR / CIP Third Party Review
347	Powdered Activated Carbon System Improvements - Electrical	2017-322-101-3	FRANKL ELECTRIC, INC. (Capital)	PO29871	General Contractor	AWARDED CONTRACT
348	Powdered Activated Carbon System Improvements - General/Mechanical	2017-322-101-2	WAYNE CROUSE	PO29872	General Contractor	AWARDED CONTRACT
349	2019 Urgent Water Repair	2019-OPS-103-0 A. Folino	A. FOLINO CONSTRUCTION, INC. (OPS)	PO29938	General Contractor	AWARDED CONTRACT - A. FOLINO
350	2019 Urgent Water - Independent	2019-OPS-103-1 Independent	INDEPENDENT ENTERPRISES, INC. (OPS)	PO29940	General Contractor	AWARDED CONTRACT - INDEPENDENT ENTERPRISES
351	Wightman Park GI Project	2017-424-105-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO30085	Program Mgt/CM Related	CE27-168 - Constructability Review
352	2019 Manhole and Point Repair	2019-OPS-101-0	Johnson, Mirmiran, Thompson, Inc. (Ops)	PO30127	Program Mgt/CM Related	JMT00-21 - CM/CI/GPS
353	2019 Sewer Reconstruction	2019-424-102-0	G. Stephens, Inc. (Capital)	PO30129	Program Mgt/CM Related	GS100-13-CM/CI/AS-Built Services
354	2019 Unmetered and Flat Rate Properties	2019-325-104-0	BUCHART HORN, INC. (Ops)	PO30130	Planning and Design Related	BH28-11 - 2019 Unmetered and Flat Rate Properties - Engineering Services
355	Aspinwall Rail Spur Replacement	2018-OPS-103-0	G. Stephens, Inc. (Ops)	PO30132	Program Mgt/CM Related	GSI00-14 - Aspinwall Rail Spur Replacement - CM/CI 2
356	Herron Hill Reservoir Improvements	2019-323-100-0	CDM (Capital)	PO30133	Planning and Design Related	CDM00-05 - Engineering Services for Herron Hill Reservoir Improvements
357	Highland Reservoir #1 Parapet Wall Repairs	2017-322-106-1	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO30220	Program Mgt/CM Related	CE27-182 - HIghland 1 Parapet Wall CM/CI Services
358	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	EVOQUA WATER TECHNOLOGIES	PO30233	Other Services	Emergency Clarifier #2 Sludge Removal Equip. Inspection
359	Highland Reservoir #1 Parapet Wall Repairs	2017-322-106-1	ARCH MASONRY, INC. (Capital)	PO30236	General Contractor	AWARDED CONTRACT
360	31st Ward Sewer System	2017-424-100-0	GAI CONSULTANTS INC. (Capital)	PO30258	Planning and Design Related	GAI28-13 - Surveying - 6150 Mifflin Road

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1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
361	Maryland Avenue Green Infrastructure Project	2017-424-101-0	MOTT MACDONALD (Capital)	PO30260	Program Mgt/CM Related	MM23-153 - Technical Review for 60/90 Design
362	CSO Flow Montoring Equipment	2016-424-101-0	MOTT MACDONALD (Ops)	PO30272	Program Mgt/CM Related	MM23-151 - Data QA/QC
363	Volunteer's Field Green Infrastructure	2018-GI-104-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO30273	Planning and Design Related	JMT00-23
364	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	MOTT MACDONALD (Capital)	PO30278	Program Mgt/CM Related	MM23-150 - Four Mile Run Green Stormwater Infrastructure - Project Management Support
365	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	Johnson, Mirmiran, Thompson, Inc. (Capital)	PO30281	Program Mgt/CM Related	JMT00-22 - Construction Management and Construction Inspection Services
366	Melwood and Finland GI Design and Construction	2016-GI-105-1	URS CORPORATION (capital)	PO30374	Program Mgt/CM Related	URS27-59 - CM/CI/GPS/As-Built Services
367	2019 Valve Replacement	2018-325-105-0	G. Stephens, Inc. (Capital)	PO30375	Program Mgt/CM Related	GSI00-12 - CM/CI/GPS for 2019 Valve Replacement Contract
368	Volunteer's Field Green Infrastructure	2018-GI-104-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO30376	Program Mgt/CM Related	CE27-187 - CM/CI
369	Ft. Duquesne Bridge Water Air Release Valve Repair	2017-325-100-0	ADVANTAGE STEEL & CONSTRUCTION LLC	PO30380	General Contractor	AWARDED CONTRACT
370	Almono Mill Street Project	2017-OPS-106-0	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO30401	Program Mgt/CM Related	CE27-175 - CM/CI time and budget
371	2019 Permitting and Compliance Support	2019-OPS-107-0	MOTT MACDONALD (Ops)	PO30460	Program Mgt/CM Related	MM23-149 - 2019 Permitting and Compliance Support
372	2019 Urgent Water - Independent	2019-OPS-103-1 Independent	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO30549	Program Mgt/CM Related	CE27-183 - Construction Management and Construction Inspection Services
373	Water Treatment Plant Roof Replacement	2018-322-101-0	URS CORPORATION (capital)	PO30550	Program Mgt/CM Related	URS27-57 - CM/CI Services for Roof Replacement
374	Wightman Park GI Project	2017-424-105-0	EISLER LANDSCAPES, INC. (Capital)	PO30555	General Contractor	Renovation / Construction work
375	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	Keystone Engineering Group, Inc.	PO30582	Other Services	MFP PLC Panel Components
376	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	LANCO ELECTRIC, INC.	PO30583	Other Services	MFP Raw Water Pump VFD
377	2019 Small Diameter Sewer Rehabilitation (Defined Sites)	2019-424-100-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO30602	Program Mgt/CM Related	CE27-186 - CM/CI/As-Built Services
378	2019 Urgent Water Repair	2019-OPS-103-0 A. Folino	HATCH ASSOCIATES CONSULTANTS, INC. (Ops)	PO30604	Program Mgt/CM Related	CE27-184 - CM/CI
379	2019 Distribution Water Quality Performance Evaluation	2019-OPS-109-0	URS CORPORATION (OPS)	PO30608	Program Mgt/CM Related	URS27-56 - 2019 Distribution Water Quality Performance Evalutation
380	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	Primary Flow Signal, Inc. (Capital)	PO30721	Other Services	PFS - Lincoln PS Venturi Rehab
381	Highland Park Membrane Filtration Plant UV System	2017-322-106-0	LANCO ELECTRIC, INC.	PO30723	Other Services	CT and Log Reduction MFP Auto Shutdown
382	Highland Park Membrane Filtration Plant Assessment and Critical Process Improvements	2017-322-104-0	Yates Electric, LLC (CAP)	PO30743	Other Services	MFP Troubleshooting Assistance

	A	B	C	D	E	F
1	Project Name	Project Number	Company Name	Commitment Number	Commitment Type	Commitment Description
383	Woods Run Stream Inflow - Mairdale Avenue	2017-424-108-0	ALLEGHENY COUNTY CONSERVATION DIST	PO30747	Other Services	Permit Fee- Woods Run Stream - Mairdale Ave
384	Four Mile Run Green Stormwater Infrastructure	2018-GI-102-0	MICHAEL BAKER, INC. (Capital)	PO30818	Other Services	MBI00-09 - Value Engineering Services
385	Aspinwall Treatment Plant Pretreatment Chemical System and Clarification Improvements	2017-322-101-0	HATCH ASSOCIATES CONSULTANTS, INC. (Capital)	PO30821	Program Mgt/CM Related	CE27-189 - Constructibility Calculation for Clearwell Ventilation Lids

Exhibit RAW/C-35

AGENDA ITEM

Originating Department:	Administration	Phone:	412.255.8960
Department Contact:	Robert A. Weimar	E-mail:	rweimar@pgh2o.com
Date:	May 16, 2019		

AGENDA ITEM 91 Authorize the Executive Director To Prioritize PWSA Capital Improvement Plan To Designate Critical Facilities As High Priorities

STATEMENT OF THE ISSUE:

Authorize the Executive Director To Prioritize PWSA Capital Improvement Plan To Accelerate Implementation of Highly Critical Facilities Consistent With State and Federal Agency Recommendations and Requirements. Most of the projects in question will reduce the risks posed by aging elements of the existing water treatment and distribution system that represent single points of failure that could potentially compromise public health and safety. As a minimum, the PWSA Capital Improvement Plan shall continue to implement the repair and replacement of the Aspinwall Clearwell ("Clearwell") as one of PWSA's high priority projects; and, to authorize negotiations with any State or Federal Agency to accelerate completion of any projects essential to the safety and health of PWSA Customers.

FINAL BOARD APPROVAL:
ADOPTED MAY 16, 2019

James Turner, Secretary

PGH2O

AGENDA ITEM REPORT

AGENDA ITEM #:	91
DATE:	May 16, 2019
TO:	PWSA Board of Directors
SUBJECT:	Authorize the Executive Director To Prioritize PWSA Capital Improvement Plan To Designate Critical Facilities As High Priorities

STATEMENT OF THE ISSUE:

Authorize the Executive Director to Prioritize PWSA Capital Improvement Plan To Accelerate Implementation of Highly Critical Facilities Consistent With State and Federal Agency Recommendations and Requirements. Most of the projects in question will reduce the risks posed by aging elements of the existing water treatment and distribution system that represent single points of failure that could potentially compromise public health and safety. As a minimum, the PWSA Capital Improvement Plan shall continue to implement the repair and replacement of the Aspinwall Clearwell ("Clearwell") as one of PWSA's high priority projects; and, to authorize negotiations with any State or Federal Agency to accelerate completion of any projects essential to the safety and health of PWSA Customers.

RECOMMENDED ACTION:

Authorize the Executive Director to Prioritize PWSA Capital Improvement Plan Projects To Accelerate Implementation of Highly Critical Facilities Consistent With State and Federal Agency Requirements.

ALTERNATIVES:

Not Prioritize Highly Critical Projects Execution Placing Higher Risks To The Proper Operation Of the PWSA Water Systems

MBE/WBE/VBE/SDVBE STATUS:

Not Applicable.

FINANCIAL IMPACT OF RECOMMENDATION:

Dependent upon future Board Actions to authorize individual projects not fully defined at this time.

Resolution 91 of 2019

FOR MORE INFORMATION:

Staff contact: Robert A. Weimar
Phone: 412.255.8960
E-mail: rweimar@pgh2o.com

LEGAL REVIEW

DATE

ACCEPTED BY BOARD CHAIR

PAUL LEGER 5-16-19 DATE

Exhibit RAW/C-36

Exhibit A: Scope of Work

MOTT MACDONALD

Mr. Robert A. Weimar, PE, BCEE
Pittsburgh Water and Sewer Authority
Penn Liberty Plaza I
1200 Penn Avenue
Pittsburgh, PA 15222

Water Distribution System Master Plan

Our Reference
396529

Two Allegheny Center
Nova Tower 2, Suite 802
Pittsburgh PA 15212
United States of America

T +1 (412) 497 2900
F +1 (412) 497 2901
mottmac.com

March 15, 2019

Dear Mr. Weimar:

The Water Distribution System Master Plan is being developed in response to comments raised through Public Utility Commission's (PUC) review of the Pittsburgh Water and Sewer Authority's (PWSA) Long-Term Improvement Implementation (LTIIP) Plan that was submitted in support of PWSA's recent tariff filing. The review comments suggested that the PWSA develop a detailed process to clearly identify needed improvements to the distribution system that will ensure and maintain adequate, efficient, safe, and reasonable service to the PWSA customers. The LTIIP included an industry-accepted methodology for evaluating and ranking candidate water mains for renewal. The proposed master planning effort will incorporate this methodology to assess and prioritize renewal of the buried water assets. In addition, the Final Water Distribution System Master Plan report will present an assessment of expected growth in the system through planned development within the City, an assessment of vertical assets and recommended capital improvements required to ensure an adequate, safe, and efficient system. The Final Water Distribution System Master Plan report will include the following sections.

1 Introduction/description of transmission and distribution system

a. Pressure zones and gradients – Defines the different pressure zones and how they relate to each other; uses elevation diagrams and other maps as a visual reference.

b. Pumping and source of supply – Describes the vertical pumping assets that provide supply and transfer between each zone, including how treated water is delivered from the Aspinwall Water Treatment Plant to the various zones.

c. Storage – Describes the reservoirs and storage facilities located within the various pressure zones.

d. Transmission mains – Discusses large diameter transmission mains. For this report, 16-inch diameter and greater are considered transmission main. Will include an inventory of pipe diameters, lengths, age, and materials of construction where available.

e. Distribution mains – Discusses 12-inch diameter and smaller distribution mains. Will include an inventory of diameters, lengths, age, and materials of

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construction where available. Introduces the challenge of limited age and material data.

f. Metering and non-revenue water – Discusses the challenges of limited metering between zones and the limits of customer meters.

g. System emergency interconnections – Identifies potential emergency sources of supply, whole sale customers, and other interconnections with adjacent water purveyors. Will include field condition assessments as well as an assessment of contract and hydraulic limitations on transfers.

2 Pressure zone descriptions

a. Metered demands – For each pressure zone, we will identify the metered demands and pumped demands in order to identify areas of high non-metered or non-revenue, apparent water losses. Demands will be updated from the current loaded 2014 data.

b. Pumping – We will conduct an updated condition assessment of the vertical assets, the pumping capacity, emergency power, ability to meet current and projected demands with largest unit out of service and overall general condition.

c. Storage – Usable storage for each zone will be compared to the required storage based upon the system demands and current standards. The analysis will determine the required storage volume needed to meet demand equalization, fire flow reserve, and emergency reserve. Tank inspection and repair/rehabilitation program recommendations will be included.

d. Redevelopment and future demands – Zoning and redevelopment plans within the City will be reviewed to identify areas where the demands of an area may change due to redevelopment of existing service areas.

e. Zonal emergency interconnections – Identify emergency transfer locations between zones such as PRVs, control valves, or manually operated zone valves that are used on an emergency basis. Assess condition, capacity, and need for improvements

f. Pumping and storage surplus/deficit – Based upon the existing and potential future redevelopment demands, identify how much surplus or potential deficit of supply and storage within each zone. This information will be used when considering changing zone boundaries or developing recommendations for pump station and storage improvement capital projects.

3 Transmission mains

a. Condition assessment – A desktop level condition assessment based upon known age, condition, break/repair history, and materials of construction will identify the most critical large diameter mains that are not in a replacement or rehabilitation program.

b. Future investigation and study – Transmission mains where data on the condition of the pipeline is very limited or unknown, a program of future field investigations will be developed. Undertaking detailed pipe condition assessments on large diameter pipelines can be very time consuming and expensive. There are a number of tools available to assess large diameter pipelines, and each pipe material has different tools that work better than others, based on the information that is expected to be identified. The need for and type(s) of testing will be determined, and a more extensive pipe condition assessment program will be outlined which could be incorporated into a future CIP.

c. Oversized mains – The hydraulic model will be used to identify mains that are potentially oversized for the current demand conditions. This information will

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be useful in making decisions regarding main replacement/rehabilitation projects.

d. Time of travel – Will be one of the criteria used to identify mains that are potentially oversized.

e. Distribution water quality – The hydraulic model will be used to show how the time of travel and transmission main sizing impacts the distribution system water quality.

4 Distribution mains

a. Identify materials – Based upon available information, water main materials and break histories will be identified. Matching break histories to mains will be included in the GIS update for the InfoMaster software. The data needs for implementing software tools will be summarized.

b. Planning and condition assessment software tools – Planning software tools (such as InfoMaster) requires a pipe age, pipe material, and break history data at a minimum in order to undertake an effective analysis. In order to obtain the benefits of the assessment tool, a data collection program will be implemented. This program will be outlined as part of the overall report.

c. Coordination with lead service replacement program – Small diameter water main replacements will be coordinated with the lead service line replacement program. The prioritization program for main replacements will include the targeted lead service areas.

d. Low and high pressure areas – There are pressure monitoring facilities at select low pressure areas. Recommendations for improvements, either by zone boundary modifications or main extensions, will be identified to improve low pressure areas. Main extensions to address low pressure areas will be included in the prioritization program. PUC requires that the PWSA develop an action plan for controlling pressures greater than 150 psi. An action plan for addressing the high pressure areas will be prepared as part of this proposal. There is an existing Capital Improvements program for low pressure areas.

e. Fire flow analysis – The hydraulic model and ISO fire flow reports will be used to identify areas with potential for lower than desired fire flows. Distribution system improvements to address inadequate fire flows will be identified and included in the water main replacement program.

f. Water main replacement program – A systematic main replacement program will be developed based upon the emergent needs identified. Criticality analysis will be performed to prioritize the identified improvements. This program will be the initial basis for the long-term replacement program using the planning tools (InfoMaster). Data collected as part of this study will be entered into the condition assessment software tool (InfoMaster) for future use.

5 Non-revenue water

a. AWWA water audit – The AWWA water audit software will be used to rank the apparent, real, and non-revenue water losses. The software includes recommendations for improving scores for different sources of loss.

b. Unmetered replacement program – We will comment on the ongoing plan for metering governmental and other buildings that are currently not metered.

c. District metering – District metering improvements at pump stations and zone transfer facilities to track non-revenue and apparent losses will be recommended.

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6 Action items and a listing of capital improvements

a. Lincoln and Garfield tanks sizing based upon zones – These tanks have been identified as candidates for replacement. We will verify the proposed replacement tank is appropriate for the pressure zone supply and system demands.

b. Herron Hill and Squirrel Hill gradient adjustments – We will investigate if low pressure and demand issues can be addressed by modifying the pressure zone boundary between these gradients.

c. Millvale pumping and storage – This zone exhibits pumping and storage constraints. Recommendations for pumping and storage in this zone will be prepared

d. Zone boundary adjustments - Recommendations for adjustments of zone boundaries to address supply, pressure, or fire flow issues will be developed.

e. District metering priorities – The zones with the highest apparent water losses or non-revenue water will be prioritized to receive metering at the pressure zone transfer facilities in order to help identify areas where further leak detection action is needed.

f. Pump curve and efficiency testing – The large pump stations will be field-tested to develop their actual operating curves and to calculate the actual operational wire to water efficiencies. The recommendations will include a program on how to engage the specialty contractor(s) to implement the actual field testing.

g. Low pressure area improvements – Main improvements or zone adjustments required to address low pressure and fire flow issues will be identified.

h. Small diameter water main replacement – The initial replacement priorities will be identified based upon the projects developed as part of the Master Plan. The analysis will be undertaken in a manner that will support the future funding request for a Distribution System Improvement Charge (DSIC) and capital improvement program which would be outlined in a future LTIIP supporting the DSIC request to the PUC.

i. Additional model needs – The existing hydraulic model will be used to analyze the entire distribution system. Recommended data improvements to enhance the performance and reliability of the model will be identified.

Deliverables

- 30 weekly planning status report update
- Assume six draft chapters of the Master Plan will be submitted for PWSA review with Mott MacDonald
- Recommended capital improvement program including immediate, short-term (three to five years) and long-term (beyond five years) for PWSA review with Mott MacDonald
- Final Draft Report

The time frame for the final deliverables is October 2019.

Mott MacDonald has incorporated the services of Sci Tek Consultants, Inc. (Sci Tek), a local MBE; as well as JMS Design Consulting, Inc. (JMS), a local WBE. We have assigned Sci Tek to services that support our site visits for the project, while JMS will support Mott MacDonald with CAD and graphic support. Fees associated with our M/WBE team members is outlined on the attached Exhibit C and the subconsultant proposals.

Mott MacDonald has allocated $3,000.00 in services of a veteran owned or a service disabled veteran owned business (SDVOB). We are presently working to

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secure the support of a SDVOB; however, we cannot identify a firm by name at this time. Our MBE participation equates to 6.67 percent and our WBE participation equates to 2.3 percent. The total project fee is estimated as scoped herein at $299,963.28.

Should you have any questions concerning this proposal of the attachments, please let us know. Thank you for your request for these services and we look forward to continued work with PWSA during the completion of this project.



Stephen B. Polen, PE
Senior Vice President
T 412.497.2950
stephen.polen@mottmac.com

KC/SBP/msr

Exhibit RAW/C-37

Exhibit RAW/C-37



Proposal for:

2019 Unmetered & Flat Rate Properties Evaluation Project

Misc. On-Call Engineering Services

PWSA Project Number 2019-325-104-0

Submitted to:

Pittsburgh Water & Sewer Authority

April 17, 2019

BUCHART HORN
ENGINEERS · ARCHITECTS · PLANNERS

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BUCHART HORN
ENGINEERS · ARCHITECTS · PLANNERS

April 17, 2019

Pittsburgh Water and Sewer Authority
Penn Liberty Plaza I
1200 Penn Avenue
Pittsburgh, PA 15222

Reference: **PWSA Project Number 2019-325-104-0**
On-Call Engineering Consulting Services, 2019 Unmetered & Flat Rate Properties Evaluation Project Task Order Proposal

Dear PWSA:

Buchart Horn, Inc. (BH) is pleased to provide our Proposal in response to your referenced request. Enclosed with this letter is the completed proposal, including Approach and Methodology and Presentation of Price and Cost Structure.

Please note, BH acknowledges receipt of both Addendum 1 on April 2, 2019 and Addendum 2 on April 9, 2019.

Our proposed fee to provide the referenced services is $894,219.20, with all options. **Karl J. Shellenberger, PE**, our assigned Project Manager, will manage our services for this Task Order. He brings extensive water engineering and metering experience. **Ronald W. Zagrocki**, **PE**, who will serve as Lead Project Engineer, will support Mr. Shellenberger. Mr. Zagrocki has served PWSA on several wastewater and water projects.

We have selected a team of subconsultants to assist us in this project. Cosmos Technologies, Inc., a certified MBE firm, will provide property owner outreach and coordination services and Collective Efforts, a certified WBE firm, will provide field work support.

We look forward to the opportunity to serve PWSA. We assure you of our commitment to satisfying your needs. If you have any questions or require additional information, please contact me at (800) 274-2224 or bfunkhouser@bucharthorn.com, or Mr. Shellenberger at (814) 206-9313 or kshellenberger@bucharthorn.com.

Very truly yours,
BUCHART HORN, INC.

Brian S. Funkhouser, PE
President and CEO

APPROACH AND METHODOLOGY

APPROACH AND METHODOLOGY

Background

Buchart Horn (BH) understands PWSA is seeking to eliminate unmetered customers to improve the recorded metered consumption and reduce the unaccounted-for water in its water distribution system. BH is proposing to provide professional engineering services to the PWSA consisting of an investigation of more than 700 properties that are either unmetered or are flat-rate water customers.

The goal of this investigation is to verify which properties require action and determine the extent of improvements required to make the unmetered properties comply with PWSA's current backflow and metering requirements. Design of new meters and other required improvements will be completed by PWSA as a separate project, but this project will provide estimates of water demands for the properties investigated and information to assist in the future design of meter connections.

The following pages summarize our proposed Approach and Methodology.

Approach

Our approach uses our team's significant experience with GIS, including the use of ArcGIS and Survey 123, as well as our familiarity with PWSA metering and backflow requirements to create an efficient ongoing inspection program that allows for easily reported progress monitoring and troubleshooting.

Immediately upon Notice-to-Proceed, our team will begin developing a database of the unmetered and flat-rate customers to be investigated. At the project kickoff meeting, BH will review the data collection protocol with PWSA and make any requested modifications. This effort would be followed by a thorough review of historical records to gather information about the configuration of the existing water service of each targeted property.

