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Capital Region Water

CONSULTING ENGINEER'S ANNUAL REPORT

Water System

October 3, 2016

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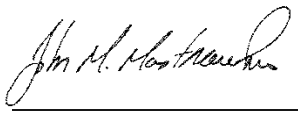

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ACRONYMS AND ABBREVIATIONS

AWWA	American Water Works Association
CCL4	Fourth Drinking Water Contaminant Candidate List
CEAR	Consulting Engineer's Annual Report
CIP	Capital Improvement Plan
CRW	Capital Region Water
Cr-6	Hexavalent Chromium
cVOC	Volatile Organic Compounds
DBP2	Stage 2 Disinfectants and Disinfection By-Products Rule
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
LT2	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
NRW	Non-Revenue Water
O&M	Operations and Maintenance
PADEP	Pennsylvania Department of Environmental Protection
UCMR4	Fourth Unregulated Contaminant Monitoring Rule
µg/L	Micrograms per Liter

1 INTRODUCTION

Arcadis U.S., Inc. ("Arcadis") prepared this Water System Consulting Engineer's Annual Report ("CEAR") for Capital Region Water ("CRW") as required by Section 7.11 of the Trust Indenture between CRW and the Bank of New York Mellon Trust Company, N.A. originally dated January 1, 1991 and Amended and Restated April 1, 2014. This CEAR is being submitted to comply with the following requirements for fiscal year ("FY") 2017, as outlined in the Indenture:

Section 7.11:

> *"It shall be the duty of the Consulting Engineers, in addition to the other duties described elsewhere in this Indenture, to prepare and file with the Authority and with the Trustee on or before October 1, 1991, and on or before 90 days prior to the beginning of each Fiscal Year thereafter, a report setting forth the following:*
>
> > *a. Their advice and recommendations as to the proper maintenance, repair and operation of the Water System during the next Fiscal Year;*
> >
> > *b. Their advice and recommendations as to the Capital Additions that should be made during the next Fiscal Year, and their estimate of the amounts of money that should be expended for Operating Expenses and their estimate of the amounts of money necessary for such purposes; and*
> >
> > *c. Their finding whether the properties of the Water System have been maintained in good repair and sound operating condition and their estimate of the amount, if any, required to place such properties in such condition and the details of such expenditures and the approximate time required therefore."*

CRW's fiscal year runs from January 1 through December 31 of each year. The Water System includes the Dr. Robert E. Young Water Services Center Water Treatment Facility, Susquehanna River Raw Water Intake, the DeHart Dam Reservoir, finished water reservoirs (Upper Reservoir, Lower Reservoirs 1&2), pump stations, pumping equipment, transmission and distribution mains, and related equipment servicing the City of Harrisburg ("City") and portions of the Borough of Penbrook, Susquehanna Township, and Lower Paxton Township, all located in Dauphin County, Pennsylvania.

1.1 Report Methodology and Limitations

In preparing this CEAR, Arcadis reviewed existing records and documents prepared by or on behalf of CRW to understand, assess and report on the technical information contained therein as it relates to the FY 2016 CEAR. The major relevant documents provided by CRW and reviewed as part of the CEAR include, but are not necessarily limited to, the following:

- The Trust Indenture between Capital Region Water and the Bank of New York Mellon Trust Company amended and restated April 1, 2014
- 2015 Dehart Dam Annual Inspection Report
- 2015 Consulting Engineer's Annual Report

- 2015 Primary Facility Report
- 2015 Sub-Facility Report for Clarks Creek DeHart Dam
- 2015 Water Loss Audit
- 2016 Drinking Water Quality Report
- Monthly Water System Reports (December 2015 and January - July 2016)
- Historic Water System Expenses (FY 2014 and FY 2015)
- Budgeted FY 2016 Water System Expenses
- Correspondence with the U.S. Environmental Protection Agency ("EPA") and the Pennsylvania Department of Environmental Protection ("PADEP")

In addition, on September 13-14, 2016, Arcadis conducted limited visual site inspections of the following components of the Water System:

- DeHart Dam, Reservoir Control Building, and Chemical Feed Facility
- Susquehanna River Raw Water Pump Station
- Dr. Robert E. Young Water Services Center Treatment Facility
- Gate House Pump Station
- Union Square Industrial Park Booster Station
- Finished Water Reservoirs (Upper Reservoir and Lower Reservoirs 1 & 2)
- The review also included discussions with representatives of CRW and performance comparisons to other comparable water systems and related industries.