Once we have identified the properties in question and have gathered the required background information about the water service, property owners will be contacted to coordinate a field visit. BH is teamed with Cosmos Technologies (a certified MBE firm) to assist with contacting property owners.

During field visits, we will team with Collective Efforts (a certified WBE firm) to gather the required data about the water service and the properties itself.

After analyzing the data collected during the field visits, BH will determine what improvements would be necessary to install a meter and/or service line and detail in a sketch. BH will also provide an estimate of the daily demand for each facility based on PWSA criteria in their Procedures Manual for Developers and other documentation as needed, such as PA DEP Chapter 93. The demand estimates will also reference information such as size and use of the property gathered and documented during the field visits.

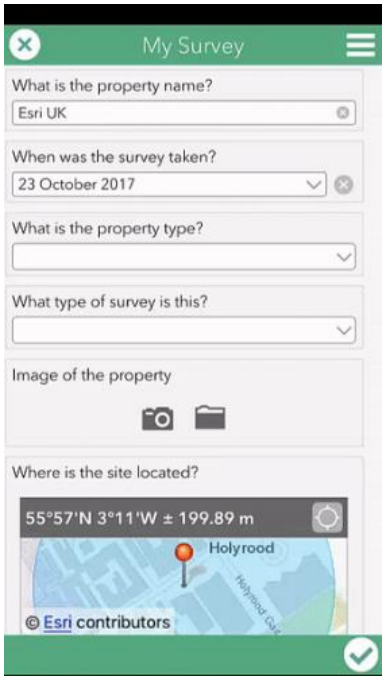
During the project, BH will attend monthly meetings at the PWSA office to discuss the project, review deliverables/ schedule, and provide current reporting on completed work. Detailed minutes will be prepared to document each meeting.

PWSA has requested an optional task to evaluate 3,996 additional potential unmetered properties that do not have any record of an active PWSA account/water meter. BH would perform this task initially using the Allegheny County Real Estate website supplemented with the latest available satellite imagery to inform the status of the property. Parcels that cannot be confirmed as being razed, or being part of a consolidated parcel, would be considered for a field verification to determine current status.

PWSA also requested an optional task to perform outreach, field work, and property evaluation/recommendation for an assumed 500 of the 3,996 properties investigated above. The approach for these 500 properties would be identical to the 718 properties detailed above.

APPROACH AND METHODOLOGY

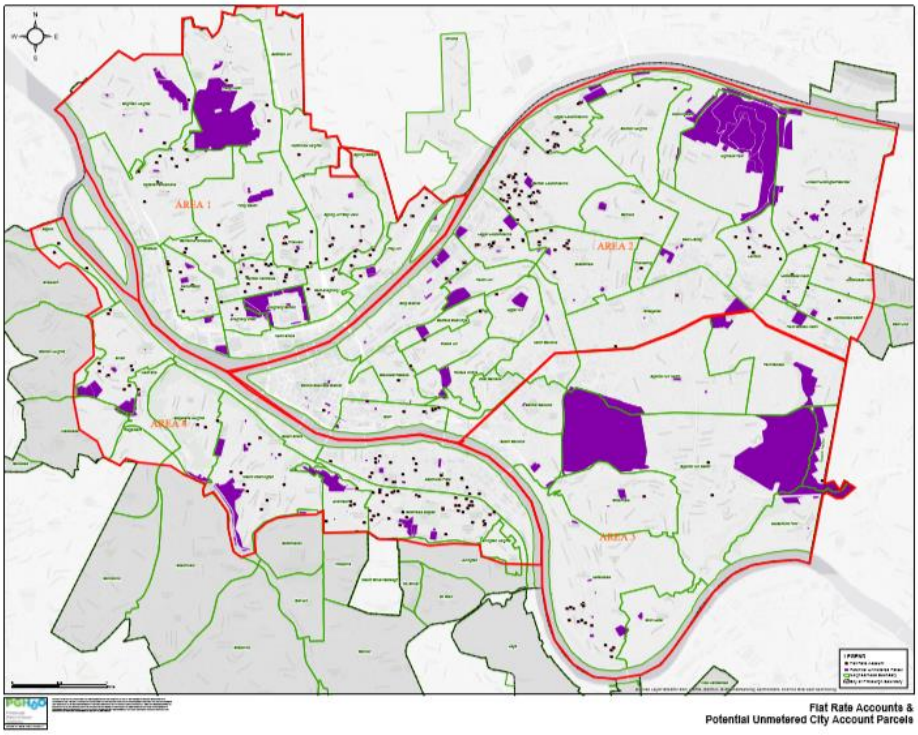
Methodology



Organization of data will be very important to the success of this project. To help with this process, we propose using **Survey 123**, a form based data collection application from ESRI. Survey 123 allows users to input data on a smartphone, tablet, or computer, and the data can then be imported directly into an ArcGIS database. Survey 123 also allows photos and sketches to be collected and made part of the database. The database will be updated weekly with collected field data, providing easily accessible and current monthly progress reports, and will be presented in its entirety to the PWSA as a final deliverable.

All information will be organized by individual property and will be linked to the GIS database. BH will provide a recommendation for each property regarding equipment requirements and feasible locations. For any properties investigated and discovered not to require metering, BH will provide an explanation and documentation, including any recommendations such as lot consolidation or termination of abandoned service lines.

BH is proposing to break the entire project area into four areas – see map below. Each area will follow the same process to permit efficient use of field crew time and orderly notifications and allow PWSA to know where the team is working throughout the city at any one time for better community relations.



BH will identify the target area and establish the sequence of which properties to visit. Cosmos Technologies will coordinate public notifications one week in advance of the field crews visits. Data collection will be compiled weekly and inform decisions on progress and the next round of public notifications. While it is understood there will be properties that lag behind due to various issues of gaining access, this system of progression should minimize wasted time and effort. It also provides feedback of completed investigations to PWSA as close to real time as possible and allowing PWSA the opportunity to take corrective actions if desired on select properties before completion of the entire project.

BH will coordinate closely with PWSA and keep PWSA informed about our status throughout the project. This includes tasks such as regular meetings, providing schedules of field work, coordination of property owner notifications, etc.

All information will be submitted to PWSA through the appropriate folder in e-Builder. Electronic deliverables, including files, data, etc., will be uploaded to E-Builder in electronic format via an e-Builder Action Item. Data will be organized by property and include all photos and inspection forms. Sketches, calculations, and recommendations will be made

available to PWSA at the monthly progress meeting. If PWSA would elect to pursue the optional additional evaluation of potential unmetered properties, the findings would also be delivered monthly.

Scope of Services

The BH team will perform services as outlined and described in the Authority's Request for Proposals. A summary of scope items and responsibilities follows:

Task 1 – Historical Record Review

BH will perform this task under the direction of our Project Manager, Karl Shellenberger, PE, and our Lead Project Engineer, Ron Zagrocki, PE. Mr. Shellenberger brings applicable experience from a project performed for the Pennsylvania State University – the inventory and investigation of backflow preventers in buildings on the University Park Campus in State College. Mr. Zagrocki has familiarity with the PWSA's Historical Records system and service line requirements through his time as a consultant stationed full-time at PWSA offices. We understand scanned copies of available water service line drill records will be made available by the PWSA. For properties where no drill record exists, BH will review drill records for adjacent properties to evaluate the potential of a party line. Where information cannot be obtained by Drill Records, BH will review additional historical records at PWSA's offices to obtain necessary information. This work will begin at project startup and will continue simultaneous to other project tasks.

Please note, 100 hours have been assumed for Historical Record Review at PWSA's offices. This task will be performed by BH.

Task 2 – Property Owner Outreach and Coordination

A key to the successful completion of this project is effective communication with the property owners and coordinating the field work.

Cosmos/BH will use owner/customer information from the PWSA GIS geodatabase and compare this information with property owner information in the Allegheny County database to determine appropriate property owners and tenants to be notified in order to gain access to perform field related work. If Cosmos cannot determine which database contains the appropriate property owner, both owners listed will be notified. If the property owner contact information is different than the serviced property, the tenant of the serviced property will also be notified. Cosmos will initially contact the property owner by phone or by letter/door hanger if phone number is unavailable, as approved by PWSA. All contact information and interactions will be recorded and provided to PWSA.

Cosmos brings knowledge of the PWSA owner outreach protocols through their work on an operating contract for PWSA Project No. PWSA72 – 48-Hour Posting Service.

Our team will provide PWSA with a detailed schedule of field work for all property inspections via e-Builder Action Item prior to the commencement of field work at those locations. BH expects to update this schedule weekly.

This task will be performed by Cosmos Technologies with oversight/support from BH.

Task 3 – Field Work

Field work will be performed collaboratively between BH and Collective Efforts. As noted earlier, BH proposes to use Survey 123, a form-based data collection application from ESRI, to streamline the field data collection process. Field personnel will use tablet computers preloaded with forms developed using Survey 123 and approved by PWSA. The data will be collected in the field and imported directly into an ArcGIS database, minimizing the need to re-enter data. Photos and sketches will also be collected and made part of the database, and will be easily traceable to the applicable property. The database will be updated monthly and provided to the PWSA as part of the final deliverables.

We plan to use up to four individuals (two teams of two as schedule necessitates) at a time to perform the inspections. Scheduling would depend on the availability of access to the facilities and homes and for the potential of having to reschedule visits due to absent owners/tenants. It is assumed a flat-rate customer would require two hours per field visit during a standard eight-hour workday. Because of the complexity of some of the unmetered properties (i.e. city parks and

facilities), it is assumed four hours would be required to perform the required field work for those properties during a standard eight-hour work day .

Properties found requiring foundation wall or other structural condition assessments will be inspected during a scheduled follow-up inspection by a structural engineer having experience in structural inspection, evaluation and assessment. It is assumed a total of 50 properties will require a field investigation of the structure.

This task will be performed jointly by BH and Collective Efforts.

Task 4 – Property Evaluation / Recommendation

As noted previously, BH will provide a monthly GIS database update that includes photos and a sketch of the existing condition of the property and the actions required to meter the property. This will include approximate location of any required excavation in the right-of-way, necessary internal plumbing improvements, and effect on private property.

This task will be performed by BH.

Task 5 – Estimate Average Daily Demand

BH will provide an estimate of average daily consumption for each property based on size and use of the property and existing criteria listed in the PWSA Procedures Manual for Developers. Any properties not easily calculated by PWSA criteria will be calculated using other industry-accepted standards, such as PA DEP Chapter 93, as necessary and references will be provided along with the calculations.

This task will be performed by BH.

Task 6 – Meetings

BH will conduct monthly meetings with the PWSA Project Manager at PWSA's Office located at 1200 Penn Ave, Pittsburgh, PA, 15222 to discuss the progress of the project and review key deliverables and schedule. BH's Project Manager, along with necessary project personnel, will attend the meeting. BH will prepare and distribute Meeting Agendas a minimum of one day prior to any meeting and prepare formal meeting minutes, including any requests for information or clarification within one day after each meeting. Meeting Agendas and Meeting Minutes will be distributed via upload into the e-Builder document structure (Folder 06.03)

This task will be performed by BH.

Task 7 – Evaluation of Additional Unmetered Properties (Optional)

BH has provided an option for additional properties as indicated in the PWSA Request for Proposals. We understand this optional task includes 3,996 unique addresses that are considered potential unmetered properties. BH proposes to use the Allegheny County Real Estate website supplemented with the latest available satellite imagery to initially inform PWSA the current status of the property. Parcels that cannot be confirmed as being razed, or being part of a consolidated parcel, would be considered for a field verification as to status. Findings will be used to determine if the property exists as a separate property requiring a separate service and meter for future follow up by PWSA.

This task will be performed by BH.

Task 8 – Outreach, Field Work, and Property Evaluation/Recommendation of Unmetered Properties Identified Under Task (Optional)

BH has provided an option to provide property evaluation services for an additional 500 properties assumed to be identified under Task 7 to be unmetered. These services would be identical to the services described in Tasks 2, 3, 4, and 5.

This task will be performed jointly by BH and Collective Efforts with additional outreach and notification services by Cosmos Technologies.

PROPOSED PROJECT TIMELINE

PROJECT TIMELINE

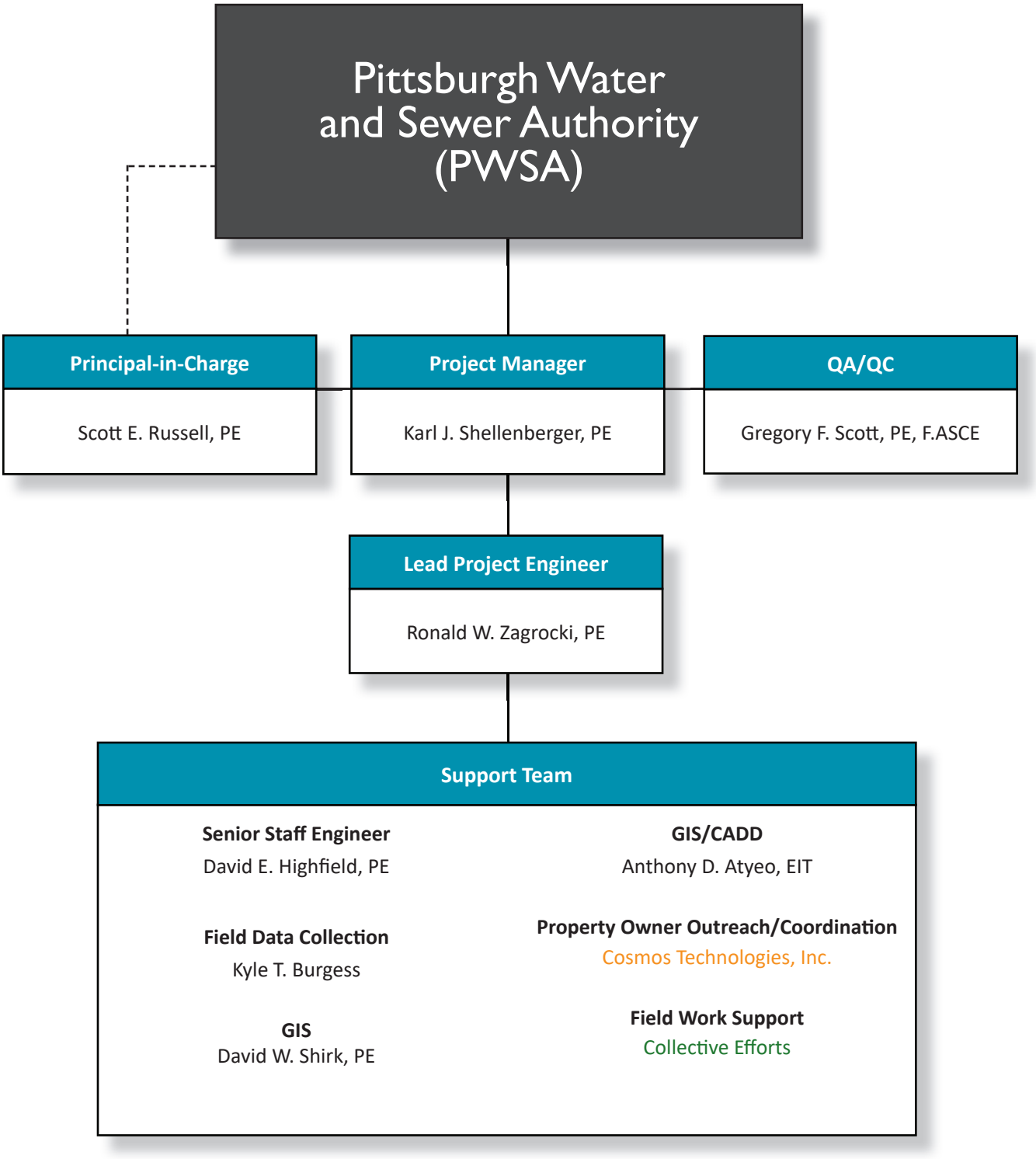
Proposed Project Timeline	
Project Milestones	**Date**
Notice-to-Proceed	4/29/2019
Project Kickoff Meeting	5/6/2019
Initiate Historical Records Review	6/3/2019
Initiate Property Owner Outreach – Area 1	6/10/2019
Initiate Field Work – Area 1	6/17/2020
Initiate Development of Recommendations – Area 1	8/19/2020
Initiate Property Owner Outreach – Area 2	9/9/2020
Initiate Field Work – Area 2	9/16/2019
Initiate Development of Recommendations – Area 1	11/18/2019
Initiate Property Owner Outreach – Area 3	12/9/2019
Initiate Field Work – Area 3	12/16/2019
Initiate Development of Recommendations – Area 1	2/10/2020
Initiate Property Owner Outreach – Area 4	3/2/2020
Initiate Field Work – Area 4	3/9/2020
Initiate Development of Recommendations – Area 1	5/11/2020
Submission of Final Property Evaluation database *	6/29/2020
*** Note that database updates will be continuously provided throughout the project**	

Assumptions:

1. Project milestones listed above are for initiation of each task with the exception of the final submission.
2. Property outreach and coordination will be an ongoing process. The date listed above is for of the initial contact with property owners for the area cited.
3. If optional Tasks 7 and 8 are included, the schedule will extend beyond June 30, 2020 and will be negotiated between PWSA and BH Team.
4. The final submission of the Property Evaluations Database, Photographs, and Estimates of Daily Demands would occur by the date listed above. However, this information will be provided monthly as it is completed throughout the duration of the project.
5. A project schedule will be prepared and updated on a monthly basis throughout the project.

KEY PERSONNEL

ORGANIZATIONAL CHART



KEY PERSONNEL

Scott E. Russell, PE

Principal-in-Charge

As Senior Vice President of BH's Water Resources Division, Mr. Russell has the authority to commit the full resources of the firm as necessary to successfully complete any project. He will secure additional resources your project requires when the Project Manager requests those resources, or if you should request those additional resources to meet agreed upon performance goals. As the Principal-in-Charge on this project, Mr. Russell will meet regularly with the Project Manager to monitor schedules and budgets. In addition, he will review project performance reports prepared by the QA/QC Officer and coordinate with the Project Manager and QA/QC Officer action to be taken to maintain excellent performance standards.

Hazardous Waste Remedial Investigation and Remediation Action, Sand Hill Maintenance Facility, NJDOT, South Brunswick Township, Middlesex County, NJ. Conducted a site investigation, remedial investigation, and remedial action workplan at a maintenance facility; advanced monitoring wells to horizontally delineate groundwater contaminant plumes; established groundwater monitoring program for natural attenuation remediation; maintained database and concentration trends for analytical results; and facilitated liaison with adjacent property owners to allow for off-site sample collection. Principal-in-Charge

Continuing On-Call Plan Reviews for Grading and Drainage, City of Memphis, TN. Continuation of a previous task order to assist the City with grading and drainage plan reviews, with the reviewer performing services at City offices. Principal-in-Charge

Education:

Bachelor of Science
Civil Engineering
Widener University

Registrations/Certifications:

Professional Engineer: PA

Years' Experience:

27

Karl J. Shellenberger, PE

Project Manager

Mr. Shellenberger has more than 17 years of civil and environmental engineering experience including studies, designs, and construction observation for municipal water, wastewater, and stormwater infrastructure projects. He has experience with grant and permit applications; Chapter 94 reports; Act 537 official sewage facilities plan components; water supply, distribution, and treatment facilities; wastewater collection, conveyance, and treatment facilities; stormwater management facilities; land development plans; and plan reviews.

Schematic Design for Back Flow Prevention in Buildings Requiring Pumps, Pennsylvania State University, University Park, PA. Study and schematic design to determine the need for backflow prevention in buildings on the University Park Campus of the Pennsylvania State University. Civil Engineer responsible for providing the study and schematic design to determine the need for backflow prevention in buildings on the University Park campus of the Pennsylvania State University.

Additional Engineering Services Studies for the Steam Services Building, Pennsylvania State University, State College, PA. Building assessment for the proposed West Campus Steam Services Building to reduce energy consumption by changing the architectural, electrical, and mechanical systems to be more energy-efficient. The study presented multiple options with associated costs, maintenance concerns and proposed energy savings. Civil Engineer responsible for preparation of site and civil plans associated with the construction of the Steam Services Building. Also responsible for E&S Plan approval.

Education:

Master of Science
Environmental Engineering
Pennsylvania State University

Bachelor of Science
Civil Engineering
Pennsylvania State University

Registrations/Certifications:

Professional Engineer: PA

Years' Experience:

17

KEY PERSONNEL

Gregory F. Scott, PE, F.ASCE

QA/QC

Mr. Scott has more than 26 years of experience in water systems engineering. His experience includes directing a technical staff of civil engineers and designers on projects involving design of distribution systems, transmission mains, pump stations, treatment works upgrades and storage facilities, including design of new elevated and ground storage tanks. He has managed projects from conceptual planning through contract document preparation, permitting, and construction services. Mr. Scott's experience also includes the development of vulnerability assessments, system models, alternative analysis, and feasibility studies. He has also been responsible for representing multiple municipal clients including boroughs, townships, and municipal authorities in western Pennsylvania.

Borough Engineer, Greenville Borough, PA. Provided miscellaneous engineering services including small tasks for Borough roads, site plan reviews, ordinances, stormwater, parks, and recreation. Larger defined projects have scope and design cost, proposals, and were approved individually. Project Manager

Thiel College Stormwater Management Plan Review, Borough of Greenville, PA. Review of Stormwater Management Plan for Thiel College Science Building for conformance to the Borough's stormwater ordinance. Project Manager

Education:

Master of Science
Civil and Environmental Engineering
University of Pittsburgh

Bachelor of Science
Environmental Engineering Technology
Pennsylvania State University

Registrations/Certifications:

Professional Engineer: PA

Years' Experience:

26

Ronald W. Zagrocki, PE

Lead Project Engineer

Mr. Zagrocki has more than 16 years of experience in water and wastewater engineering design and construction. From June 2007 through February 2016, Mr. Zagrocki worked for Chester Engineers as a consultant to PWSA. During much of this time, he was under the direct supervision of PWSA management. Duties varied from construction inspection to project management, but included review of tap-in plans and ghost writer of several revisions of the Pittsburgh Water and Sewer Authority's (PWSA's) *Procedures Manual for Developers.* This included extensive use of PWSA record documents, the calculation of existing and proposed peak flows, and verification of compliance with PWSA metering and backflow requirements. Mr. Zagrocki was also part of previous PWSA investigations into several unmetered properties including Lake Carnegie, Lake Elizabeth, and Phipps Conservatory. In addition, Mr. Zagrocki brings extensive mechanical and leadership skills from his time as a petty officer in the US Navy.

Borough Engineer, Greenville Borough, PA. Provided miscellaneous engineering services including small tasks for Borough roads, site plan reviews, ordinances, stormwater, parks, and recreation. Larger defined projects have scope and design cost, proposals, and were approved individually. Environmental Engineer

Education:

Bachelor of Science
Environmental Engineering
Pennsylvania State University

Graduate Coursework
Hydrology
Pennsylvania State University

Registrations/Certifications:

Professional Engineer: PA

Bicycle Pedestrian Facilities Training/Pennsylvania

NASSCO Pipeline Assessment

National Green Infrastructure Certified Professional

Years' Experience:

16

KEY PERSONNEL

David E. Highfield, PE

Senior Staff Engineer

Mr. Highfield has more than 25 years of experience as an environmental professional. His background includes seventeen years in the design, permitting, and construction of public water and wastewater infrastructure. He has an additional seven years of experience working for state environmental regulatory agencies in Texas and Massachusetts, giving him a strong background in environmental regulatory issues and compliance related to hazardous waste, municipal waste, and site remediation. Mr. Highfield has been responsible for the coordination and preparation of detailed construction plans and specifications, design reports, permit applications, analyses, and studies.