This CEAR summarizes the findings of the visual inspections at the time they were conducted and the findings of the data reviewed and discussions with CRW up to the date of the issuance of the CEAR. Changed conditions occurring or becoming known after such date could affect the material presented and the conclusions reached herein to the extent of such changes.

Arcadis has not independently verified the accuracy of the information provided by CRW and others. However, we believe such sources are reliable and the information obtained to be appropriate for the analysis undertaken and the conclusions reached herein. In addition, the scope of our review did not include any pending or threatened litigation against CRW. CRW has stated that there is no significant litigation that they believe would have any material impact on its operations.

In completing this CEAR for CRW, Arcadis is not serving in the role of a "municipal advisor" under the regulations of the Securities and Exchange Commission. As such, Arcadis is not recommending any action regarding municipal financial products or the issuance of municipal securities, and is not acting as a registered municipal advisor to CRW and does not owe a fiduciary duty to CRW pursuant to Section 15B of the Securities Exchange Act of 1934, as amended by the Dodd-Frank Wall Street Reform and Consumer Protection Act, with respect to the information and material prepared in connection with this CEAR. CRW should discuss any information and material prepared in connection with this CEAR with

any and all internal and external financial and other advisors that they may deem appropriate before acting on this information and material.

2 WATER SYSTEM MANAGEMENT

2.1 Overview of the Water System

The primary source of drinking water for the Water System is the William T. DeHart Dam and Reservoir located 20 miles northeast of the City in the Clarks Valley Watershed. The Dam and Reservoir collect water from a 22 square mile watershed. The Susquehanna River provides CRW with a backup water supply and currently is only used in case of severe drought or emergency. The Susquehanna River had been used as a primary water source up until construction of the DeHart Dam in 1940.

Components of the Water System were first established in 1839 when the Commonwealth of Pennsylvania granted the City permission to withdraw water from the Susquehanna River to serve City residents in the central part of the City. Over the years, numerous upgrades and expansions were undertaken to meet new regulations and to expand services City-wide and to other municipalities located in Dauphin County.

Currently, the Water System includes over 20 miles of 42-inch diameter transmission mains, 250 miles of distribution piping ranging from four to 36-inches in diameter, approximately 1,780 fire hydrants and 5,340 valves, four hydrant interconnections with United Water, Inc., and the sources of supply, pumping and treatment facilities summarized in Table 2-1.

Table 2-1: Summary of Major Water System Facilities

Facility	Item	Capacity
DeHart Dam and Reservoir	Full Storage Capacity Reservoir Yield Allocation	6.0 billion gallons 10.5 MGD 13.5 MGD
Susquehanna River Intake	Source Allocation Pumping Capacity	15 MGD (Secondary) 30 MGD
Dr. Robert E. Young Water Services Center Treatment Facility	Design Flow	20 MGD
Upper Reservoir	Storage Capacity	28 MG
Lower Reservoir #1	Storage Capacity	6.0 MG
Lower Reservoir #2	Storage Capacity	6.0 MG
Susquehanna River Pump Station	Pumping Capacity	14,000 GPM (with one out of service)
Gate House Pump Station	Pumping Capacity	8,700 GPM (with one out of service)
Union Square Industrial Park Booster Station	Pumping Capacity at: -Triplex Constant Pressure -Fire Pump	 750 GPM 1,000 GPM

A more detailed description of the Water System is provided in Appendix A. In addition, an overview of the history of the Water System, since its original creation in 1839, is provided in Appendix B.