Education:

Master of Science
Environmental Engineering
Arizona State University

Bachelor of Science
Mechanical Engineering
Pennsylvania State University

Registrations/Certifications:

Professional Engineer: PA, AZ

Years' Experience:

25

David W. Shirk, PE

GIS

Mr. Shirk has extensive experience in industrial waste treatment design, landfill leachate treatment design, municipal waste treatment design, water distribution analysis and design, wastewater collection analysis and design, database development, Geographic Information System (GIS) development and analysis, environmental site assessments, soil and groundwater sampling, materials testing and inspection, construction inspection, and project sales.

Eastern Avenue Water and Sewer Main Rehabilitation, Washington Suburban Sanitary Commission, Takoma Park, MD.BH provided design to relocate and replace 1,300 feet of cast iron water main and 1,100 feet of clay sanitary sewer pipe in a right-of-way through the backyards of homes. The water main design included 1,500 feet of 8-inch ductile iron pipe (DIP). The sewer pipe replacement also used 8-inch DIP. Both were installed using horizontal directional drilling , chosen to minimize environmental impacts to old growth trees in the backyards of the affected homes. BH provided complete permitting, geotechnical, and design services. Public outreach was a major element in this project. Project Engineer

Education:

Bachelor of Science
Civil and Environmental Engineering
Clarkson University

Registrations/Certifications:

Professional Engineer: PA

OSHA 16-Hour Confined Space Operations (Supervisor)

OSHA 40-Hour Hazardous Waste Operations & Emergency Response/Level A

OSHA 8-Hour Annual HAZWOPER Refresher/Level A

Years' Experience:

27

KEY PERSONNEL

Kyle T. Burgess
Field Data Collection

As a Survey Technician, Mr. Burgess is responsible for supporting Professional Land Surveyors in all phases of survey projects from initial deed research to final plan drafting. He is proficient in survey process and calculations and is trained in the use of survey equipment.

Hazardous Waste Remedial Investigation and Remediation Action, Sand Hill Maintenance Facility, NJDOT, South Brunswick Township, Middlesex County, NJ. Conducted a site investigation, remedial investigation, and remedial action workplan at a maintenance facility; advanced monitoring wells to horizontally delineate groundwater contaminant plumes; established groundwater monitoring program for natural attenuation remediation; maintained database and concentration trends for analytical results; and facilitated liaison with adjacent property owners to allow for off-site sample collection.

Additional Engineering Services Studies for the Steam Services Building, Pennsylvania State University, State College, PA. Building assessment for the proposed West Campus Steam Services Building to reduce energy consumption by changing the architectural, electrical, and mechanical systems to be more energy-efficient. The study presented multiple options with associated costs, maintenance concerns and proposed energy savings. Field Technician responsible for assisting with field sampling.

Education:

Associate
Surveying Engineering Tech
Pennsylvania State University

Bachelor of Science
Secondary Education
Pennsylvania State University

Registrations/Certifications:

OSHA 40-Hour Hazardous Waste Operations & Emergency Response/29 CFR 1910.120(e)

OSHA 8-Hour Confined Space Operations/29 CFR 1910.46, Entrant, Attendee, Supervisor

Years' Experience:

5

Anthony D. Atyeo, EIT
GIS/CADD

Mr. Atyeo's primary responsibilities include modeling, dynamic three-dimensional drafting, GIS, permitting, assisting environmental engineers in designing water-related aspects of projects, and providing periodic site inspections.

I-40/I-240 East Interchange Construction Engineering and Inspection (CEI) and Engineering Support Services, Smith Seckman Reid, Inc./Tennessee Department of Transportation, Shelby County, TN. Provided bridge/structural inspection for this $109 million interchange modification project, the largest single bid project in TDOT's history. Our services also included responding to Requests for Information from the contractor and assisting with public outreach. Engineer-in-Training responsible for assisting in modeling in Autodesk 3DS Max.

Borough Engineer, Greenville Borough, PA. Provided miscellaneous engineering services including small tasks for Borough roads, site plan reviews, ordinances, stormwater, parks, and recreation. Larger defined projects have scope and design cost, proposals, and were approved individually. Engineer-in-Training responsible for assisting in inspecting stormwater facilities for Borough-wide repair plan; drafting a waterline for Bracken Alley replacement project; and inspecting the replacement of the storm sewer and repaving of Bracken Alley.

Education:

Master of Engineering
Civil Engineering - Water Resources and Hydrology
University of Florida

Bachelor of Science
Civil Engineering
University of Florida

Bachelor of Science
Accounting
University of Florida

Registrations/Certifications:

Engineer-in-Training: FL

Years' Experience:

5

Holly Hudson

Property Owner Outreach/Coordination

Ms. Holly Hudson has over 25 years' experience as an environmental and safety manager for various agencies and corporate entities including consulting, oil and gas, waste, and manufacturing. Her key competencies include assessments, permitting, compliance, grants, and training. She is experienced in air, water, and waste issues.

Pittsburgh Water and Sewer Authority PWSA – 48 hr. notice., Pittsburgh, PA. Posting shut off notices for customers of PWSA. Project manager responsible for liason with PWSA and the overall QAQC for the project.

Pittsburgh Water and Sewer Authority, Curb Box Replacement Program, Pittsburgh PA. Posting 15,000 notices to alert customers of work on/near residence. Notices are date and time stamped and loaded into ArcGIS program. Project manager assigning field technicians and performing quality assurance.

City of Pittsburgh Facilities Assessment, Pittsburgh, PA. Comprehensive building audits for various city facilities. including vehicle repair facilities, EMS buildings, Fire Stations, recreational centers, and police stations. Audit services included an assessment of mechanical systems, HVAC, electrical, lighting, plumbing, fire protection, and life safety systems. Project Manager responsible for project management, field assignments and quality assurance.

Pittsburgh Water and Sewer Authority (PWSA) Construction Safety Compliance, Pittsburgh, PA. Construction inspection and safety management for the facility renovations and upgrades at the Aspinwall Water Treatment Plant and the Brecken Pump Station in Aspinwall, PA. Project manager and construction safety manager. Conducted facility inspections and reviewed contractor submittals to ensure compliance with the safety requirements in the technical specifications. Monitored Cosmos resident inspector and Cosmos industrial hygienist.

Education:

MBA
Business Administration,
Katz School of Business
University of Pittsburgh

Master of Science
Safety Management
West Virginia University

Bachelor of Science
Biology
Clarion University

Registrations/Certifications:

Engineer in Training: PA

American Society of Quality,
Quality Manager: PA

OSHA Authorized Construction
Safety Trainer

National Green Infrastructure
Certification Program Trainer

NASSCO – PACP, LACP & MACP

Years' Experience:

29

KEY PERSONNEL

Jonathan Mozingo, EIT

Field Work Support

Mr. Mozingo is an engineering specialist at Collective Efforts, LLC. His experience includes environmental site assessments, data collection, field inspections, interpretation of analytical data, and water quality sampling.

Pittsburgh Water and Sewer Authority, Lead Service Line Replacement, City of Pittsburgh, PA. Mr. Mozingo assisted with Pittsburgh Water and Sewer Authority (PWSA) Lead Service Line Replacement GPS Project. His daily tasks included collection of data points for old and new water main and new curb box locations associated with the lead service line replacements. Mr. Mozingo operated a Trimble GeoXH 3.5G Geoexplorer 6000 Series device and communicated daily with construction inspectors and the construction foremen to coordinate data collection in several different locations.

Allegheny County Sanitary Authority Diversion Structures Upgrade, Allegheny County, PA. Mr. Mozingo assisted with the Allegheny County Sanitary Authority (ALCOSAN) Diversion Structure Upgrade Project. Ms. Mozingo was responsible for taking photographs of proposed construction lay down areas at nineteen diversion structures in the City of Pittsburgh. He also managed the air monitoring equipment and safety equipment (tripod and harness) for the confined space entry activities. Mr. Mozingo completed the daily confined space entry forms for the project.

Saw Mill Run Watershed Assessment, Allegheny County, PA. Mr. Mozingo was part of the field team that evaluated the existing physical conditions of the stream channels in along the entire length of Saw Mill Run and each of its tributaries. He completed data sheets for each reach of the stream on an electronic tablet. A data sheet was completed for each reach of stream defined by when there was a change in character of the stream or surrounding land use. He also used the tablet to photo-document the stream reaches and record their GPS locations.

Education:

Bachelor of Civil Engineering Technology
Point Park University

Registrations/Certifications:

Engineer-In-Training: PA

8-Hour OSHA Confined Space Entry Training

OSHA 10-Hour General Industry Outreach

ATSSA 8-Hour Flagger

Years' Experience:

6

SUBCONSULTANTS

SUBCONSULTANTS

BH has assembled a strong team of subconsultants who are integral to our effort for this assignment, providing necessary equipment and expertise and giving us the flexibility to address the needs of this project. Our team includes:

Collective Efforts, LLC
Civil and Environmental Engineers

Collective Efforts (CE), a certified WBE firm, will provide field work support. CE brings an outstanding knowledge of the PWSA system, as well as experience in flow meter installation, siting, and data analysis.

BH has worked with CE on numerous projects to supply services ranging from field services, design support, and permitting. Most recently, BH used CE to provide construction field services for ALCOSAN's Level Sensing System Improvements Project-1645.

Cosmos Technologies Inc.

Cosmos Technologies, Inc. has also agreed to be part of the BH team, providing property owner outreach and coordination services.

Cosmos Technologies is a certified MBE firm with extensive water and wastewater engineering experience.

PRESENTATION OF PRICE AND COST STRUCTURE

PRESENTATION OF PRICE AND COST STRUCTURE

Task	BH Fee	Cosmos Technologies MBE	Collective Efforts WBE	BH Expenses	Total Fee
Task 1	$ 23,297.00	$ -	$ -	$ -	$ 23,297.00
Task 2	$ 23,746.00	$ 105,551.25	$ -	$ -	$ 129,297.25
Task 3	$ 143,783.89	$ -	$ 96,690.30	$ 4,000.00	$ 244,474.19
Task 4	$ 65,908.36	$ -	$ -	$ -	$ 65,908.36
Task 5	$ 26,256.38	$ -	$ -	$ -	$ 26,256.38
Task 6	$ 31,480.75	$ -	$ -	$ -	$ 31,480.75
Subtotal	$ 314,472.37	$105,551.25	$ 96,690.30	$ 4,000.00	$ 520,713.92
Task 7	$ 111,226.02	$ -	$ -	$ -	$ 111,226.02
Task 8	$ 163,600.27	$ 30,975.00	$ 67,704.00	$ 2,800.00	$ 262,279.27
Total Fee	$ 589,298.65	$136,526.25	$ 164,394.30	$ 6,800.00	**$ 894,219.20**

Notes:
1. 5% markup for subconsultants is included for all subconsultant fees in this table.

Please see the following page for a detailed breakdown of cost.

Fee Development: PWSA 2019 Unmetered and Flat Rate Properties Evaluation Project

		Hrs										Subtotal	Cosmos Technologies (1.05 Multiplier)	Collective Efforts (1.05 Multiplier)	BH Expenses (no multiplier)
	Enter Staff Name →	S. Russell	G. Scott	K. Shellenberger	D. Highfield	K. Burgess	R. Zagrocki	A. Atyeo	D. Shirk	E. Macione	T. Suchevich		**Direct Costs**	**Direct Costs**	**Direct Costs**
	Enter Staff Classification →	Officer of the Firm	Senior Staff Engineer	Project Engineer	Senior Staff Engineer	Engineer I	Senior Engineer	Engineer I	Project Engineer	Administrative Secretary	Senior Staff Engineer				
Tasks 1-6	**Enter Staff Role** →	Principal	QA/QC	Project Manager			Deputy Project Manager						**Direct Costs**	**Direct Costs**	**Direct Costs**
Task 1 - Historical Record Review			12	16	8		140		8			$23,297.00			
Task 2 - Property Owner Outreach				40			140			24		$23,746.00	$100,525.00		
Task 3 - Field Work, including Data Processing and GIS			12	80		1133	140	48	48	24	100	$143,783.89		$92,086.00	$4,000.00
Task 4 - Property Evaluation/Recommendation		4	12	45	8	280	280		8			$65,908.36			
Task 5 - Daily Demand Estimates		4	12	100	8		24	48	8			$26,256.38			
Task 6 - Meetings		8	4	156			40			40		$31,480.75			
		16	52	437	24	1413	764	96	72	88	100	3062	$100,525.00	$92,086.00	$4,000.00
Total Hrs		16	52	437	24	1413	764	96	72	88	100	3062			
Unit Labor Rate		$69.50	$53.17	$44.40	$55.75	$24.50	$38.00	$28.23	$50.09	$23.50	$47.90				
Multiplier		3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	1.0500	1.0500	1.0000
Total Effort for Each Individual		$3,447.20	$8,571.00	$60,148.68	$4,147.80	$107,317.35	$89,999.20	$8,401.25	$11,180.09	$6,410.80	$14,849.00	$314,472.37	$105,551.25	$96,690.30	$4,000.00

BH	**$314,472.37**	
Cosmos Technologies (1.05 Multiplier)	**$105,551.25**	**20.27%**
Collective Efforts (1.05 Multiplier)	**$96,690.30**	**18.57%**
BH Expenses (no multiplier)	**$4,000.00**	
Total	**$520,713.92**	

		Hrs										Subtotal	Cosmos Technologies (1.05 Multiplier)	Collective Efforts (1.05 Multiplier)	BH Expenses (no multiplier)
	Enter Staff Name →	S. Russell	G. Scott	K. Shellenberger	D. Highfield	K. Burgess	R. Zagrocki	A. Atyeo	D. Shirk	E. Macione	T. Suchevich		**Direct Costs**	**Direct Costs**	**Direct Costs**
	Enter Staff Classification →	Officer of the Firm	Senior Staff Engineer	Project Engineer	Senior Staff Engineer	Engineer I	Senior Engineer	Engineer I	Project Engineer	Administrative Secretary	Senior Staff Engineer				
Task 7	**Enter Staff Role** →	Principal	QA/QC	Project Manager			Deputy Project Manager						**Direct Costs**	**Direct Costs**	**Direct Costs**
Task 7 - Evalation of additional addresses (optional)		2	8	65		1000	200			14		$111,226.02			
		2	8	65	0	1000	200	0	0	14	0	1289	$0.00	$0.00	$0.00
Total Hrs		2	8	65	0	1000	200	0	0	14	0	1289			
Unit Labor Rate		$69.50	$53.17	$44.40	$55.75	$24.50	$38.00	$28.23	$50.09	$23.50	$47.90				
Multiplier		3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	1.0500	1.0500	1.0000
Total Effort for Each Individual		$430.90	$1,318.62	$8,946.60	$0.00	$75,950.00	$23,560.00	$0.00	$0.00	$1,019.90	$0.00	$111,226.02	$0.00	$0.00	$0.00

BH	**$111,226.02**	
Cosmos Technologies (1.05 Multiplier)	**$0.00**	**0.00%**
Collective Efforts (1.05 Multiplier)	**$0.00**	**0.00%**
BH Expenses (no multiplier)	**$0.00**	
Total	**$111,226.02**	

		Hrs										Subtotal	Cosmos Technologies (1.05 Multiplier)	Collective Efforts (1.05 Multiplier)	BH Expenses (no multiplier)
	Enter Staff Name →	S. Russell	G. Scott	K. Shellenberger	D. Highfield	K. Burgess	R. Zagrocki	A. Atyeo	D. Shirk	E. Macione	T. Suchevich		**Direct Costs**	**Direct Costs**	**Direct Costs**
	Enter Staff Classification →	Officer of the Firm	Senior Staff Engineer	Project Engineer	Senior Staff Engineer	Engineer I	Senior Engineer	Engineer I	Project Engineer	Administrative Secretary	Senior Staff Engineer				
Task 8	**Enter Staff Role** →	Principal	QA/QC	Project Manager			Deputy Project Manager						**Direct Costs**	**Direct Costs**	**Direct Costs**
Task 8 - Outreach, Field Work, and Evaluation (optional)		2	4	104	4	1000	600			12		$163,600.27	$29,500.00	$64,480.00	$2,800.00
		2	4	104	4	1000	600	0	0	12	0	1726	$29,500.00	$64,480.00	$2,800.00
Total Hrs		2	4	104	4	1000	600	0	0	12	0	1726			
Unit Labor Rate		$69.50	$53.17	$44.40	$55.75	$24.50	$38.00	$28.23	$50.09	$23.50	$47.90				
Multiplier		3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	3.1000	1.0500	1.0500	1.0000
Total Effort for Each Individual		$430.90	$659.31	$14,314.56	$691.30	$75,950.00	$70,680.00	$0.00	$0.00	$874.20	$0.00	$163,600.27	$30,975.00	$67,704.00	$2,800.00

BH	**$163,600.27**	
Cosmos Technologies (1.05 Multiplier)	**$30,975.00**	**11.81%**
Collective Efforts (1.05 Multiplier)	**$67,704.00**	**25.81%**
BH Expenses (no multiplier)	**$2,800.00**	
Total	**$262,279.27**	

Total Proposal	**$894,219.20**



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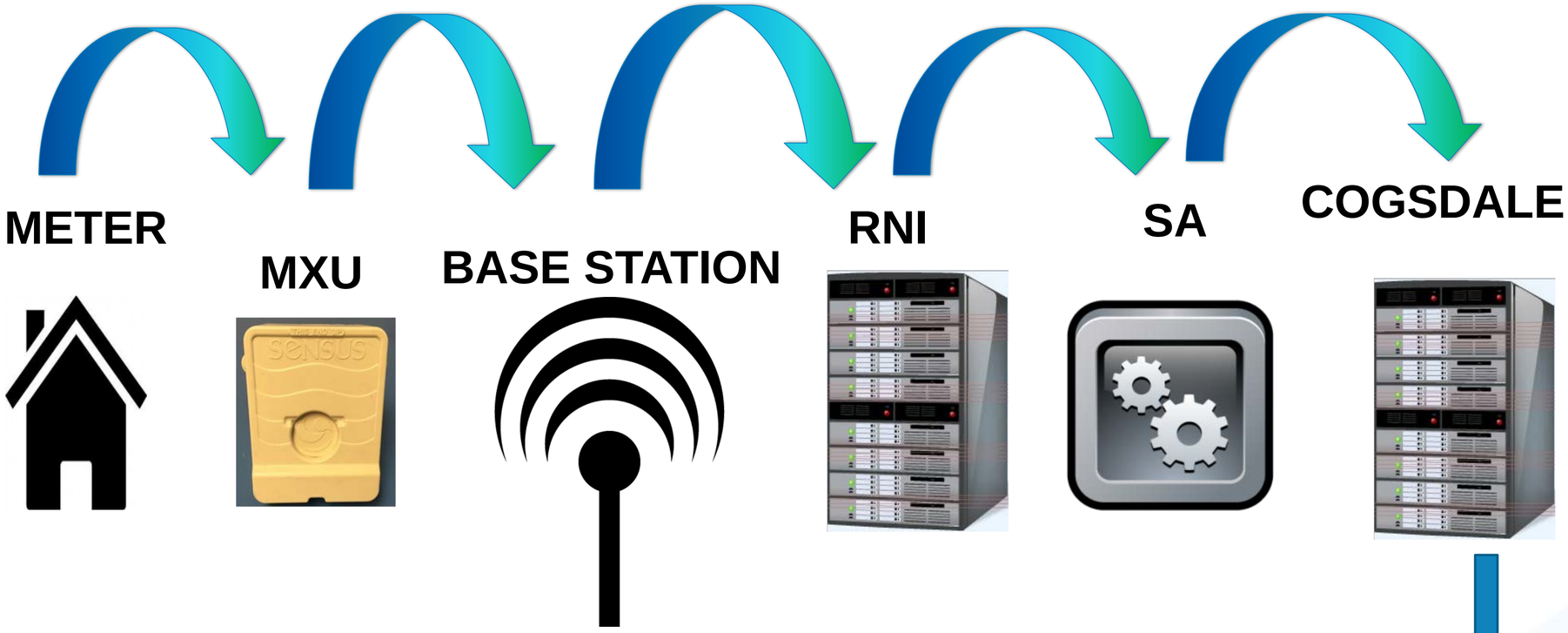
Exhibit RAW/C-38

Pittsburgh Water & Sewer Authority

All Party PWSA Compliance Plan Settlement Workshop - Metering

May 29, 2019

Meter Read Data Flow



Definitions

Meter – *Water meter installed at the property.*
MXU – *Radio device that transmits reads over the network.*
Base Station – *Receives reads from the MXU's.*
RNI – *The infrastructure used to collect reads from the Base Station.*
SA – *Sensus Analytics collects and stores reads for analysis.*
Cogsdale – *PWSA customer service and billing system.*

Improvements in the Advanced Metering Infrastructure (AMI)

- Promoted from within to fill the RNI Data Analyst role as of May 14, 2018.
- Promoted from within to fill the AMI and Billing Manager role as of July 30, 2018.
- Upgraded to Sensus Analytics as of October 30, 2018.
- Launched the Customer Usage Portal on December 18, 2018.
- Upgraded all four Base Stations from 3G to 4G as of April 8, 2019.
- Through the Non-Access Program, increased the Actual Read Rate from 89% in October 2017 to 94% as of April 2019.

Meters

Small

- 1” & Less
- Badger
- Sensus
- Neptune
- Resolution 0.1 Gal

Intermediate

- 1 ½” & 2”
- Badger
- Sensus
- Neptune
- Resolution 1 Gal

Large

- 3” & Greater
- Badger
- Sensus
- Neptune
- Resolution Varies

Meter Upgrade Program

- In April 2019, Customer Service and Field Operations personnel embarked on a concerted effort of mailing letters, calling customers, scheduling appointments, and replacing water meters.
- 884 meters were upgraded in April 2019, and 723 meters were upgraded to date in May 2019.
- Of these 1,607 upgraded water meters, 1,561 were 5/8” to 1”, 29 were 1 1/2” to 2”, and 17 were 3” and greater.
- PWSA is on track to upgrade over 6,000 meters by the end of 2019, which is in keeping with PWSA’s Compliance Plan filed September 28, 2018.

Meter Testing
2” or Less



- PWSA purchased and installed a state of the art water meter testing bench in its Central Warehouse in March 2019.
- Currently, all 2” or less meters pulled from service are being tested.
- To date, 1,849 5/8” to 1” and 13 1 1/2” to 2” meters have been tested.

Meter Testing
3” & Greater

- Following its competitive bid process, PWSA entered into a contract in May 2019 with Vanguard to test water meters 3” and greater in-line or at Vanguard’s testing facility.
- PWSA has 806 3” and greater meters in the billing system.
- Of these 806, PWSA will determine the age of each meter. If a 3” or greater meter is found to be in service longer than 8 years, PWSA will either test in-line or replace the meter, whichever is more cost-effective. If the meter is tested, PWSA will record the testing results in its billing system. If the meter fails testing, it will be replaced.