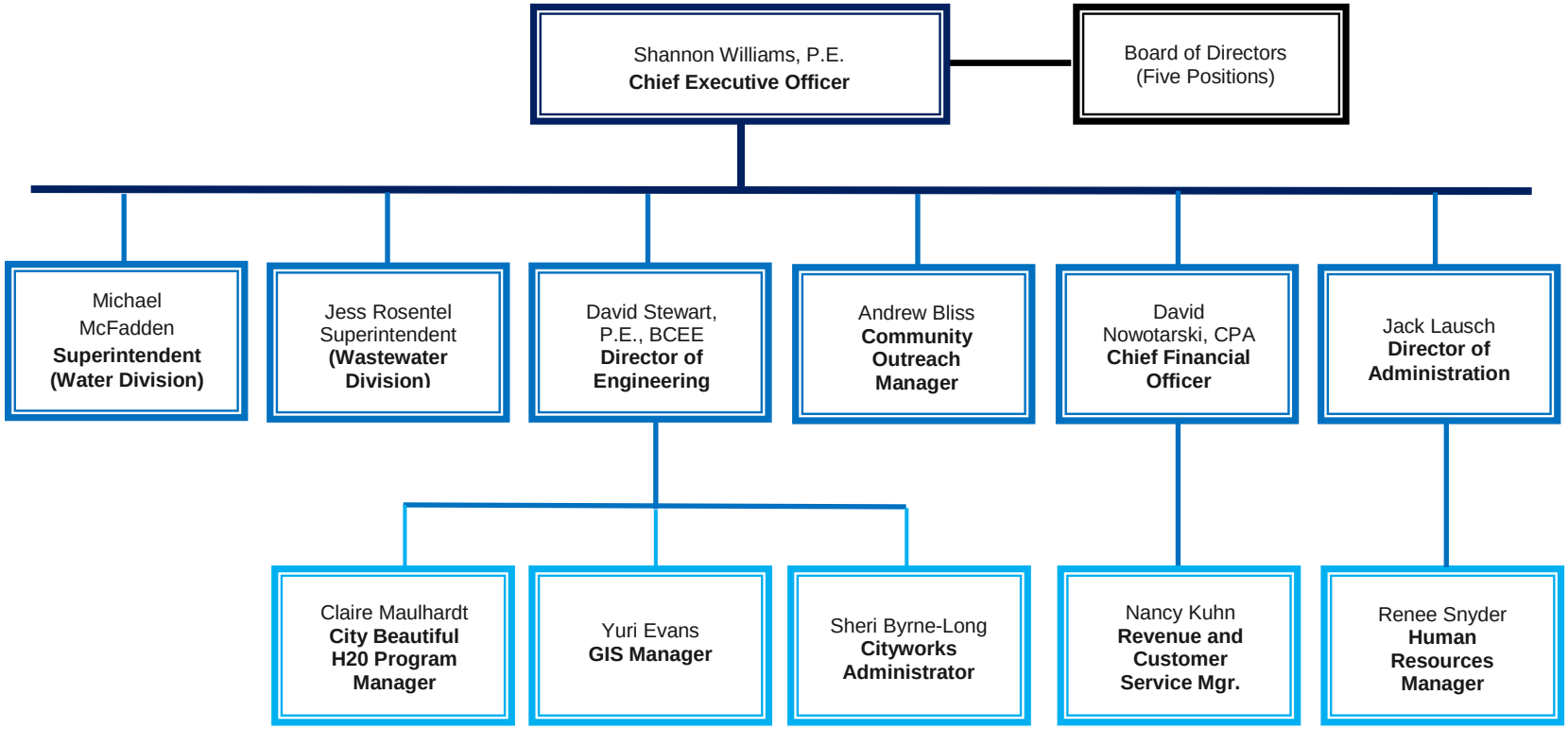
2.2 Management and Staffing

The Water System was originally managed, owned, and operated by the City. In 1990, the Harrisburg Authority, which has since been renamed Capital Region Water, was created to purchase the Water System from the City and at the same time enter into the 1990 Management Agreement with the City for continued management and operation of the Water System.