Questions



Exhibit RAW/C-39

Pittsburgh Water & Sewer Authority

All Party PWSA Compliance Plan Settlement Workshop - Leak Detection

June 7, 2019

Leak Detection Team

- Currently, PWSA's Leak Detection team is comprised of 1 Senior Manager, 1 Foreman and 4 Leak Detection Specialists.
- The Field Operations operating budget request for 2020 will include additional leak detection personnel.
- PWSA is currently creating an MS Excel leak detection spreadsheet to document leaks with the following information, location, date located, date repaired, type of leak, and estimated amount of water loss.

Existing Equipment



- PWSA currently utilizes an older style fixed base logger. By manually setting these, PWSA has ruled out several complaints and concerns through locating sources from ground water and natural springs.
- In the month of May 2019, PWSA located and repaired 63 main line leaks, 52 service line leaks, 6 leaking hydrants, and 12 leaking valves.

Recent Improvements



- Under new management, the Leak Detection Specialists have been more proactive in locating leaks.
- PWSA has purchased a Tri Corr Correlator, 12- LD12 ground mics, and 1-SD30 listening device to better pin point leaks.
- The leak detection personnel are completing forms in the field that document the location and measurements of leaks. These forms are then returned after the leak is repaired, along with new measurements to identify any discrepancies.

Elusive Leak Located



Here is a picture of a long-standing leak on a 12” water main on Aliquippa St. that was detected and located utilizing our new equipment and excavated for repair May 2019.

SpryMobile – Work Orders and Asset Management

SpryMobile – Work Orders and Asset Management will leverage the SpryMobile platform launched by PWSA in October 2018, converting Plumbers and Field Technicians from paper work orders to a web based application. PWSA is on track to manage assets and resources such as staff, vehicles, tools, and materials via this application before the end of 2019. This app will track system repairs, inspections, preventative and corrective maintenance, and will more efficiently record with GIS mapping the numerous field activities that occur over a long duration. Notifications can be sent to PWSA personnel and to customers via electronic media from the app. SpryPoint will import existing asset data into the app during implementation, and PWSA personnel will have the ability to create and input asset data not currently documented.

PWSA intends to track leak detection activities and outcomes via the SpryMobile app.

Questions



Exhibit RAW/C-40

PWSA System Flow Meter Operation Status
current as of 7/31/19

Exhibit RAW/C-40

Meter Name	Meter Size (inches)	Date Reinstated	Status
Ross (Raw Water)	48	4/17/2019	Dall Tube Type - New sensing lines, differential transmitters, and calbration.
Aspinwall - Riser 1 & 4	36	4/9/2019	Dall Tube Type - New sensing lines, differential transmitters, and calbration.
Aspinwall - Riser 2 & 3	36	4/9/2019	Dall Tube Type - New sensing lines, differential transmitters, and calbration.
Bruecken - Riser Main 1	48	Expected by End of 2019	Sensing lines are leaking. Replacement will require the installation of a new manhole and possibly taking the rising main out of service. If the rising main must be taken out of service, the MFP will need to be running to supplement flow.
Bruecken - Riser Main 2	48	Expected by End of 2019	Sensing lines are leaking. Replacement will require the installation of a new manhole and possibly taking the rising main out of service. If the rising main must be taken out of service, the MFP will need to be running to supplement flow.
Bruecken - Riser Main 3	48	4/9/2019	Venturi Type - New sensing lines, differential transmitters, and calbration.
Bruecken - Riser Main 4	48	4/9/2019	Venturi Type - New sensing lines, differential transmitters, and calbration.
Herron Hill Pumps 1 & 3	20	2019/2020	Planned for rehabilitation in 2019/2020
Herron Hill Pump 2 & 4	20	2019/2020	Planned for rehabilitation in 2019/2020
Herron Hill Pump 5	20	2019/2020	Planned for rehabilitation in 2019/2020
Herron Hill Pump 6	12	2019/2020	Planned for rehabilitation in 2019/2020
Herron Hill Tank	12	2019/2020	Planned for rehabilitation in 2019/2020
Mission Pumps 1 - 3	24	2019/2020	Planned for rehabilitation in 2019/2020
Mission Pumps 4 & 5	24	2019/2020	Planned for rehabilitation in 2019/2020
Howard Pumps 1 - 4	20	2019/2020	Planned for rehabilitation in 2019/2020
Howard Pumps 5 - 7	24	2019/2020	Planned for rehabilitation in 2019/2020
Saline Pumps 1 - 3	20	2019/2020	Planned for rehabilitation in 2019/2020
Lincoln	20	2019/2020	Planned for rehabilitation in 2019/2020
WTP - Filter Composite	96	N/A	Replaced with indifidual filter effluent venturi meters when WTP filters were replaced.
New Highland Pumps 1 - 3	20	NEW	Replaced with mag meter at temporary pump station. New pump station will be incorporated into Highland Reservoir Pump Station.
Fox Chapel	16	NEW 4/9/2019	New mag meter installed in March 2019 and operational on 4/9/2019. This is a system flow meter, not a bulk sales meter.

Exhibit RAW/C-41

Pittsburgh Water & Sewer Authority

SOP for Reporting Low Pressure Readings, Breaks, and BWA

Notifying the DEP

1. You receive an alarm from FCS DataGate regarding low pressure
2. Contact operations to investigate the cause of the alarm
    a. Rick Obermeier - robermeier@pgh2o.com [redacted]
    b. BJ McFaddin – wmcfaddin@pgh2o.com [redacted]
3. Report the incident and the cause to the DEP no more than 1 -hour from when the issue was discovered.
    a. Email rediehl@pa.gov
    b. Call the afterhours number at [redacted]
4. If it is determined that a BWA is needed, notify the public as soon as possible, but no later than 24 hours.
    a. Follow BWA protocol for determining the area affected. Include the following departments
        i. Engineering
        ii. Operations
        iii. Communications

Notifying the PUC

52 PA Code§ 69.1601. UNSCHEDULED WATER SERVICE INTERRUPTIONS AND ASSOCIATED ACTIONS

(b) Affected ratepayers/occupants should be notified when 2,500 or 5%, whichever is less, of a utility's total ratepayers/occupants have an unscheduled service interruption involving any reduction in the quantity of water in a single incident of 6 or more consecutive hours. Timely notification of fewer customers, however, is recommended when practicable. When there is an unscheduled service interruption involving the quality of water, water utilities should follow the applicable Department of Environmental Protection regulations regarding the public notification requirements for events requiring Tier 1 notification under 25 Pa. Code § 109.408(b) (relating to Tier 1 public notice—form, manner and frequency of notice), or Tier 2 notification under 25 Pa. Code § 109.409(b). Timely notification of customers in other incidents affecting the quantity or quality of water, such as water in short supply, discolored or sediment-laden, however, is recommended when practicable. It is also recommended that utilities set as a goal the Tier 1 time frame of ''as soon as possible'' rather than ''no later than 24 hours'' and the Tier 2 time frame of ''as soon as possible'' rather than ''but no later than 30 days.''

1. If more than 2,400 customers, are affected by an outage or BWA, email the following
    a. Derek Ruhl - druhl@pa.gov Cell [redacted]
    b. John Van Zant - jvanzant@pa.gov
    c. Daniel Searfoorce – dsearfoorc@pa.gov
    d. Kenneth Shaffer – kennshaffe@pa.gov
    e. Paul Diskin – pdiskin@pa.gov
    f. 24 hour email - RA-PUCPEMA@pa.gov
2. Include PUC on DEP communications
    a. Include number of people affected
    b. Size of main
    c. Map of area affected
    d. Location of Temporary Water or Water Buffalo
3. Provide update once issue is corrected or BWA is lifted

Exhibit RAW/C-42

PWSA Process Flow for Reporting Low Pressure Readings, Breaks, and Boil Water Advisory - July 2019

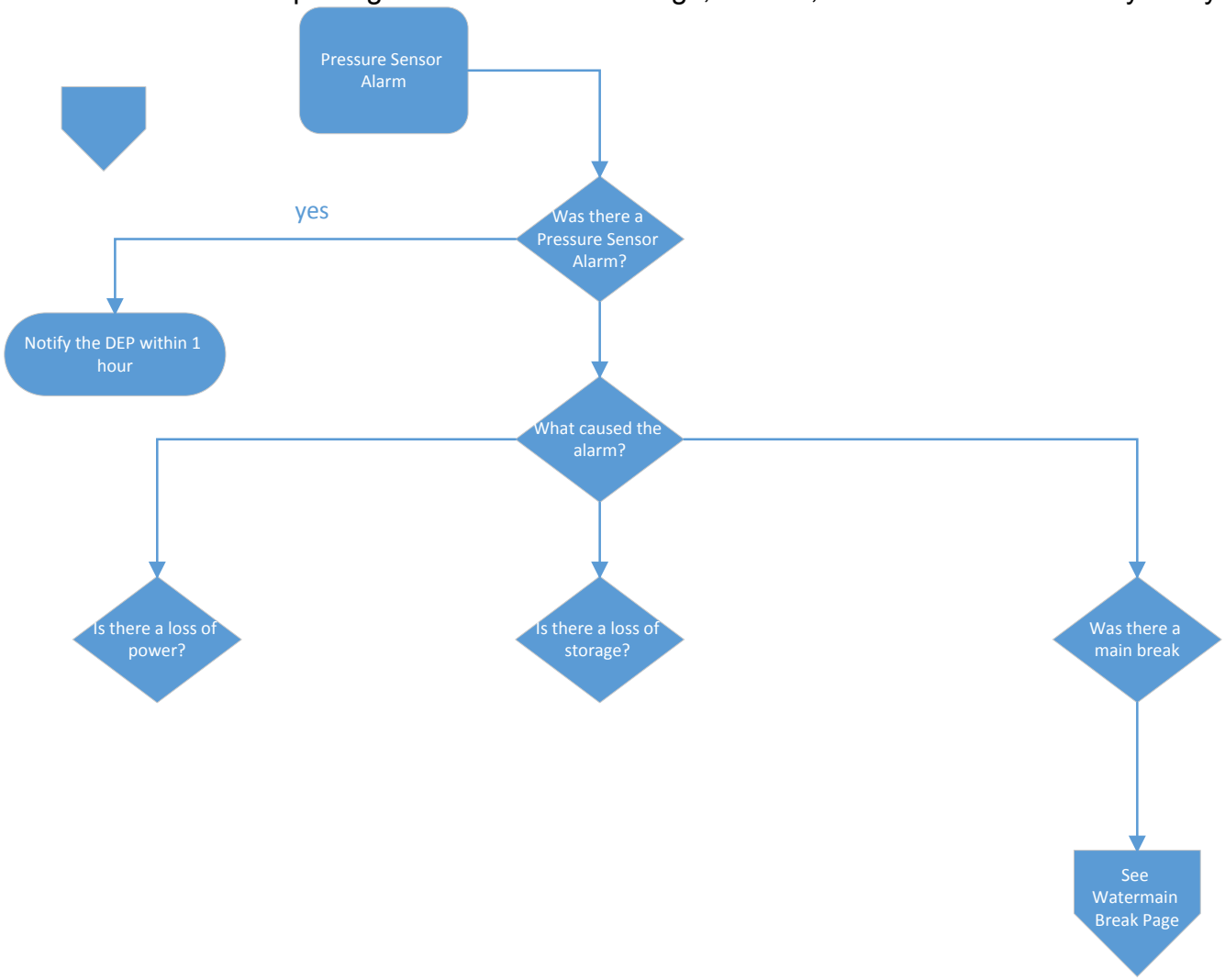
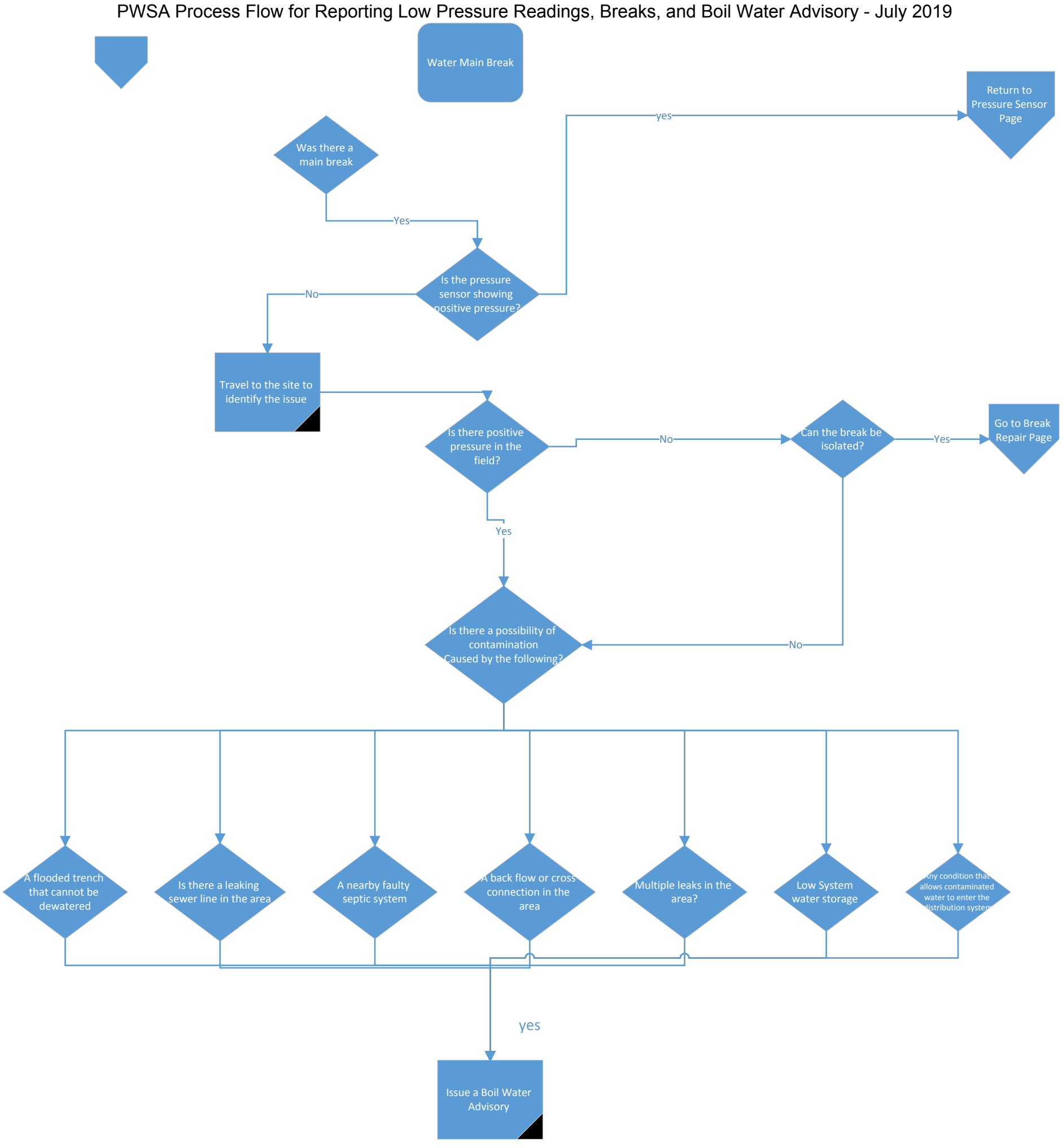
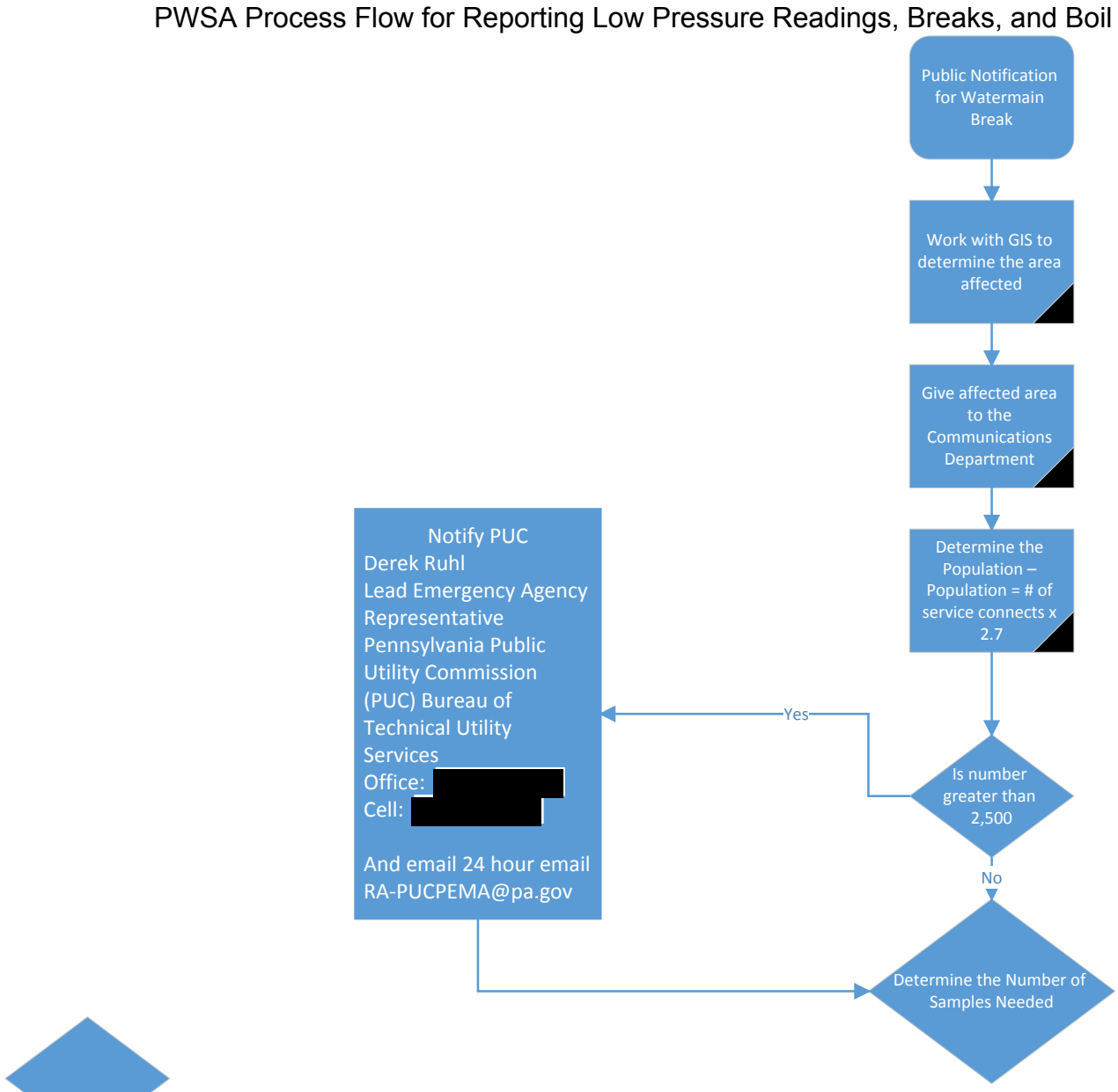


Exhibit RAW/C-42

PWSA Process Flow for Reporting Low Pressure Readings, Breaks, and Boil Water Advisory - July 2019



PWSA Process Flow for Reporting Low Pressure Readings, Breaks, and Boil Water Advisory - July 2019



Population Effected	Minimum # Samples Needed
1-500	1
501-1,000	2
1,001-2,000	3
2,001-3,000	4
3,001-4000	5
4,001-5,000	6
5,001-7,500	7
7,501-10,000	8
10,001-25,000	9
25,001-50,000	10
>50,000	11

PWSA Process Flow for Reporting Low Pressure Readings, Breaks, and Boil Water Advisory - July 2019

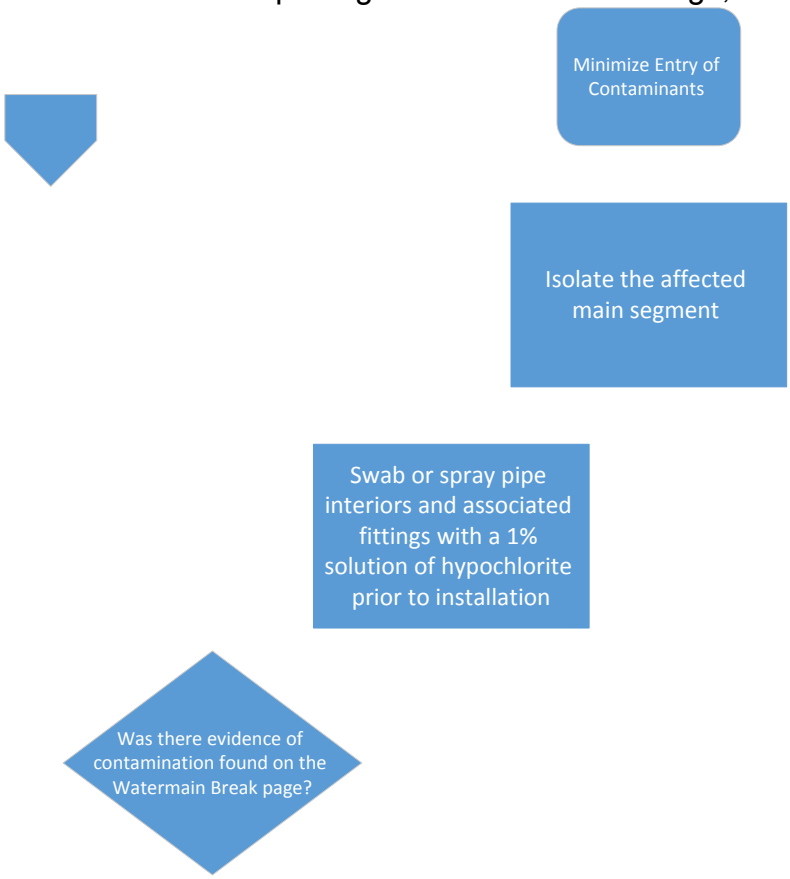


Exhibit RAW/C-43

The new meters will need to be installed in accordance with the Authority's design guidelines which may include meter vaults in sidewalk areas. It is anticipated that in many instances the installation of new meters will require that a detailed design be undertaken for each location including: field location surveys to determine underground utilities in the area; determination of the appropriate size and type of meter for the facility and the potential need for separate fire suppression lines and detector check-metering; meter orientation and accessories to assure accurate metering; means and methods to effectively install the new meter(s) while minimizing shutdown periods to the building; positioning the new meters in a location that will be easily accessible for future maintenance; etc.

Approximately 100 sites have already been identified and there is a program in place to locate and visit the remaining locations. Once the inventory of unmetered properties is completed, a prioritization process will be undertaken. It is envisioned that the priorities would be to install meters at the largest users first and concentrating on those facilities that can easily accommodate a new meter with minimal impact on the facility and surrounding areas. It is expected that the meter installations will be included in annual meter installation contracts which will include approximately 50 - 75 installations depending on overall complexity and cost of the installations.

PWSA commits to the following timeframes:

- By June 29, 2020 unmetered and/or unbilled locations shall be identified.
- PWSA will provide status updates regarding this process in the PWSA Compliance Plan Quarterly Reports and, once complete, PWSA will identify all the newly metered and/or previously unbilled properties.

2.3.7.2 Flat Rate Properties

The first step for flat rate properties will be to evaluate each site to determine the reason that the property is flat rate. Some meters can be installed by Authority operations. However, some properties, such as party line properties, will need assistance from engineering or an outside contracting service for design of the party line separation. The Authority anticipates that many of these party lines could be lead and will also require the assistance of the lead service line replacement program team for customer outreach and regulatory compliance.

2.3.8 Large Meter Replacement Program

In addition to the installation of new meters at unmetered buildings, the Authority will also be undertaking a large meter changeout program. Those aged meters (estimated to be approximately 800, 3-inch and larger units and approximately 2,500 1.5-inch to 2-inch units) that are not in compliance with PUC regulations will be scheduled for replacement. These meter replacements will be undertaken by current staff over the next 5 years. However, the Authority will evaluate the need for additional outside contract services to perform pre-installation inspections of each location to determine work and equipment required prior to mobilization of meter crews.

2.4 Eligible Water System Property to be Improved

Table 2-5 in Appendix B describes the 12 projects or project categories which comprise the eligible water system projects of this LTIIP as discussed above. These projects conform to the definition of "eligible property" described in section 1.1.1.

7 WORKFORCE MANAGEMENT AND TRAINING PROGRAM

The Commission requires a utility to have a workforce management and training program adequate to ensure that the utility has access to a qualified workforce to perform work in a cost-effective, safe, and reliable manner. The Authority's proposed workforce management and training program is described below.

7.1 Current and Proposed Workforce

7.1.1 Workforce Development

The challenges presented by an expanded infrastructure improvement program described in Section 5 of this LTIIP are not insurmountable. The existing workforce at the Authority provides a solid foundation upon which to build the staff and skills it~~s~~ needs to become a high-performing organization.

The current and projected full-time workforce of the Authority is presented in Table 7-1. It is shown in the table that 122 new employees are planned to be hired to accomplish the work associated with the CIP which includes the eligible property infrastructure improvements. Onboard staff will be supplemented by contracted personnel.

Table 7-1

Current and Projected Workforce

DEPARTMENT	CURRENT	2019 BUDGET	PROPOSED ADDITIONS	2023 PROJECTED TOTAL
Executive/Administration	4	4	1	5
Customer Service	49	55	4	59
Management Information Systems	8	10	9	19
Finance	5	8	6	14
Procurement	3	3	3	6
Human Resources	4	6	3	9
Legal	2	3	1	4
Warehouse	4	6	3	9
Public Affairs	6	8	3	11
Water Quality (Lab)	5	5	7	12
Water Treatment Plant	45	56	12	68
Water Distribution	97	132	20	152
Sewer Operations	37	34	20	54
Engineering & Construction	29	64	30	94
Environmental Compliance	3	8	0	8
Total	301	402	122	524

PWSA quantified these staffing projections by evaluating the then current job openings/ postings for both the current and projected project demands coupled with an understanding of PWSA staff utilization/capacity to handle additional, (both planned and estimated unplanned) projected work load. Additionally, PWSA expects that it will need to hire additional contractors to accomplish the work

associated with the CIP. PWSA is not able to present an estimate of the exact number of contractors that may needed at this time as that figure is dependent on both the progress of building an internal workforce and the final determination of actual needs and scope of the projects associated with the CIP. The objectives, commitments, outreach activities, and measures of success discussed below will enable PWSA to build a workforce to meet the needs of increased capital spending.

Success in hiring new permanent employees will depend upon the attainment of two major objectives:

1. Increasing our hiring effectiveness
2. Enhancing workforce engagement and performance

Developing a strong workforce to meet the demands of planning, designing, and overseeing the construction of new and rehabilitated infrastructure and other capital improvement programs will rely upon identifying and hiring qualified applicants. To that end, the Authority is committed to:

- Implementing a new Human Resources Information System (HRIS)
- Reviewing and improving job postings and position descriptions
- Optimizing and streamlining the hiring process and timeline
- Reviewing employee total compensation packages to ensure competitiveness with the engineering and utility industries

The Authority will aim to extend its outreach to industry publications, community partnerships, and other venues to reach prospective talent.

The Authority will use two measures of success to determine the effectiveness of its hiring program:

1. Hiring response time: our goal will be that the average time to fill existing positions is less than three months from the date of the vacancy
2. Position vacancy rate: our goal will be an average vacancy rate of less than 3%.

In terms of the second goal to enhance workforce engagement and performance, the Authority understands that increasing the efficiency and effectiveness of the organization requires engaged, developed, and high-performing employees. Growing and retaining the existing workforce will require the Authority to:

- Work cooperatively with unions to find and act on opportunities to increase workforce performance and effectiveness
- Complete a training program roadmap and inventory of the training requirements for all positions at the Authority
- Dedicate additional resources to training and development, as well as health, safety, and risk management
- Establish and track productivity goals for work groups, where applicable
- Develop a program to recognize high-performing employees

Four measures of success will be used to determine effectiveness of its workforce engagement program:

- Training hours per year: with a goal of 20 hours per year per employee
- Safety compliance: our goal will be to maintain a worker's compensation experience modification rate of less than 1.0
- OSHA compliance: meet OSHA requirements
- Staff engagement survey: one every 3 years

The Authority will use a combination of internal and external resources to address the critical staffing needs associated with the infrastructure improvement program. The Authority will utilize Program Management support to execute the program with design and construction management services primarily provided by consultants. The Authority intends to cost-effectively increase staffing levels to ultimately assume the role of program management of the CIP.

7.1.2 Overcoming Workforce Challenges

In order for PWSA to implement the wide variety of improvements discussed in this LTIIP, PWSA must continue to restructure its resources, increase the number and expertise of Operations and Engineering Staff, and increase the number of available consultants and contractors. PWSA has previously encountered a number of workforce challenges, including frequent leadership turnover, a union environment that limits workforce flexibility, limited compensation, financial constraints, residency requirements, water utility recruitment issues, and an aging workforce. PWSA has addressed these workforce challenges by focusing on its workforce objectives, adhering to its workforce commitments, extending its outreach activities, and evaluating its measures of success, as described in detail in Section 7.1.1. PWSA is committed to continuing these practices. PWSA's success in overcoming its workforce challenges is demonstrated as follows:

- Operations has been reorganized. Four experienced (from Pennsylvania American Water Company) Senior Managers have been hired to manage the Operations field services teams. Existing field service managers, one of whom is retiring, are being assigned to Valves, Hydrants and other related appurtenances management.
- Operations is now realigning its resources to ensure that the key program metrics are being met, including meter installation rates. A number of plumbers have been assigned to these tasks, and have achieved a significant improvement in the meter install rate.
- Operations continues to hire laborers to the extent that they are available. Plumbers, electricians and other trades candidates have become limited, and hiring is impacted by the current domicile requirement.
- Engineering has been restructured under a full time Senior Program Manager, and a permanent Director of Engineering and Construction, as well as a Permanent Deputy Director, have been hired (most of these Senior Managers have been working for PWSA for several years as embedded consultants). Four new project managers have been hired, as well as several

additional consultants to manage the outstanding critical projects. Additional Project Managers will be hired as temporary staff as they become available to manage the existing projects.

- Consultants operate under On Call Services Agreements, which are about to expire. A new Request For Proposals has been prepared and will be advertised to engage consultants under new contracts by the end of July (when existing contracts start to expire).

- Construction Contractor outreach is being implemented to solicit contractors from outside the Allegheny County area. As project sizes increase, the interest by out of state contracting firms will be evident.

- Metering activities have been accelerated by restructuring the process, and PWSA has now achieved a change out rate of more than 800 per month. We continue to optimize the process and expect that the 10,000 meter per year rate can be achieved.

- The metering of unmetered buildings is now beginning the initial assessment phase, during which consultants will determine what physical plumbing and other improvements are needed to install meters in unmetered public buildings. Once these initial studies are completed, PWSA will establish a formal schedule for the implementation of metering.

The Authority continues to increase its staff and consultant resources to increase the rate of project implementation, at all levels and departments. The Authority is confident that the proposed schedules can be met, and possibly improved upon, dependent upon the ability of its Management Team to effectively add the additional resources. PWSA anticipates that its Management Team restructuring for Engineering, Finance, Procurement, Operations, and Human Resources can implement the entire program, though some time to "ramp up" its capacity is needed. The Authority is extremely sensitive to the need for its capacity increase to be sustainable, and is stressing the development of internal infrastructure and related systems to enable its growth in project execution and delivery. The Authority intends to be deliberately cautious with the rate of personnel increase to ensure the sustainability and optimize performance of its organization.

PWSA will continue to update its project schedules based upon the availability and capability of its workforce, and the commitments of its Consultants and Contractors. All schedules will account for the larger issues related to other mandates from Federal and State regulators, which could pre-empt some of PWSA's commitments to the PUC.

7.2 Training Programs

7.2.1 e-Builder Training

The Authority's Program Management Team with support of Authority Project Controls personnel have conducted e-Builder training for Authority personnel and others on the myriad elements of the system. The personnel trained and to be trained, and the topics of training, are shown in Table 7-2 (located in Appendix B). The Team provides one-on-one and group training and distributes reference materials to each participant. In addition to this formal training, "e-Builder Hot Topic Meetings" are held monthly. Typical topics include:

8 OUTREACH AND COORDINATION ACTIVITIES

8.1 Construction Coordination

The Authority has developed a coordination team with the City and its other utility members. In addition, PWSA is developing a robust GIS based data layer to communicate its plans to other utilities. At present, the critical coordination appears to be with the City, specifically the annual paving plans, and the local Gas Companies' piping improvements. Significant improvement is expected with the coordination between the PWSA and the City as a result of the City's hiring of a new Chief Engineer, and additional engineering staff, which has delayed coordination in the past. Additionally, PWSA has assigned specific utility coordination duties to a primary, internal utility coordination staff member within the Engineering Department.

Additionally, a~~A~~s previously indicated in this report, the Authority is currently updating its GIS to add water and sewer system data, evaluate and edit existing data, and refine its data retrieval processes in order to make the system more comprehensive, dependable, and easy to use. Annually, water and sewer system capital projects including replacements, rehabilitations, and repairs are selected and vetted to the Authority's engineering department before being prioritized for the coming budget year. As part of this process, the Authority solicits information from PennDOT, Allegheny County, homeowner's associations and other utilities as to their intentions to undertake paving and other public works projects during the budget year. The Authority attends monthly utility coordination meetings with the City's Department of Mobility and Infrastructure (DOMI) and other local utilities and coordinates construction and repair efforts when possible to avoid conflicts where overlapping work is identified. Additionally, PWSA will utilize resources, including the Pennsylvania 811 Coordination web service application, to identify opportunities for collaboration between projects and to meet the need for increased coordination with local utilities and local, state, county and city government agencies.

Whenever and wherever the Authority decides to undertake a pipe or manhole refurbishment project on a road pre-scheduled for paving, the project is coordinated with the State, County, City or appropriate municipality. The Authority works closely with the government agency to ensure that the design, permitting and construction of the Authority's infrastructure project will be completed in time to allow for the road to be paved.

In some cases, the government agencies will agree to postpone paving of its roads to match the Authority's completion of construction date, even if it extends into the subsequent year. Typically, where the Authority undertakes a project where paving has been pre-planned by the involved government agency, the Authority and its rate payers will benefit financially through the avoidance of road surface restoration.

The Authority will continue the proactive means to identify opportunities to coordinate pipe replacement and road paving.

8.2 Lead Service Line Replacement Program Outreach

In full support of the COA, the Authority has built a program to support its customers through the lead service replacement process. These outreach and communication efforts encourage property owners to participate in the current no-cost private lead service replacements offered in contract work areas. The

Exhibit RAW/C-44

Pittsburgh Water & Sewer Authority

Service Line Material Inventory
Revised Approach
July 31, 2019

1.0 Introduction

In 2017 Pittsburgh Water and Sewer Authority (PWSA) developed a Curb Box Inspection (CBI) program to assist in their efforts to complete an inventory of service line materials throughout the water service area's 70,073 residential customer Accounts. After an initial trial of about 5,060 locations in 2017, PWSA developed a comprehensive CBI program and completed inspections in 2018 at around 15,000 locations. After the 2018 Curb Box Inspection (CBI) Program was completed, PWSA conducted an evaluation of the program and its value for completing the supplemental materials evaluation required by the November 2017 Consent Order and Agreement (COA) between the Pennsylvania Department of Environmental Protection (PA DEP) and PWSA, specifically provision 1. c. iii which reads as follows:

> *On or before December 31, 2020, PWSA shall provide a supplemental materials evaluation to the Department for all residential structures (single family and multi-family) connected to the system for which PWSA has not been able to confirm the absence of lead service lines, based on the sources of information listed in 25 Pa. Code SS 109.1103(g)(1)(ii) and (iii), the results of PWSA's inspection of service lines (including curb box inspections, if technically feasible, and other field studies, if technically feasible), or both. PWSA shall also identify the ownership of all portions of each line.*

The purpose of the CBI Program is to determine service line material type for both the PWSA-owned and privately-owned portions of the service line at the curb box, where historic records indicate lead, galvanized iron, or there is indeterminate or no data.

2.0 Effectiveness of CBI Program to Diagnose Service Line Materials

Based on the results of the 2018 CBI Program, PWSA had an opportunity to evaluate the data and determine if continuing the program would meet the requirements of the COA and other program objectives in providing a supplemental service line materials evaluation by 2020 to confirm the absence of lead service lines.

2.1 Objective of CBI Program

There are three main objectives associated with the CBI Program as follows:

Lead Help Desk:
412.255.8987
LeadHelp@pgh2o.com

Resources:
pgh2o.com/lead-facts

Stay Connected:
@pgh2o

Penn Liberty Plaza I
1200 Penn Avenue
Pittsburgh PA 15222

1. Comply with Paragraph 3.c.iii of the Consent Order and Agreement between PWSA and the PADEP as described above;
2. Use as a planning tool for determining which portions of the water system to conduct water main relays and future LSLR programs (i.e. what percent or number of service lines are lead in a given main or area); and,
3. Provide data for the LSLR program related to exactly which locations require replacement.

2.2 Description of CBI Program

Service line material is determined by locating and cleaning the curb box and inserting a small camera down the box to determine material type. The camera is typically inserted the full depth of the curb box so that the curb stop and connecting service lines (public- and private-side) are visible. A lead line is identified as having an indicative bulb-type "wipe joint" - this wipe-joint is the method in which the lead line was attached to the valve. Non-lead lines are typically identified by the fittings observed in the curb box.

Where the CBI indicates lead, the result has been extremely accurate when the location is excavated, and the actual service line observed. In instances where non-lead is identified at the curb box, PWSA cannot determine with certainty that the entire service line is not lead. This is because in some instances the curb stop and a small portion of the service line necessary to complete the reconnection to the existing service line (called a tail piece) may have been replaced, so the investigator cannot confirm if other portions of the service line may still be lead material.

The CBI itself may also not be successful for the following reasons:

- Inability to locate curb box (labeled as "cannot locate" in records);
- Curb box damaged or misaligned such that equipment cannot access the curb stop (labeled as "not accessible" in records); and,
- Line degraded or photos not clear and cannot determine material type (labeled as "unknown" in records).

2.3 Results of the 2018 CBI Program

The results of the public side 2018 CBI Program are as follows:

Lead Help Desk:
412.255.8987
LeadHelp@pgh2o.com

Resources:
pgh2o.com/lead-facts

Stay Connected:
@pgh2o

Penn Liberty Plaza I
1200 Penn Avenue
Pittsburgh PA 15222

Table 1: 2018 CBI Program Results – Public Only

Category	Public Side		Private Side	
	Quantity	Percent	Quantity	Percent
Total CBI	14,745	-	14,745	-
Public Side Lead	1,310	8.9	1,194	8.1
Public Side Non-lead	2,410	16.3	2,363	16.0
Public Side Unknown	6,764	45.9	6,927	47.0
Public Side Cannot Locate or Not Accessible	4,261	28.9	4,261	28.9

2.4 Comparison between 2017 CBI and 2018 LSLR

As the 2018 Lead Service Line Replacement (LSLR) Program has progressed, PWSA has continued to compare the LSLR verification process (conducted by excavation) to the results of the CBI programs. The following shows a comparison of the results of the 2017 CBIs and the actual verifications for almost 3,000 LSLR locations completed in 2018 and 2019:

Table 2: Verification of 2017 CBI Data

Verified To-date	CBI Public			Verified Public		
	Material	Quantity	% of Verified To-date	Material	Quantity	Percent of CBI Material Quantity (%)
2,955	Lead	549	19	Lead	531	97
				Non-Lead	18	3
	Non-Lead	588	20	Lead	165	28
				Non-Lead	423	72
	Unknown	1,340	45	Lead	733	55
				Non-Lead	607	45
	Cannot Locate or Not Accessible	478	16	Lead	298	62
				Non-Lead	180	38

Lead Help Desk:
412.255.8987
LeadHelp@pgh2o.com

Resources:
pgh2o.com/lead-facts

Stay Connected:
@pgh2o

Penn Liberty Plaza I
1200 Penn Avenue
Pittsburgh PA 15222

As shown, when a CBI indicates lead, the result is extremely accurate as lead is found 97 percent of the time when the curb box is excavated. However, if the CBI result is non-lead, 28 percent of these locations are determined to be lead upon excavation, often representing a location where a curb stop has been replaced. The results for locations where the CBI program was unsuccessful in identifying the service line material are closer to being equally split between lead and non-lead.

2.5 Discussion of CBI Results

Results from the 2018 CBI program (note the table in Paragraph 2.4 above represents the results of the 2017 CBI program) indicate that there is no usable data for about 75 percent of the locations inspected. Of the remaining 25 percent, verification of the 2017 CBI data indicates that service lines identified as lead can be reasonably relied upon (a 3% false positive rate). Verification of the 2017 CBI results produced less reliable results for those identified as non-lead (a 28% false negative rate).

With regards to the three objectives of the CBI program previously discussed, the results thus far indicate the following:

1. COA Compliance: While continuation of the CBI Program might technically comply with the stated language of the COA, it can be argued that the program is not technically feasible for determining the inventory of service lines. About 9 percent of the total data on the public side of the service line indicates lead and can be relied upon, however there is little confidence in the remaining data, therefore the CBI program is not meeting the intent to confirm the absence of lead service lines.
2. Planning for Relay and LSLR Program: In areas that the CBIs do identify lead, the lead only data could be used to prioritize streets and work areas for future relay and LSLR programs. Again, however, this will be a comparison of streets/work areas using only about 9 percent of the actual locations in the data set that identify lead.
3. Provide Data for LSLR Replacement Sites – since the actual service line material is unknown in over 90 percent of the CBI locations (with the other 9 percent being identified as lead) all CBI locations need to be excavated to confirm the service line material type when conducting the LSLR program (given the 28% false negative rate in the non-lead CBI results). Therefore, the data collected from the CBI program does not meet this objective.

2.6 Potential Modifications to Future CBI Programs to Improve Results

Of the 75 percent of the locations where no public side information is available, actions can be taken to improve this data. For “not-accessible” and “cannot locate” locations, specific tools and instruments can be used to find the curb box, and once found, provide access to complete the CBI. Improving methods to find and access more curb boxes could result in additional data.

The largest quantity where there is no usable data for the public side is represented by the "unknown" category. These are locations where the photograph cannot positively identify the service line material type with a high degree of confidence. As the data was reviewed PWSA staff observed that there are several actions that can be taken to lower the number of "unknowns", including:

1. Classifying locations with visible plastic wrapping around the service line as "non-lead", as this material is used to wrap new copper service lines (but not when only a curb stop is replaced, and new copper tail pieces installed).
2. Attempt to classify curb-stop type to service line materials given certain curb stops were historically only used on lead service lines.
3. Lower the acceptance criteria to a different level of certainty.

3.0 Evaluation of Options to Completing the Updated Service Line Material Inventory

Based on a review of the results of the CBI Program, PWSA examined the current status of the Service Line Material Inventory and evaluated other options to complete the updated inventory. This evaluation was prepared taking into consideration work done to date and future near-term planned work (2019 and 2020) and longer-term planned work (2021-2026).

3.1 Current Expectation of Inventory through 2020

PWSA has 70,073 residential water customers in its service area. The following is a list of categories of the inventory of locations where we have (or will by the COA date of December 31, 2020) reliable data confirming the absence of public lead service lines.

Table 3: Service Line Inventory Status

Category	Number
Total Residential Services in PWSA System	70,073
Confirmed absence of lead lines expected by December 31, 2020	
By historic record, verification or replacement as of July 1700, 2019	38,292
2019-2020 LSLR and Relay Projects	9,164
Sub-total	47,456
Customers potentially with lead service lines after December 31, 2020	22,617
Locations of confirmed lead as of April 1, 2019[1]	609
Customers needing a plan for service line material diagnosis	22,008

1. Based on 2018 CBI Program areas outside 2019 LSLR areas.

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In light of the above concerns with continuing the CBI program in its historical format, PWSA evaluated other alternatives for providing the inventory at these 22,890 locations. Each of these possible alternatives is discussed below.

3.2 Deploy Different Detection Methods under CBI Program

Completion of the 2018 CBI Program allows the opportunity for an evaluation of the data being collected and reassess the program. If the CBI Program is continued, it should include the methods evaluated after the 2018 CBI Program (and discussed briefly herein) to reduce the occurrence of "not accessible", "unknown" and "cannot locate" results in future programs.

While the methods for improving the current CBI Program discussed above may increase the amount of usable data, the results still contain a large amount of uncertainty in the lead identification results. Based on the review prepared herein, PWSA believes that the CBI Program, by itself, is not a feasible nor cost-effective means to complete the updated service line material inventory.

3.2 Other Field Studies

In addition to CBI as a method of determining the absence of lead service lines, the COA references "other field studies" that can be used. PWSA considered other field studies to complete the inventory as follows:

Water Testing

PWSA evaluated the use of water testing as an alternate field study to assist in the service line inventory (or to test-out of replacement). Based on the research conducted and our experience, the following issues were encountered:

- Considerable variability in customer-conducted sampling procedures producing less reliable results;
- Inconsistent flushing of household plumbing affecting results; and,
- Internal plumbing and fixtures with lead content skewing the results.

PWSA will not attempt to use water testing to confirm the absence of lead lines.

Material Verification Through Excavation

Although not a "field study" (as described in the COA), PWSA evaluated options for completing the inventory through excavation of curb stops at all remaining residential service line locations.

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We examined programs in other communities (mainly Flint, Michigan) where this method has been successful to see if it could be duplicated in Pittsburgh. In Flint, the city based their initial verifications using hydro-excavation to excavate a 10 to 15-inch diameter hole on either side of the curb stop so that the service line material could be observed. This relatively low-cost option (around $300-$400 for the excavation only at both sides of the curb stop) can be completed because their curb stops (and sufficient distance on either side to identify the service line material) are located in the 'green space' between the street and sidewalk.

In Pittsburgh, the curb stops are generally located in sidewalks, with relatively few in 'green space' that would allow this simplified method to be used. Our current LSLR contracts have an average bid price of over $1,300 for excavation verification, not including a cost of about $500 for replacing the sidewalk concrete. This represents a cost to inventory the remaining 22,890 of about $41,000,000 (not including management, inspection and GIS updates which might add another $8 to 10 million to the budget).

Due to the cost and general disturbance associated with this option, PWSA will not use Material Verification through Excavation to confirm the absence of lead lines.

Private Side Internal Service Line Material Data

In late 2018, PWSA commenced an aggressive campaign to replace 50,000 residential water meters over the next 5 years. As part of the meter replacement program, PWSA created a tablet application used by PWSA plumbers to record the service line materials in the basement (or external meter pit as applicable). In addition to the service line materials, PWSA is identifying the household plumbing materials to better inform customers about other sources of lead in their properties.

The private side service line material types identified during the meter replacement program are loaded into the Geographic Information System (GIS) used by PWSA and become part of the overall service line material inventory. This program allows an excellent method to update the service line materials on the private side but will not address inventory needs on the public (PWSA owned) side. In addition, on occasion, the material PWSA identified inside the residence does not match what is found at the curb stop as a result of past line break repairs and replacements.

Additional Records

While not a 'field study' PWSA has recently discovered additional records that *may* include information regarding service line materials. These records mainly consist of data retained by the City of Pittsburgh that were not previously made available to PWSA. In addition, some data has been found for historical water main repairs and water main relay projects. PWSA is in the process now of compiling this additional data and updating the GIS with these records. We anticipate being able to update an

additional 2,000 to 3,000 service line records through this process. We expect that these records will provide data for mainly public service line materials.

3.3 Predictive Modelling

Flint, Michigan and other cities in the United States are either using or planning to use a predictive model to assist their LSLR Program to improve upon lead inventories, inventory discovery activities, and inventory replacement decisions. The Flint model uses statistical and machine learning tools to aid in identifying locations of lead. The statistical model adapts to incoming information, allowing it to become more accurate in its predictions over time. A copy of a technical paper describing the approach is attached.

Modeling is expected to identify the locations of lead lines to target the LSLR and Water Main Relay programs, so that more available funds are spent on replacing lead instead of identifying non-lead. The statistical model adapts to incoming information, allowing it to become more accurate in its predictions over time. Given the over 10,000 locations PWSA plans to excavate as part of its 2019 LSLR program, the 2019 Water Main Relay and 2020 Water Main Relay programs, this presents an opportunity to prepare and calibrate/validate the model with data collected during these programs. The model can then assist in determining where remaining lead lines exist which then will prioritize areas for future water main relay and LSLR programs.

The models that were used for the September 2016 and March 2018 materials evaluation updates predicted the number of residential lead service lines in the PWSA system. This model will predict the *locations* of residential lead service lines.

4.0 Recommendations for Completing the Updated Service Line Material Inventory

Based on the past two years of efforts by PWSA, it is clear that no single method is effective in performing a service line inventory that meets the intent of the COA to determine the presence or absence of lead service lines. Therefore, the approach PWSA developed for completing the Updated Service Line Material Inventory consists of multiple tools and methods for investigating the remaining 24,972 locations where the absence of a lead line will not be confirmed solely by the use of the CBI Program. These methods consist of the following:

1. Compile documents available from the City and PWSA archives to continue to update the GIS with these records. We anticipate being able to update an additional 2,000 to 3,000 service line records through this process, which should be complete in the fall of 2019.

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2. Continue to replace meters throughout the water service areas to provide information on the private side service line materials. This information will be a part of the inventory submitted by December 2020, but the effort will be complete in 2023.

3. A predicative, machine-learning model is being developed in partnership with the University of Pittsburgh (Pitt). Pitt Professors and students are working closely with the methods employed by the developers of the Flint, Michigan model to create a similar model for the data available in the PWSA water service area. Similar to Flint, the PWSA model will use a combination of CBI results, service line inspection results, service line replacement information, meter replacement information, historical records, water sample data, and Allegheny County property data. The results of the model will be used to predict the location of lead service lines throughout the remaining 22,890 water service locations.

   Preliminary efforts in developing the model show good correlation between the Flint model and PWSA efforts. The expected primary methodological differences between models customized for PWSA and those developed for Flint, MI are that Pitt will develop separate predictions for public and private lateral extents and use spatial cross validation for model development. Pitt and PWSA feel it is important to distinguish between public and private service lines given requirements of the Lead and Copper Rule.

   Spatial cross validation is important where predictions are to be made in neighborhoods unrepresented by the data used for model development, as is PWSA's intended use. Relative to models developed absent spatial cross validation, spatial cross validation will weaken performance diagnostics when applied to the data used for model development but, in turn, will produce more reliable predictions in new neighborhoods.

   The model will be completed (including calibration with available data) by the end of 2019.

4. For the locations predicted by the model, if the model predicts that a lead line is present, the results will be used to determine the location of a future LSLR or water main relay program by PWSA and the location will be excavated and replaced if lead is found.

   If the model predicts that a lead line is not present, a future CBI program will be developed to conduct a CBI of these locations. As the CBI is extremely accurate in determining the presence of a lead line, if no lead is observed through that inspection, coupled with the results of the inventory model and data from the meter replacement program, it will be considered confirmation of the absence of a lead service line. The future CBI Program will be completed by the end of 2020.

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A summary of the status of the PWSA service line material inventory is as follows:

Table 4: Service Line Inventory Status and Plan

Category	Number	Deadline for Update
Total Residential Services in PWSA System	70,073	-
Known Copper or Non-lead[1]	38,292	Complete
Locations of Confirmed Lead[2]	609	Complete
GIS Records Update[3]	3,000	December 2019
Predictive Modelling	31,172	December 2019
2019 Water Main Relay Projects[4]	695	December 2019
2019 LSLR Planned Verification or Replacement[5]	6,872	July, 2020
2020 Water Main Relay Projects[4]	1,597	December 2020
2020 CBI Program	Up to 19,008	December 2020
Remainder Needed to Inventory	0	December 2020

1. Based on historic record, verification or replacement as of April 1, 2019
2. Based on 2018 CBI Program areas outside 2019 LSLR areas.
3. Estimated
4. Estimated, based on 6 miles in 2019 and 10 miles in 2020
5. Planned LSLR locations

This plan and approach will result in a comprehensive and accurate inventory of residential service line materials throughout the PWSA water service area. Through PWSA's experience thus far with the inventory program, including significant verification of the current inventory approach and research of other inventory methods in cities across the United States, we have determined that no single method for inventorying the service line materials will provide accurate results. Based on this understanding, PWSA developed the proposed approach. The ultimate inventory developed through this process will provide immensely more value to PWSA and our customers in gaining a true understanding of residential service line materials throughout our water service area.

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Exhibit RAW/C-44

ActiveRemediation: The Search for Lead Pipes in Flint, Michigan

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ABSTRACT

We detail our ongoing work in Flint, Michigan to detect pipes made of lead and other hazardous metals. After elevated levels of lead were detected in residents' drinking water, followed by an increase in blood lead levels in area children, the state and federal governments directed over $125 million to replace water service lines, the pipes connecting each home to the water system. In the absence of accurate records, and with the high cost of determining buried pipe materials, we put forth a number of predictive and procedural tools to aid in the search and removal of lead infrastructure. Alongside these statistical and machine learning approaches, we describe our interactions with government officials in recommending homes for both inspection and replacement, with a focus on the statistical model that adapts to incoming information. Finally, in light of discussions about increased spending on infrastructure development by the federal government, we explore how our approach generalizes beyond Flint to other municipalities nationwide.

CCS CONCEPTS

• **Information systems** → **Data analytics**; • **Machine learning** → *Applied computing*;

KEYWORDS

Water Infrastructure; Flint Water Crisis; Risk Assessment; Machine Learning; Active Learning; Public Policy

ACM Reference Format:
Jacob Abernethy, Alex Chojnacki, Arya Farahi, Eric Schwartz, and Jared Webb. 2018. ActiveRemediation: The Search for Lead Pipes in Flint, Michigan. In *KDD '18: The 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining, August 19–23, 2018, London, United Kingdom.* ACM, New York, NY, USA, Article 4, 10 pages. https://doi.org/10.1145/3219819.3219896

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KDD '18, August 19–23, 2018, London, United Kingdom
© 2018 Association for Computing Machinery.
ACM ISBN 978-1-4503-5552-0/18/08…$15.00
https://doi.org/10.1145/3219819.3219896

1 INTRODUCTION

The story of the Flint Water Crisis is long and has many facets, involving government failures, public health challenges, and social and economic justice. As Flint struggled financially after the 2008 housing crisis, the state of Michigan installed emergency managers to implement several cost saving measures. One of these actions was to switch Flint's drinking water source from the Detroit system to the local Flint river in April 2014. The new water had different chemical characteristics which were overlooked by water officials. Of course many water systems have lead pipes, but these pipes are typically coated with layers of deposits, and the water is treated appropriately in order to prevent corrosion and the leaching of heavy metals. City officials failed to follow such necessary procedures, the pipes began to corrode, Flint's drinking water started to give off a different color and smell [11], and Flint residents were exposed to elevated levels of lead for nearly two years before the problems received proper attention. In August 2015 environmental engineers raised alarm bells about contaminated water[1] [21], not long after a pediatrician observed a jump in the number of Flint children with high blood lead levels[2][14], and by January 2016 the Flint Water Crisis was international news.

As attention to the problem was growing, government officials at all levels got involved in managing the damage and pushing recovery efforts. In looking for the primary source of lead in Flint's water distribution, attention turned to Flint's *water service lines*, the pipes that connect homes to the city water system. These service lines are hypothesized to be the prime contributor to lead water contamination across the United States [20]. Service lines, therefore, became a top priority for the City of Flint in February 2016. The Michigan state legislature eventually appropriated $27M towards the expensive process of replacing these lines at large scale; later the U.S. Congress allocated another nearly $100M towards the recovery effort. The group directed to execute the replacement program was called Flint Fast Action and Sustainability program (FAST Start), and their task was to remove as many hazardous service lines as possible up to funding levels.

The primary obstacle that the FAST Start team has faced throughout their work is uncertainty about the locations of lead or galvanized pipes. Although the U.S. Environmental Protection Agency requires cities to maintain an active inventory of lead service line locations, Flint failed to do so. Service line materials are in theory

[1] Prior work by the authors involved estimation of water lead contamination [1].
[2] For further analysis of blood lead levels, see [19]

documented during original construction or renovation, but in practice these records are often incomplete or lost. Most importantly, because the information is buried underground, it is costly to determine the material composition of even a single pipe. Digging up an entire water service line pipe under a resident's yard costs thousands of dollars. City officials were uncertain about the total number of hazardous service lines in the city, with estimates ranging from a few thousand to tens of thousands. Uncertainty about the service line material for individual homes has dramatic cost implications, as construction crews will end up excavating pipes that do not need to be replaced. These questions—how many pipes need to be replaced and which home's pipes need remediation—are at the core of the work in this paper.

Beginning in 2016, our team began collaborating directly with Flint city officials, analyzing the available data to provide statistical and algorithmic support to guide decision making and data collection, focusing primarily on the work of the FAST Start pipe replacement efforts. By assembling a rich suite of datasets, including thousands of water samples, information on pipe materials, and city records, we have been able to accurately estimate the locations of homes needing service line replacement, as well as those with safe pipes, in order to target recovery resources more effectively. Specifically, we have combined statistical models with active learning methods that sequentially seek out homes with hazardous water infrastructure. Along the way we have developed web-based and mobile applications for coordination among government offices, contractors, and residents. Over time, the number of homes' service lines inspected and replaced has increased, as seen in Figure 1.

In the present paper, we detail the challenges faced by decision-makers in Flint, and describe our nearly two years of work to support their efforts. With the understanding that many municipalities across the US and the world will need to undertake similar steps, we propose a generic framework which we call ActiveRemediation, that lays out a data driven approach to efficiently replace hazardous water infrastructure at large scale. We describe our implementation of ActiveRemediation in Flint, and describe the empirical performance and potential for cost savings. To our knowledge, this is the first attempt to predict the pipe materials house-by-house throughout a water system using incomplete data and also the first to propose a statistical method for adaptively selecting homes for inspection to replace hazardous materials in the most cost effective manner. This work illustrates a holistic, data-driven approach which can be replicated in other cities, thereby enhancing water infrastructure renovation effort with data-driven approaches.

Key Results. Among our main results, we emphasize that our predictive model is empirically accurate for estimating whether a Flint home's pipes are safe/unsafe, with an AUROC score of nearly 0.92, and a true positive rate of 97%. Since our approach involves a sequential protocol that manages the selection of homes for inspection and replacement based on our statistical model, we are also able to compare the model's total remediation cost to that of the existing protocol of officials. ActiveRemediation reduces the costly error rate (fraction of unnecessary replacements) to 2%, lowering the effective cost of each replacement by 10% and yielding about $10M in potential savings.

Methodology. Let us now give a birds-eye view of our methodological template. ActiveRemediation manages the inspection and replacement of water service lines across a city, with the long-term objective of replacing the largest number of hazardous pipes in a city under a limited budget. The formal in-depth exposition of this framework will be given in Section 3.

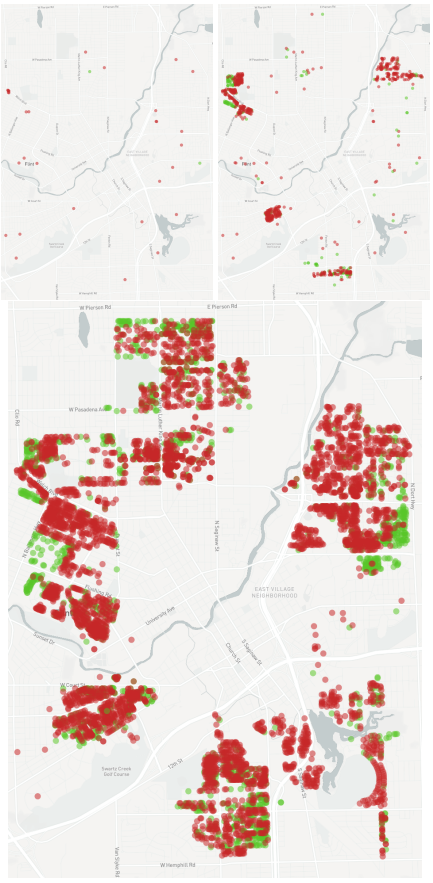


Figure 1: Progress of the replacement program. By March of 2016, only 36 homes had undergone replacement (top left); by December 2016, a total of 762 homes either been inspected or fully replaced (top right); as of September of 2017, this had grown to a total of 6,506 homes (bottom). Homes labeled green were selected for replacement but were deemed safe after copper lines were discovered by contractors.

Algorithm 1 ActiveRemediation

```
Input: parcel data, available labeled homes
for decision period t = 1, ..., T: do
    Predict hazardous/safe material via StatisticalModel
    if Budget remaining then querying StatisticalModel,
        Generate inspections via InspectionDecisionRule
        Generate replacements via ReplacementDecisionRule
        Input observed data to StatisticalModel
```

Since the process of identifying and replacing these lines around a city is naturally sequential, the decisions and observations made earlier in the process ought to guide decisions made at future stages. With this in mind, our framework continuously maintains three subroutines that are updated as data arrives. Following the outline

Date	Description
2016 Feb.	Attributes for all 55k parcels provided by the City of Flint
2016 Feb.	SL records digitized by M. Kaufman at UM Flint GIS
2016 March	Pilot Program, 36 homes visited, 33 SLs replaced
2016 June	Michigan DEQ provides SL private-portion inspections dataset
2016 Sept.	Phase One begins, contractors use our mobile data collection app
2016 Oct.	Fast Start begins hydrovac inspections to verify some home SLs
2016 Oct.	Congress appropriated $100M in WIIN Act.
2016 Dec.	Fast Start & authors release report: 20-30k replacements needed
2017 March	Federal court orders 18k homes to receive SL replacement by 2019
2017 Sept.	Fast Start replaced 4,419 hazardous service lines so far, identifying composition of a total of 6,506 homes.

Table 1: Timeline of service line data availability

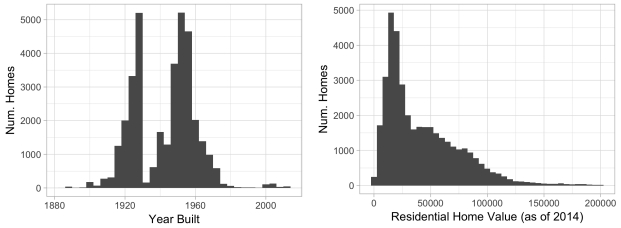


Figure 2: From city parcel data, distribution of home construction by year (left) and building value by dollar (right). The majority of the housing stock in Flint was built when it was a major automobile manufacturing hub, before current regulations about lead infrastructure were in place. Flint has experienced significant economic decline in recent years, leading to depressed real estate prices.

in Algorithm 1, the first of these is a StatisticalModel, that generates probabilistic estimates of the material type of both the public and private portion of each home's service lines. The input of this model is property data, water test results, historical records, and observed service line materials. The second subroutine is InspectionDecisionRule, the decision procedure that that generates a (randomized) set of homes for inspection. This should be viewed as an *active learning* protocol, with the goal of "focused exploration." The third routine, ReplacementDecisionRule, makes decisions as to which homes should receive line replacements; for reasons we discuss below, we typically assume that ReplacementDecisionRule is a *greedy* algorithm.

Roadmap. This paper is structured as follows. We begin in Section 2 by laying out the datasets available to us, with the story given chronologically to describe the shifting narrative as information emerged. We then explain the ActiveRemediation framework in greater detail in Section 3, and sketch out the statistical model mixed with the prediction, inspection, and decision-making framework. In Section 4 we employ ActiveRemediation on the data available in Flint, to show the empirical performance of our proposed methods in an actual environment, as well as in a simulated environment leveraged from Flint's data. We finish by detailing the potential for significant cost savings using our approach.

2 EMERGING DATA STORY OF FLINT'S PIPES

We now describe the various sources of data and the timeline during which these became available. This is summarized in Table 1 and more precise chronology is given throughout this section. More details will be available in the full version of this work.

2.1 Pre-crisis Information – Through mid-2015

In this section, we explain the relevant datasets that had been collected and maintained prior to the water crisis. This information, as we discovered later, was limited in both depth and quality.

2.1.1 Parcel Data. The city of Flint generously provided us with a dataset describing each of the 55,893 parcels in the city. These data include a unique identifier for each parcel and a set of columns describing City-recorded attributes of each home, such as the property owner, address, value, and building characteristics. A complete list of the parcel features is discussed in our previous work [7]. The distributions of the age of homes and their estimated values (Figure 2) tell an important story about the kinds of properties in Flint.

2.1.2 City Records of Service Lines. Initially, Flint struggled to produce any record of the materials in the city's service lines. Eventually, officials discovered a set of over 100,000 index cards in the basement of the water department[3] (see top of Figure 3). As part of a pro bono collaboration, the handwritten records have been digitized by Captricity.com and provided to the City of Flint.[4] Around the same time, a set of hand-annotated maps were discovered that contained markings for each parcel that specified a record of each home's service line (bottom of Figure 3). The map data was digitized by a group of students from the GIS Center at the University of Michigan-Flint lead by the director Prof. Martin Kaufman [10]. Many of the entries in the city's records list *two* materials for a given record, such as "Copper/Lead," but they do not specify the precise meaning of the multiple labels. However, our latest evidence suggests that, at least in the typical case, the double records were intended to specify that the second label ("Lead" in "Copper/Lead") indicates the public service line material (water main to curb stop), and the first label describes the private service line (curb stop to home), while an entry that is simply given as "Copper" may refer to both sections or only one. Lastly, there are a number of entries in the records that say "Copper/?" for the service line material, indicating missing information for the service line on the original handwritten records. Many other records are simply blank, recorded as "Unknown/Other."

2.2 Peak of Crisis & Replacement Pilot

In the wake of the crisis the State of Michigan began to discuss plans for lead abatement in Flint. It had become clear to lawmakers in Michigan that they would need to invest in a large-scale removal of lead pipes from the city. To begin, FAST Start initiated a pilot phase, with the goal of replacing the service lines of a small set of residences. Flint's Mayor and the FAST Start team awarded a contract to Rowe Engineering to replace pipes at 36 homes around the city. They selected these homes based on risk factors including the presence of high water lead levels, pregnant women, and children younger than 6 years old. Nearly all of the homes, 33 of 36, had some hazardous material (lead or galvanized) in one or both

[3] http://www.npr.org/2016/02/01/465150617/flint-begins-the-long-process-of-fixing-its-water-problem

[4] We would like to thank Captricity, especially their machine learning team, Michael Zamora, Michael Zamora, David Shewfelt, and Kayla Pak for making the data accessible.

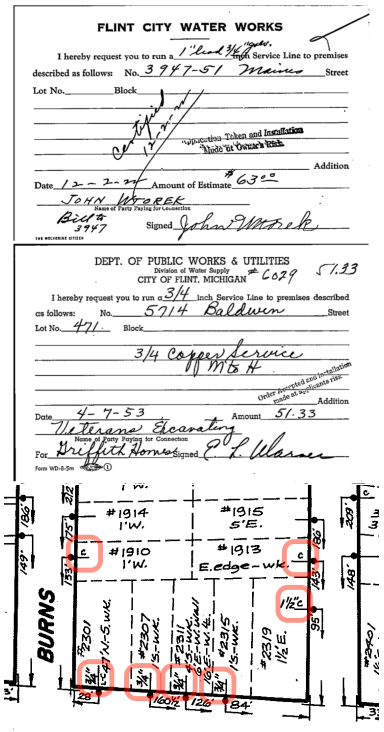


Figure 3: City officials located a set of over 100,000 handwritten index cards (top) with recorded work information dating back over 100 years, and annotated maps with data on home SLs (bottom). Red circles added to emphasize markings denoting material types.

portions of the service lines, while only 3 were safe. Therefore, the number of homes with physical verifications of both service line portions through September 2016 was only 36 out of over 55,000 homes. A map showing the progress of replacement in Flint can be found in Figure 1.

	Verified SL Materials (Public-Private)						
City Records	C-C	C-G	L-C	L-G	L-L	Other	All
Copper	1115	10	258	84	13	9	1489
Cop./Lead	109	20	816	91	15	25	1076
Galv./Other	113	18	565	1286	81	31	2094
Lead	24	2	29	14	12	3	84
Unknown	152	18	535	1169	118	42	2034

Table 2: Discrepancies between city records of service lines, and materials verified via inspection or replacement.

Meanwhile, in order to gather reliable information about private part of the service lines, the Michigan Department of Environmental Quality (DEQ) directed a team of officials and volunteers from the local plumbers union to personally inspect a sample of the homes of Flint residents. The public portion of the service line runs entirely under the street and sidewalk, while the private portion runs directly into the basement of the residents' home. Thus, the private portion can be inspected without any digging. The DEQ inspectors submitted their inspection results. As of June of 2016, the department had collected a data from over 3,000 home inspections. We consider this data to be reliable, since it was curated by DEQ officials who provided it to our team. This dataset allowed us to partially evaluate the reliability of the city records discussed in Section 2.1. It is important to note that the comparison is not "apples to apples," as the DEQ inspections were private-portion only whereas the labels in the city records did not specify which portion of the line was indicated. We report the confusion matrix between DEQ inspection data and city records in Table 2. The comparison suggests that, while the records were correlated with ground truth, the discrepancies were substantial.

2.3 Large-Scale Replacement, Mid-2016 to Now

Our group at the University of Michigan began engaging with the FAST Start team in the summer of 2016. One of the critical decisions the team needed to make was the selection of homes that would be recommended for service line replacement. According to the FAST Start payment agreements, contractors receive roughly half ($2500) the cost of a full replacement ($5,000) for excavated homes with copper on both public and private portions, due to removing concrete, refilling concrete, machine use, and labor. The choice of homes was deemed critically important, as the excavation of a home's service line that discovers a "safe" (e.g., copper) pipe is effectively wasted money, aside from the benefit of learning of the pipe's true material. Our work has focused on minimizing such unnecessary excavations, using the tools we describe below.

2.3.1 Early Replacement Activity and Findings (Fall 2016). By summer 2016, FAST Start had selected a set of 200 homes for replacement, scheduled to begin August, 31st. This selection is called Phase One. Like the Pilot Phase, their criteria included the presence of high water lead levels, pregnant women, children under six years old, as well as veterans and the elderly. In the present section, we describe how we helped facilitate data collection for Phase One, and how the results forced us to rethink our objectives and adjust our models.

By late September 2016, the early data from the service line replacement program began to arrive, and the rate of lead and other hazardous pipes discovered was alarming; 96% (165/171) of excavations revealed lead in the public portion of the line. These findings differed significantly from the city records, which had previously indicated that among those homes only 40% would contain lead in either portion. As data from Phase One arrived it was becomingly increasingly clear that *likely over 20,000 homes* have unsafe pipes serving their water – dramatically higher than earlier estimates. Critically, as these discoveries were being made, a debate was taking place in the U.S. Congress discussing the possibility of more than $100M in funding for the Flint's recovery efforts.

With the debate in the Congress ongoing, our team decided to put out an informal report to raise the alarm about the extent of the lead issue, and several news outlets reported on our findings [e.g. 5, 8]. This effort lead to a formal report in November of 2016 that provided a more precise estimate of the number of lead replacements likely to be needed [18], which was provided to the city's mayor, the DEQ, and the U.S. Environmental Protection Agency. Our report, based on comparing the city records and the data gathered from

contractors, suggested that the number of needed replacements would be between 20,600 and 37,100. The large range accounts for the inherent uncertainty in data collection and model assumptions, as well as the question of *occupancy*. One challenge that is specific to Flint is the fact that around one third of the city's homes are not occupied, a rate that is the *highest in the country*[5].

2.3.2 Contractor Data Collection Application. With thousands of homes scheduled to have their water service lines excavated by multiple contractors, the collection and management of the data generated by this large-scale effort would prove to be a logistical challenge. While initially there was a plan in place to collect data via paper forms that would later get transferred to a spreadsheet, it was increasingly clear that digitally recording information, and storing it centrally, would be a more effective strategy and less prone to error.



Figure 4: Mobile and web app, developed by the authors, to gather replacement data from contractors on-site.

Our team volunteered to facilitate the data collection efforts. In the fall of 2016, we developed a web and mobile application with various access levels. The latest version of this app is a custom-built web application using Python and the web framework using Flask. The users, on-site contractors as well as DEQ and Fast Start officials, are asked to select homes and to fill in essential information about service line work accomplished at each site. This information includes the excavated pipe materials, lengths, dates, and data on the home's residents. The output of the form appears in real-time in a live database with mapping capabilities. We adopted a tiered permissions structure with password-protected information to maintain the privacy of the data. The app continues to be used as of this writing for tracking progress for the public and for paying contractors for completed work.

2.3.3 Hydrovac Digging: Inspection without Replacement. The foremost challenge of a large-scale service line replacement program is the uncertainty about which homes possess safe service lines and which homes have lines made of hazardous materials. As of the summer of 2016, the only concrete verified data on pipe materials across the city consisted of the 36 data points provided by the Rowe engineering. By the end of Phase One, this number increased to about 250 homes. At this point, the excavation of pipes at a single home would cost anywhere from $2,500-5,000, a prohibitively high cost for data collection. At the same time, the available replacement data consisted of *cherry-picked homes*: houses were selected for line replacement if they were presumed to have an overwhelming likelihood of lead. These addresses and were highly concentrated in only three neighborhoods (see Figure 1) and provided nothing close to a representative sample of the broader city. We therefore realized, and emphasized to members of FAST Start, that the effort required a cheaper, quicker, and more statistically sound method to gather data.



Figure 5: Using a hydrovac truck for inspection, requires a large truck and crew (left) and exposes the pipe material underground (right).

After a lengthy discussion with water infrastructure experts and contractors, a new alternative emerged: *hydrovac inspections*. A hydro-vacuum truck, or simply a hydrovac (see Figure 5), has two main components: a high-pressure jet of water used to loosen soil and a powerful vacuum hose that sucks the loosened material into a holding tank. The hydrovac technique allows workers to dig a small hole quickly and then inspect whatever is observed underground. It is ideal for determining service line materials, as it can dig at the location of the home's curb box (connects the home's service line at the property line to the water main), and observe the pipe materials for both the public and private portions of the service line. The cost can be as low as $250 per inspection and often does not require prior approval from residents, as the digging site is mostly confined to city property. One limitation is that the hydrovac can only dig through the soil, and not through driveway or sidewalk pavement. This limitation led to unsuccessful excavations 20%-25% of the time, according to the hydrovac engineers.

The selection of homes for hydrovac inspection was one of the primary contributions of our team to FAST Start's efforts, and we were given wide discretion for "sampling" homes. This reflects the political and logistical challenges of service line replacement, as full excavation of service lines required a much longer process with oversight by the city council. We would emphasize that, in the following section where we describe our sequential decision protocols, our primary focus was on the model and inspection subroutines, and we assume the replacements are made using a simple greedy strategy.

3 PREDICTION & DECISION FRAMEWORK

In this section, we formally define the sequential decision-making problem for a city, in our case the city of Flint, seeking to remove all of the lead service lines from its homes under the following conditions: (i) for almost all homes, the service line materials of homes are unknown; (ii) there is a method of inspection to collect information; (iii) it is costly to excavate service lines that do not

[5]https://www.reuters.com/article/us-flint-vacancies-idUSKCN0VK08L

need to be replaced; and (iv) there is a fixed budget for replacement and inspection.

There are N total homes in the city, and it is unknown which homes need new service lines. We let the unknown label for home i be $y_i \in \{0, 1\}$, taking on the value 1 if the home needs a replacement and 0 otherwise. Note that a home needs replacement if either the public *or* private portion of the service line is hazardous. We also have information about each home, denoted by a vector x_i, with m features, that describe it (see Section 2). We want to learn the label y_i given x_i, for each $i = 1, \ldots, N$. We divide the procedure to find out these labels into two steps: first, a statistical model for prediction (StatisticalModel); and second, an algorithm that decides which homes to observe next (InspectionDecisionRule).

There is another decision rule, ReplacementDecisionRule, that determines which pipes to replace next. ReplacementDecisionRule is a *greedy* algorithm. That is this algorithm recommends that the replacement crew should go to the homes with the highest probabilities of having hazardous pipes. Given that, our InspectionDecisionRule is focused on learning, and ReplacementDecisionRule uses that learning to reduce costs.

3.1 StatisticalModel

In this section, we describe StatisticalModel, which assign a probability that a service line contains hazardous materials. StatisticalModel is a novel combination of predictive modeling using machine learning and Bayesian data analysis. First, a machine learning prediction model gives a prediction for the public and private portion of each home's service line using known features. These predictions then become the parameters to prior distributions in a hierarchical Bayesian model designed to correct some of the limitations to the machine learning model.

3.1.1 Machine Learning Layer. The machine learning layer of StatisticalModel outputs a probability of having a hazardous service line material for each home for which the material is unknown. Specifically, this layer gives a prediction, $\hat{y}_{i,k} = f_\theta(X_{i,k})$, the probability that service line portion k for home i is hazardous, and $X_{i,k}$ is a vector of features, described in Section 2.1. After examining several models empirically (see Section 4.1) we chose the machine learning layer, $f_\theta()$, to be XGBoost, a boosted ensemble of classification trees [6].

3.1.2 Hierarchical Bayesian Spatial Model Layer. One limitation of classification algorithms is how they handle unobserved variables, which may be correlated with the outcome. We address this limitation with a hierarchical Bayesian spatial model. This accounts for unobserved heterogeneity related to geographic location and similiarity of homes, which is used in hierarchical spatial models with conditional autoregressive structure [12, 13, 15, 16]. Empirically, each geographic region across the city (e.g., voting precincts) has a different number of observed service lines. While a city-level (pooled) model ignores precinct differences and a separate (unpooled) model for each precinct is limited by small sample sizes or even no observations, our full hierarchical (partially pooled) model strikes a balance with shrinkage. Precincts with little information will have their parameters pulled towards the city-wide distribution. Details of the Bayesian model, and how these are combined with the machine learning layer, are explained further in the full version of the paper.

Table 3: Summary of notation

Notation	Explanation
$\mathcal{X}$	observable feature space for each parcel/home
x_i, y_i	observable features for home i, label for home i
$\mathbf{h}_t / \mathbf{r}_t$	indicates "home i inspected/replaced at t?"
$y_t^{\mathbf{h}} / y_t^{\mathbf{r}}$	indicates "learned i's' label via inspect./replace?"
Q_{it}	indicates "learned i's label at t?"
q_{it}	indicates "already know i's label at t?"
$c^h, C^{\mathbf{r}+}, C^{\mathbf{r}-}$	cost of inspect., successful SLR, & failed SLR
U_t, L_t	set of labeled/unlabeled data at t

3.2 InspectionDecisionRule

Now we describe InspectionDecisionRule, which utilizes active learning [2, 3, 17] to efficiently allocate scarce resources to find and replace hazardous service lines. In general, a decision-maker may choose any active learning algorithm for inspection. In this work, we implement a version of Importance Weighted Active Learning (IWAL).

3.2.1 Active Learning Setup: Inspection and Replacement. We begin by describing the problem of efficiently locating and replacing hazardous pipes in a pool-based active learning framework (see Algorithm 2). Consider a budget of B total queries and a pool $\mathcal{P} = \{x_1, \ldots, x_n\}$ of unlabeled homes. Then at each time period t the algorithm will produce a probability vector $\phi_t = (\phi_{1,t}, \ldots, \phi_{n,t})$ that gives the probability that any home i is chosen at t.

Contractors can determine the material of a service line via either hydrovac inspection or service line replacement. When home i is chosen for hydrovac inspection at time t, we denote $\mathbf{h}_t = i$. When the service line for home i is replaced at time t, we denote $\mathbf{r}_t = i$. Once inspected or replaced, y_i is known for all subsequent rounds $t, t+1, \ldots$ and $p_{i,k}$ becomes 1 or 0, and we define $q_{i,t} = 1$ if home i has been observed through round t. $n_t^{\mathbf{h}}$ and $n_t^{\mathbf{r}}$ are the number of hydrovac and replacement visits, respectively. The number of successful replacements is denoted as $n_t^{\mathbf{r}+}$ (true positives) and the number of unnecessary replacements as $n_t^{\mathbf{r}-}$ (false positives).

We initially set $U_0 = \mathcal{P}$, and let $U_t = \{x_i | q_{i,t} = 0\}$ be the set of homes whose service line material is unknown at time t, and L_t be the set of homes with known service line materials. Finally, the budget also allows for a fixed number of inspections d for each period. The problem is how to select these d homes with unknown labels at each period t to maximize information gained.

3.2.2 Simple Active Learning Heuristics: Uniform and Greedy. We first propose several benchmark strategies for selecting homes for inspection. This family of algorithms randomly alternate between *random exploration* of the unobserved data and *greedy inspection* of the highest-predicted hazardous homes. As we see in Table 4, these decision rules differ in the costs they incur.

- **HVI uniform** *(egreedy(1.0))*: Select homes uniformly at random from the pool of those with unknown service lines.

Algorithm 2 ActiveRemediation for MultiEpochReplacement sequentially selects homes for both inspection and for replacement each epoch, incorporating ideas from both active learning and multi-armed bandits.

Input: parameters B, N, T
Input: initial observed data
for $t = 1, \ldots, T$: **do**
  Update: $\hat{p}_t(\theta) \leftarrow$ StatisticalModel $p_t(\theta, L_{t-1})$
  Inspect: $\mathbf{h}_t \leftarrow$ InspectionDecisionRule $\phi^{\mathbf{h}}(\theta)$
  Observe labels: $y_t^{\mathbf{h}}$
  Update: $\hat{p}_t(\theta) \leftarrow$ StatisticalModel $p_t(\theta, \{L_{t-1}, y_t^{\mathbf{h}}\})$
  Replace: $\mathbf{r}_t \leftarrow$ ReplacementDecisionRule $\phi^{\mathbf{r}}(\theta)$
  Observe labels: $y_t^{\mathbf{r}}$
  Update: $U_t \leftarrow \{U_t\} \setminus \{\mathbf{h}_t, \mathbf{r}_t\}$, $L_t \leftarrow \{L_t\} \cup \{\mathbf{h}_t, \mathbf{r}_t\}$
  $\text{TotalCosts}_t \leftarrow \text{TotalCosts}_{t-1} + (c^h + \mathbf{1}^{\mathbf{r}+}_{(c^{\mathbf{r}+})} + \mathbf{1}^{\mathbf{r}-}_{(c^{\mathbf{r}-})})$
  if $\text{TotalCosts}_t \leq B$ check budget **then** continue
  else stop
$\text{HitRate}^{\mathbf{r}}_T \leftarrow n^{\mathbf{r}+}_T / (n^{\mathbf{r}+}_T + n^{\mathbf{r}-}_T)$
$\text{EffectiveCost}_T = \text{TotalCosts}_T / n^{\mathbf{r}+}_T$

- **HVI greedy** *(egreedy(0.0))* Select the homes most likely to have hazardous service lines, based on current model estimates.
- **HVI ε-greedy** *(egreedy(ε))*: For a $1-\varepsilon$ fraction of the inspections, select *greedily*, that is select homes for HVI based on the highest predicted likelihood of danger. For the remaining ε fraction, select homes uniformly at random for HVI. We experiment with values $\varepsilon = \{0.1, 0.3, 0.5\}$. Also, we note that **HVI uniform** and **HVI greedy** are special cases, with ε set to 1.0 and 0.0, respectively.

3.2.3 Importance Weighted Active Learning. We propose an algorithm that takes in the current beliefs about whether each home has hazardous pipe material, and outputs a decision of which homes should be inspected next period. This proposal is a variant of the Importance Weighted Active Learning (IWAL) algorithm [4]. The key idea behind IWAL is to sample unlabelled data from a *biased* distribution, with more weighted placed on examples with greater uncertainty, and then after obtaining the desired labels to incorporate the new date on the next iteration of model training. Our implementation of this approach takes the part of InspectionDecisionRule which is core to Algorithm 2. A full explanation of our IWAL implementation will be available in the full version of the paper.

3.2.4 Analyzing Costs. There are two categories of costs incurred in Algorithm 2: hydrovac inspections and replacement visits. Hydrovac inspections always cost the same amount and are denoted $c^{\mathbf{h}}$. Service line replacement costs, however, depend on what is actually in the ground. If contractors excavate a service line that does not need be replaced, we still incur a cost $c^{\mathbf{r}-}$ for labor and equipment, even though no replacement occurred. On the other hand, if contractors uncover a line that needs to be replaced then the direct cost of replacement is $c^{\mathbf{r}+}$.

But *effective cost per successful replacement* is greater than its direct cost, and we define formally it as $\text{TotalCosts}/n^{\mathbf{r}+}$, where

$$\text{TotalCosts} = c^{\mathbf{h}} n^{\mathbf{h}} + c^{\mathbf{r}+} n^{\mathbf{r}+} + c^{\mathbf{r}-} n^{\mathbf{r}-}$$

			Homes visited by rule		
Hydrovac Inspection	Replacement Visit	(Cost)	*Uniform*	*None*	*10%*
Finds Safety	→ not needed	($250)	230	0	23
Finds Danger	→ replaces Danger	($5,250)	770	0	77
None	→ finds Safety	($2,500)	0	230	207
None	→ replaces Danger	($5,000)	0	770	693
Effective Cost per Successful Replacement:			$5,325	$5,747	$5,705

Table 4: Average effective cost per successful replacement varies by simple InspectionDecisionRule, shown by 1,000 home visits.

(See Algorithm 2). In Flint, hydrovac inspection costs are summarized in Table 4. We note that the effective cost of a successful replacement is driven by two factors: the model accuracy ($\text{HitRate}^{\mathbf{r}}$) and the ratio of their costs, $c^{\mathbf{r}-}/c^{\mathbf{h}}$. Since unnecessary replacement visits can be avoided by prior inspection with a hydrovac, these two metrics, which naturally vary by city, will be critical guides to applying this approach to other cities.

4 AN EMPIRICAL ANALYSIS IN FLINT

In our empirical analysis, we use the data of the confirmed service line material from the 6,505 homes identified and replaced by Flint FAST Start, as of September 30, 2017 collected via our data collection app. This data is combined with our supplementary datasets describing homes (Section 2) and we train a suite of classification models to predict the presence of hazardous service line materials for a given home, and the predictive power of each model is measured on hold-out sets of homes (Section 4.1). After selecting a strong empirical model, we utilize the model predictions in our decision-making algorithms, which recommend those homes which will be most informative for inspection, and also those most likely containing hazardous service line materials for replacement (Section 4.2).

We emphasize that our methods and models were utilized by FAST Start officials for the management of the hydrovac process, and during the early days of the efforts we were given discretion over which homes would receive inspections. We used this freedom to select statistically representative samples, as well as targeted inspections on homes of interest. In practice, our modeling efforts had less impact on the choice of replacement homes, as these decisions carried greater political and logistical challenges.

4.1 Classification Algorithm Performance

Selecting a robust, precise, unbiased, and properly calibrated classification algorithm is key for our proposed active learning framework. Ultimately, the selected decision-making algorithm requires both accurate and well-calibrated probability estimates when selecting the next round of homes to investigate. To select such a classification model, we employ several machine learning model and compare them across various performance metrics. These metrics include the Area Under Receiver Operating Characteristic curve (AUROC), learning curves, and confusion matrices (including accuracy and precision). Using these scores, we find that tree-based methods are the most successful and robust category of models for this data. In particular, the model for gradient boosted trees implemented in the package `XGBoost` exhibits the strongest performance with a fewest data points.

4.1.1 ROC and Learning Curves. The overall accuracy of the best performing XGBoost model, based on a holdout set of 1,606 homes (25% of available data), is 91.6%, with a false-positive rate of 3% and false-negative rate of 27%. The homes falling in the top 81% of predicted probabilities are classified as having hazardous service lines. The ROC curves and AUROC scores show XGBoost's superior performance with an AUROC score of 0.939 on average in a range of [0.925, 0.951], Figure 6 and 7). While the ROC curves show a single run of each model, the AUROC scores are shown as distributions of 100 bootstrapped samples obtained using a stratified cross-validation strategy with 75%/25% of the data randomly selected for training/validation. We further examine AUROC scores using learning curves (Figure 8), using random subsets of data to illustrate diminishing returns of additional data on model performance using AUROC. We also introduce, *temporal learning curves*. These temporal learning curves reflect the exact order of data collection in 2016-17, and they show the AUROC as we re-estimate the model every two-week period to predict the danger for all remaining not-yet-visited homes. We finally ensure that the model's predicted probabilities, which we use to quantify our prediction uncertainty, are indeed well-calibrated probabilities. [6]

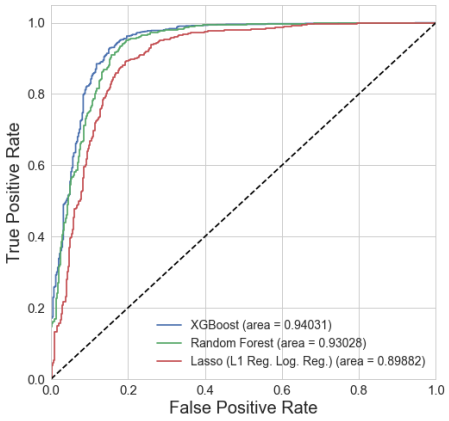


Figure 6: ROC curves measuring predictions of XGBoost, RandomForest, and lasso logistic regression on a random holdout set of all available data.

4.1.2 Risk factors. Now that we have a robust predictive model, we can look at which features of a home and its surrounding neighborhood are the most predictive feature in identifying homes with hazardous service lines. But we are cautious to not make any causal claims from this analysis. We obtain the feature importance values[7] produced by each model by training with 20 bootstrapped samples of the data and reported the average feature importance values. The most informative home features relate to its *age*, *value*, and *location*, suggesting that the context (place and time) in which the home was built, as expected, is strongly correlated with service line material. For instance, homes built during and before World War II

[6] While not shown here, we also considered ExtraTrees, AdaBoost (with decision tree classifier), and Ridge Regression (regularized with L2 loss), but performance was lower than the three presented. Full details on hyperparameter optimization will be available in the full version.

[7] We calculate feature importance by weight, which is the normalized frequency with which a feature appears in a tree amongst the ensemble.

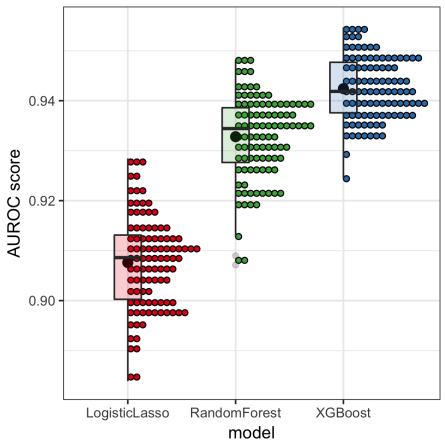


Figure 7: Empirical distributions of AUROC scores of classifiers over several runs on random holdout sets. Both XGBoost and RandomForest show marked performance improvement over lasso logistic regression, and XGBoost gives marginal improvement on RandomForest.

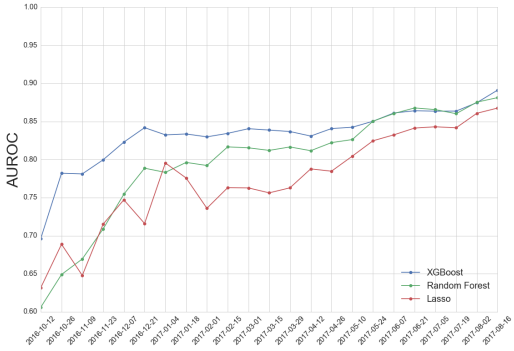


Figure 8: Temporal Learning curves for classification of hazardous service line materials. XGBoost consistently outperforms the other classifiers, especially at the beginning of the timeline when there is less data available.

and those that are lower in value are more likely to contain lead in their public service line. Two additional features were the *city records* and the *DEQ private SL inspection reports*. Each was shown to be a noisy but useful predictor, as indicated earlier in Table 2.

4.2 ActiveRemediation: Evaluation

We now discuss our implementation of the ActiveRemediation framework applied to the particular case of Flint's large-scale pipe replacement program. With over $100M in investment, Flint is a perfect testbed to compare the performance of our proposed methods (developed in Section 3.2) with the actual empirical performance of the work of FAST Start thus far. Our goal is to show a high potential for savings by minimizing the number of unnecessary replacement visits, thus replacing more hazardous lines under the same budget.

4.2.1 Experimental testbed, and potential biases. Any experimental framework needs a quality dataset, with known labels for a large sample which we can evaluate our procedure. Fortunately for the City of Flint, where contractors have been working for over

18 months, we have a total of 6,506 observations of service line materials. A natural choice for an experimental environment, which we call ActualFlint, is to use the set of observed homes in Flint as a template for the overall city, i.e. a municipality with precisely 6,506 homes whose service line material we can query as needed.

A major challenge of relying solely on observed data is that the actual home selection process is biased, in both the hydrovac inspections and the line replacements. While a certain fraction of the home selection was random, it was often reasonably arbitrary due to political and logistical constraints. For instance, many of the homes selected for service line replacement were chosen to maximize lead discovery. To assess the effect of sample bias, we developed an experimental environment, SimulatedFlint, in which we suppose Flint contains only those properties *not in* the observed dataset. For this dataset, labels are assigned based on the labeled hold-out data. With observed data as training, we used a K-Nearest-Neighbors (KNN) classifier to estimate a probability for each unknown home, and then sampled a Bernoulli random variable – "safe"/"unsafe" – to assign labels. This randomized dataset has lower potential selection bias concerns. In the reported results below, we focus on ActualFlint, but we note that results from SimulatedFlint were nearly equivalent.

4.2.2 Backtesting Simulation on ActualFlint. We quantify the cost savings from implementing our algorithm by comparing the sequential selection of homes from the proposed decision rules to what the Flint FAST Start initiative actually did in 2016-17. The goal is to stretch the allocated funds to remove hazardous pipes from as many homes as possible. One source of inefficiency in spending is unnecessary service line replacement (SLR) visits (the false-positive error rate). Therefore, our key performance metric is the SLR hit rate, i.e. the percentage of homes visited for replacement that required replacement.

The proposed approach greatly improves the hit rate. Our key finding from the simulation shows that we predict a reduced rate of costly unnecessary replacements visits from 18.8% (actual) to 2.0% (proposed). Figure 9 illustrates the direct comparison of hit rates for our proposed approach, IWAL(0.7), based on our ActualFlint simulation, compared to Flint FAST Start.

Second, the cost savings are substantial. The proposed algorithm, with a higher hit rate, increases the number of homes that receive service line replacements for the same number of visits. This, in turn, reduces the *effective cost* of a successful service line replacement. The effective cost includes both the direct costs of successful replacement visit and the average costs incurred by exploring homes from hydrovac inspections or unnecessary replacement visits. Having access to the exact same set of 6,505 homes actually observed, we find that the algorithm on average saves an additional 10.7% in funds per successful replacement (see Table 5). Across 18,000 total planned service line replacements, this would extend to an expected savings of about $11M out of current spending. In terms of the overall removal of lead pipes, this is approximately equivalent to 2,100 additional homes in the city that would receive safe water lines. These estimates are made using the current costs in Flint, where hydrovac inspection costs $c^h = \$250$, unnecessary replacement costs $c^{\mathbf{r}-} = \$2,500$, and successful replacement costs $c^{\mathbf{r}+} = \$5,000$.

	Actual	Proposed Algorithm	
		Mean	*Range*
For every 1 successful replacement:			
Effective cost	$5,818	$5,196	($5,186 to $5,208)
Predicted savings ($)	–	$621.7	($610.4 to $632.4)
Predicted savings (%)	–	10.7%	(10.5% to 10.9%)
For every 1,000 successful replacements, the savings generate:			
Extra inspections	–	94	(92 to 96)
Extra replacements	–	120	(117 to 122)
For 18,000 successful replacement:			
Predicted savings ($ in millions)	–	$11.18m	($10.99m to $11.39m)

Table 5: Cost savings. The proposed method lowers the effective cost per successful service line replacement, saving $621.7 per home (10.7%), enough to remove lead from an additional 2,000 homes on the same budget.

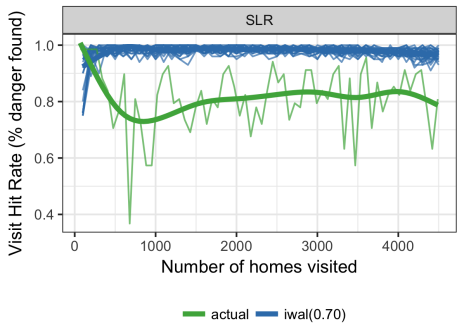


Figure 9: Tracking hit rates over time, the proposed IWAL algorithm (blue; mean = 98.0%) outperform actual (green; mean = 81.2%; thick line is smoothed plot)

The proposed approach outperforms a competitive set of natural benchmark strategies. Instead of only comparing our proposed method to what actually occurred, we also consider a range of alternative methods. In particular, greedy (egreedy with 0% exploration) inspects the highest rate of hazardous homes inspected (HVI hitrate 91%), and uniform (egreedy with 100% exploration) inspects the lowest (63%). But IWAL does better with a more principled approach, selecting homes that are likely to be most informative, with risk probabilities near 70%. Figure 10 shows how IWAL and two greedy heuristics differ. Higher HVI hit rate is not better; instead, it is the choice of which homes to explore with inspection that matters. The uncertainty in performace of each algorithm comes from sampling variation from running 25 independent simulated experiments. We prefer IWAL to alternatives because it has greater savings and is less sensitive to tuning parameters.

We acknowledge some assumptions in our simulations. First, we only consider the cost of each job and not the time required for crews to move between homes, where there may be logistical issues with redirecting teams around the city. Second, in this analysis we have treated the ActualFlint as having only 6,506 homes of which all are visited. This creates an arbitrary finite end point, as the algorithm runs out of homes with unsafe service lines. To avoid this effect, the above calculations, figures, and tables are based on the first 4,500 replacement visits and 2,250 hydrovac inspections. Of course, to validate this, we would need access to a larger set, and thus we turn to our larger simulation using a full size of Flint. Finally, the results are robust to resource allocation schedule and batch size. We recognize that we used a schedule of SLR and HVI

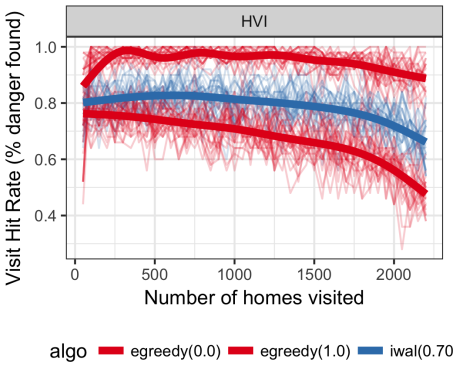


Figure 10: HVI Hit Rates. egreedy(0) tends to over-inspect whereas egreedy(1) is too conservative. IWAL more effectively optimizes HVI hit rate.

activities different than Flint FAST Start. To disentangle the confound between our choice of algorithms and the schedule, we ran an additional version of the ActualFlint backtest, with the schedule as closely aligned with Flint FAST Start in 2016-17 as possible. Across alternative scenarios tested the results differed only slightly.

4.2.3 Results from SimulatedFlint. In our second simulation, we demonstrate the potential value of deploying the algorithm at scale and characterize the long-term performance of the algorithms. Via SimulatedFlint we find that the proposed algorithms, with the aim of replacing hazardous lines from 18,000 homes out of a simulated city of 48,000 homes, can achieve 11.8% savings relative to the current rate of spending. The best algorithm using IWAL yields an average effective cost of $5,133 per successful replacement, better than $5,818 observed in Flint (Table 5). As a final note, the proposed algorithms' SLR hit rates are all above 98.0%.

ACKNOWLEDGMENTS

The authors would like to thank the FAST Start team for their phenomenal work and openness to collaboration. This includes Brigadier General (Ret.) Michael McDaniel, Ryan Doyle, Major Nicholas Anderson, and Kyle Baisden. Professors Lutgarde Raskin and Terese Olson, environmental engineering faculty at U-M, provided invaluable scientific support throughout. We are incredibly grateful to the work of, and communication with, Professor Martin Kaufman and Troy Rosencrantz at U-M Flint's GIS Center. We would like to thank Captricity, especially their machine learning team, Michael Zamora, Michael Zamora, David Shewfelt, and Kayla Pak for making the data accessible, and Kuang Chen for the generous support. We had major support from Mark Allison and his team of U-M Flint students. Rebecca Pettengill was enormously generous with her time and ability to help in the Flint community. We thank U-M Professors Marc Zimmerman and Rebecca Cunningham for their encouraging and helpful discussions. Among the many students involved in this work, we would like to recognize the roles of Jonathan Stroud and Chengyu Dai. And this work would not have happened without the expertise and enthusiasm of the students in the Michigan Data Science Team (MDST, http://midas.umich.edu/mdst/, [9]). The authors appreciate the many seminar and conference participants at U-M and elsewhere for their feedback on the academic work. The authors gratefully acknowledge the financial support of the Michigan Institute for Data Science (MIDAS), U-M's Ross School of Business, Google.org, and National Science Foundation CAREER grant IIS 1453304.

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Exhibit RAW/C-45

Policy: Lead Service Line Replacement Program

Effective Date: 1/26/2018
Approved By: Robert A. Weimar
Revision No.: 1.0
Revision Date: 5/24/2019

1. Overview

In efforts to reduce the amount of lead in the Pittsburgh Water and Sewer Authority's (PWSA's) water distribution system, mitigate lead exposure through water consumption for the customer, and comply with state and federal regulations, the PWSA Board of Directors (Board) is asked to authorize a revised residential Lead Service Line Replacement (LSLR) Program Policy which includes the replacement of both the public and private portion of lead service lines (LSLs) located in PWSA's drinking water service area, under circumstances defined by the Board.

2. Purpose

This Policy would serve as the principle guidance by which the PWSA can implement a full-line LSLR strategy to comply with the Pennsylvania Department of Environmental Protection (DEP) requirements included in the November 17, 2017 Consent Order and Agreement (COA) between PWSA and DEP. This policy update retains those provisions previously established the PWSA Board of Directors - to refrain from performing partial lead service line replacements at residential properties.

3. Policy

The PWSA Board of Directors adopts this revised policy to allow for the goal of full-line LSLR at residential properties with no more than four (4) dwelling units with service lines 1-inch in diameter or less, for which the PWSA has maintenance responsibility for the water service line from the water main to and including the curb stop, as more fully described in PWSA Rules and Regulations (**eligible residential property**). This policy commits PWSA to full-line lead line replacement in various circumstances detailed in the procedures section of this policy. Because galvanized iron has been proven to release lead into water, galvanized iron service lines will be treated as lead service lines and replaced under this policy.

1. Any **eligible residential property** receiving a partial public service line replacement after February 1, 2016 due to a PWSA action such as a water main replacement or PWSA's Operations' public side service line replacement, will be eligible to have their private side lead service line replaced by PWSA, at no charge to the customer.

2. If **an eligible residential property** owner replaced their private side LSL as a result of a PWSA public side replacement under an LSLR contract, PWSA operations replacement, or water main replacement between February 1, 2016 and December

Policy: Lead Service Line Replacement Program

Effective Date: 4/26/2018
Approved By: Robert A. Weimar
Revision No.: 1.0
Revision Date: 5/24/2019

31, 2018, PWSA will offer a direct reimbursement for costs incurred up to a maximum of $5,500 (based on the average cost for PWSA to replace private lines). Customers who opted to replace their private lead service line on their own (i.e. unrelated to a public side replacement) are not eligible for reimbursement.

3. If PWSA determines, in its sole discretion, that replacement of the portion of the lead water service line owned by the property owner at a particular residence or related interior plumbing modification is not technically feasible, the residence is unsafe from a structural or sanitary condition, or will result in excess expense, due to conditions such as length, terrain, obstructions, structures, pavement, trees, or other utilities, PWSA may exclude such residence from the Program and not replace the portion of the lead water service line owned the property owner. These locations will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement will not, however, be completed if permission has not been obtained from the property owner, where there are tenants, unless it is a relay or emergency LSLR as defined below in section 2(c).

4. **Procedure**

1. Contracts, Agreements and Purchases shall be awarded only to responsible firms or individuals that possess the ability to perform successfully under the terms and conditions of a proposed contract.

2. PWSA contracts for LSLR shall accomplish the full LSLR through various contractual approaches.

a. **Full LSLR:** PWSA will coordinate with customers identified as having public and private LSLs to replace the full line during 2019 LSLR construction at no cost to the property owner. The overall work orders will be prioritized based on the prevalence of children under six years of age and women of child bearing age, and incidences of high blood lead levels in PWSA's drinking water service territory.

b. **Full LSLR, targeting at-risk households using funding from the DEP Community Environmental Project (CEP):** PWSA's program will target its private LSLRs to households with income levels below 250 percent of the federal poverty level, as adjusted annually.

c. **Emergency LSLRs:** PWSA will address replacement of the private LSL when PWSA's operations crew replaces a public service line as a result of line breaks

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Policy: Lead Service Line Replacement Program

Effective Date:	5/26/2018
Approved By:	Robert A. Weimar
Revision No.:	1.0
Revision Date:	5/24/2019

and leaks. This construction contract shall address partial LSLR caused by unplanned emergency replacements. These private replacements will be offered at no cost to the property owner through the end of 2019.

d. **Water Main Relays:** When replacing water mains (referred to as a water main relay), PWSA will offer to replace the private side lead service line when it replaces the public service line. These private side replacements will be at no cost to the homeowner through the end of 2019.

3. Property owners eligible for private LSLRs under the program described in 2(a) and 2(d) will be contacted ahead of time and asked to enter into an agreement to allow PWSA employees and contractors to gain access to their private property in order to replace their private LSL. The agreement that will allow PWSA employees and contractors to gain access to the private property in order to replace LSLs will include provisions that require that the property owner(s) release and hold harmless the PWSA from any and all claims, causes of action, damages or losses, of any nature, whatsoever with respect to the work performed by PWSA or its contractors. Homeowners will then be asked to cooperate with PWSA's timeline for replacement and allow workers access to the service line.

4. Replacements performed under the CEP described in 2(b) will be identified by customer-requests and vetted through a third-party administrator. Details of the program associated with the November 2017 consent order and agreement with between PWSA and DEP are approved by DEP. Funds for this program are limited and are available from a settlement of an enforcement action between PWSA and the Pennsylvania Department of Environmental Protection.

5. Property owners who are in a position to receive a full LSLR per program described in 2(c) will be asked to coordinate with PWSA in an expedited fashion. PWSA will work to make the replacement process as convenient for the homeowner as possible.

6. Property owners who do not agree to PWSA's terms for full LSLR will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement will not, however, be completed in the event that the property owner does not live at the property location, unless it is a relay or emergency situation.

7. PWSA will restore roadways and public sidewalks, backfill any trenches excavated as part of the replacement process and will fill and seal any wall or floor penetrations in the private home. No other restoration will be conducted in for the private side

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Policy: Lead Service Line Replacement Program

Effective Date: 1/26/2018
Approved By: Robert A. Weimar
Revision No.: 1.0
Revision Date: 5/24/2019

replacement. PWSA will not replace any landscaping, interior finishes, paving, seeding, or walkways. All restoration costs shall be borne by the homeowner.

8. PWSA's management shall monitor all contracts to ensure that this policy is carried out and will report to the PWSA Board of Directors routinely on the status of the LSLR program.

9. PWSA management will evaluate the efficacy of each program and may propose policy modifications to the Board from time to time.

10. If a homeowner elects to replace their lead service line at their own cost after January 1, 2019, PWSA will agree to the following:
    a. PWSA will replace the public portion of the lead service line at no cost to the homeowner, including sidewalk public replacement.
    b. PWSA will not charge a tapping fee for this service.
    c. If it is to the homeowner's or PWSA's benefit to tap into a different main for ease of connection, PWSA can agree to this on a case by case basis and will waive any tapping fee for this service. The homeowner will be wholly responsible for terminating the service line at the point of the original connection.
11. PWSA may offer an income-based replacement or reimbursement for the cost of the private side based on a policy to be adopted at a later date.

Exhibit RAW/C-46

Policy: Lead Service Line Replacement Program

Effective Date: 1/26/2018
Approved By: Robert A. Weimar
Revision No.: 2.0
Revision Date: 7/26/2019

1. Overview

In efforts to reduce the amount of lead in the Pittsburgh Water and Sewer Authority's (PWSA's) water distribution system, mitigate lead exposure through water consumption for the customer, and comply with state and federal regulations, the PWSA Board of Directors (Board) is asked to authorize a revised residential Lead Service Line Replacement (LSLR) Program Policy which includes the replacement of both the public and private portion of lead service lines (LSLs) located in PWSA's drinking water service area, under circumstances defined by the Board.

2. Purpose

This Policy would serve as the principle guidance by which the PWSA can implement a full-line LSLR strategy to comply with the Pennsylvania Department of Environmental Protection (DEP) requirements included in the November 17, 2017 Consent Order and Agreement (COA) between PWSA and DEP. This policy update retains those provisions previously established the PWSA Board of Directors - to refrain from performing partial lead service line replacements at residential properties. Revision 2.0 also adds to the existing policy by offering income-based reimbursements for homeowners who elect to replace their own private side lead service line.

3. Policy

The PWSA Board of Directors adopts this revised policy to allow for the goal of full-line LSLR at residential properties with no more than four (4) dwelling units with service lines 1-inch in diameter or less, for which the PWSA has maintenance responsibility for the water service line from the water main to and including the curb stop, as more fully described in PWSA Rules and Regulations (**eligible residential property**). This policy commits PWSA to full-line lead line replacement in various circumstances detailed in the procedures section of this policy. For future work where PWSA is replacing the public side of the service line, private side lead service lines will be replaced at no cost to the customer. Other customers who elect to replace there private side lead service line (where PWSA is not replacing the public side of the service line) will be offered an income-based reimbursement of those costs. Because galvanized iron has been proven to release lead into water, galvanized iron service lines will be treated as lead service lines and replaced under this policy.

1. Any **eligible residential property** receiving a partial public service line replacement after February 1, 2016 due to a PWSA action such as a water main replacement or

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Policy: Lead Service Line Replacement Program

Effective Date: 1/26/2018
Approved By: Robert A. Weimar
Revision No.: 2.0
Revision Date: 7/26/2019

PWSA's Operations' public side service line replacement, will be eligible to have their private side lead service line replaced by PWSA, at no charge to the customer.

2. If **an eligible residential property** owner replaced their private side LSL as a result of a PWSA public side replacement under an LSLR contract, PWSA operations replacement, or water main replacement between February 1, 2016 and December 31, 2018, PWSA will offer a direct reimbursement for costs incurred up to a maximum of $5,500 (based on the average cost for PWSA to replace private lines). Customers who opted to replace their private lead service line on their own (i.e. unrelated to a public side replacement) are not eligible for reimbursement.

3. If PWSA determines, in its sole discretion, that replacement of the portion of the lead water service line owned by the property owner at a particular residence or related interior plumbing modification is not technically feasible, the residence is unsafe from a structural or sanitary condition, or will result in excess expense, due to conditions such as length, terrain, obstructions, structures, pavement, trees, or other utilities, PWSA may exclude such residence from the Program and not replace the portion of the lead water service line owned the property owner. These locations will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement will not, however, be completed if permission has not been obtained from the property owner, where there are tenants, unless it is a relay or emergency LSLR as defined below in section 2(c).

4. **Procedure**

1. Contracts, Agreements and Purchases shall be awarded only to responsible firms or individuals that possess the ability to perform successfully under the terms and conditions of a proposed contract.

2. PWSA contracts for LSLR and Water Main Relay shall accomplish the full LSLR through various contractual approaches.

   a. **Full LSLR:** PWSA will coordinate with customers identified as having public and private LSLs to replace the full line during 2019 LSLR construction at no cost to the property owner. The overall work orders will be prioritized based on the prevalence of children under six years of age and women of child bearing age, and incidences of high blood lead levels in PWSA's drinking water service territory.

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Policy: Lead Service Line Replacement Program

Effective Date: 1/28/2018
Approved By: Robert A. Weimar
Revision No.: 2.0
Revision Date: 7/26/2019

b. **Full LSLR, targeting at-risk households using funding from the DEP Community Environmental Project (CEP):** PWSA's program will target its private LSLRs to households with income levels below 250 percent of the federal poverty level, as adjusted annually.

c. **Emergency LSLRs:** PWSA will address replacement of the private LSL when PWSA's operations crew replaces a public service line as a result of line breaks and leaks. This construction contract shall address partial LSLR caused by unplanned emergency replacements. These private replacements will be offered at no cost to the property owner.

d. **Water Main Relays:** When replacing water mains (referred to as a water main relay), PWSA will offer to replace the private side lead service line when it replaces the public service line. These private side replacements will be at no cost to the homeowner.

3. Property owners eligible for private LSLRs under the program described in 2(a) and 2(d) will be contacted ahead of time and asked to enter into an agreement to allow PWSA employees and contractors to gain access to their private property in order to replace their private LSL. The agreement that will allow PWSA employees and contractors to gain access to the private property in order to replace LSLs will include provisions that require that the property owner(s) release and hold harmless the PWSA from any and all claims, causes of action, damages or losses, of any nature, whatsoever with respect to the work performed by PWSA or its contractors. Homeowners will then be asked to cooperate with PWSA's timeline for replacement and allow workers access to the service line.

4. Replacements performed under the CEP described in 2(b) will be identified by customer-requests and vetted through a third-party administrator. Details of the program associated with the November 2017 consent order and agreement with between PWSA and DEP are approved by DEP. Funds for this program are limited and are available from a settlement of an enforcement action between PWSA and the Pennsylvania Department of Environmental Protection.

5. Property owners who are in a position to receive a full LSLR per program described in 2(c) will be asked to coordinate with PWSA in an expedited fashion. PWSA will work to make the replacement process as convenient for the homeowner as possible.

6. Property owners who do not agree to PWSA's terms for full LSLR will be subject to a partial lead service line replacement. The potential health risks of a partial LSR will be outlined in the communications provided to the homeowner. A partial replacement

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Policy: Lead Service Line Replacement Program

Effective Date: 7/26/2018
Approved By: Robert A. Weimar
Revision No.: 2.0
Revision Date: 7/26/2019

will not, however, be completed in the event that the property owner does not live at the property location, unless it is a relay or emergency situation.

7. PWSA will restore roadways and public sidewalks, backfill any trenches excavated as part of the replacement process and will fill and seal any wall or floor penetrations in the private home. No other restoration will be conducted in for the private side replacement. PWSA will not replace any landscaping, interior finishes, paving, seeding, or walkways. All restoration costs shall be borne by the homeowner.

8. PWSA's management shall monitor all contracts to ensure that this policy is carried out and will report to the PWSA Board of Directors routinely on the status of the LSLR program.

9. PWSA management will evaluate the efficacy of each program and may propose policy modifications to the Board from time to time.

10. If a homeowner elects to replace their private side lead service line after January 1, 2019, PWSA will agree to the following:
    a. PWSA will replace the public portion of the lead service line at no cost to the homeowner, including sidewalk public replacement.
    b. PWSA will not charge a tapping fee for this service.
    c. If it is to the homeowner's or PWSA's benefit to tap into a different main for ease of connection, PWSA can agree to this on a case by case basis and will waive any tapping fee for this service. The homeowner will be wholly responsible for terminating the service line at the point of the original connection.
    d. PWSA will offer an Income-Based reimbursement for the private side costs as follows:
        i. PWSA will reimburse the entire cost of the private side lead service line replacement for households with income levels below 300 percent of the federal poverty level, as adjusted annually;
        ii. PWSA will reimburse 75 percent of the cost of the private side lead service line replacement for households with income levels between 301 and 400 percent of the federal poverty level, as adjusted annually;
        iii. PWSA will reimburse 50 percent of the cost of the private side lead service line replacement for households with income levels between 401 and 500 percent of the federal poverty level, as adjusted annually;
        iv. All other households will be offered a $1,000 stipend towards the replacement cost of a private side lead service line replacement.