In 2011, the City was placed under State of Pennsylvania Receivership due to severe financial distress, which primarily resulted from having insufficient funds to pay solid waste system debt associated with the Harrisburg Resource Recovery Facility. The financial distress resulted in a shortage of experienced and qualified personnel needed to operate, manage, and administer the Water System, and a loss in access to capital markets. As a result, the Commonwealth's Office of the Receiver, the City, and CRW agreed to terminate the 1990 Management Agreement with the City on November 4, 2013. With the termination of this Agreement, CRW has taken back operational and management control of the Water System.

An overview of the current organization structure of CRW is shown in Figure 2-1.

Figure 2-1: CRW Management Level Organizational Chart



CRW is governed by a five member Board of Directors and is headed by the Chief Executive Officer, who is responsible for all technical and administrative operations of CRW, as well as the implementation of programs, policies, and procedures, and the execution of contracts upon approval by the Board. In addition to providing drinking water services, CRW also provides wastewater treatment services. CRW operates as one entity; however, CRW separately tracks and records the provision of services associated with each of the utilities it manages and operates.

CRW's organizational chart is made up of four departments, which include Finance, Engineering, Administrative, and Operations, all headed by their respective department directors, as shown in Figure 2-1. These departments provide services to support CRW's water utility as well as its wastewater utility.

2.2.1 Administration, Engineering, Finance, and Operations Departments

The Administrative Department provides office management, information technology, human resources, insurance, health and safety, and administrative support services. The Engineering Department provides engineering support, project coordination, GIS coordination, wet weather coordination, and asset management services. The services currently provided by the Finance Department include accounting, billing and collections, customer service, and payroll. It is our understanding that CRW has plans to staff these departments with a total of 40 positions (21 for Finance, 9 for Engineering, and 10 for Administration), and as of the beginning of FY 2016, 31 of the 40 positions have been filled. Personnel expenses associated with these departments is allocated to each of the utilities based on budgeted time allocated to each of the services.

The Operations Department of CRW includes the Drinking Water Division, Water Quality Division, Wastewater Division, Stormwater Division, and the Facility Maintenance and Field Services Division. The Operations Department is responsible for operation and maintenance ("O&M") of facilities, permit compliance, tracking and reporting, energy management, monitoring, long-term planning, repair and construction, and assistance in budget preparation and tracking. The Operations Department's Drinking Water Division includes plans for 16 positions, with 14 being filled as of the beginning of FY 2016. The Operations Department's Water Quality Division includes 4 filled positions dedicated to water quality and one open position for a Division head. The Facility Maintenance and Field Services Division includes 12 filled positions dedicated to the Water System.

In summary, CRW's FY 2016 Water System budget includes estimated costs associated with the current and planned employees dedicated to the Water System and the Water System's share of costs associated with the planned positions under Finance, Engineering, and Administrative Departments, which provide support to CRW's water and wastewater utilities. These employees are all employees of CRW, with the majority belonging to a new collective bargaining unit established separately from the City, even though certain employees of the City have become direct employees of CRW upon termination of the 1990 Management Agreement. CRW's current collective bargaining agreement is scheduled to expire on December 31, 2016.

The organizational structure of CRW provides strong opportunities for economies of scale through the sharing of finance, engineering and administrative services between the water and wastewater utilities. The structure is generally consistent with similar-sized, combined utilities and it appears that all required Water System functions of CRW are adequately staffed. However, there were a few observed

shortcomings in the operation and maintenance of the system due to inadequate staffing, particularly related to the lack of a valve exercising program, as discussed in Section 4 in this report.

3 WATER SYSTEM PERFORMANCE

3.1 Service Area

The service area of the Water System includes the City of Harrisburg and portions of Penbrook Borough, Lower Paxton Township, and Susquehanna Township. CRW maintains interlocal agreements with these municipalities that govern the provision of services to the customers located within these community boundaries. With the exception of some distribution system piping and related equipment, the majority of CRW's water assets are located within the municipal boundaries of the City.

3.2 Customer Base

CRW maintains approximately 20,700 active meter connections within its service area, with the majority, or approximately 82.0 percent, located within the City. The remainder are primarily located in Susquehanna Township and Penbrook Borough. CRW maintains only two commercial connections in Lower Paxton Township. The total estimated population served by the Water System is approximately 66,550, with approximately 44,000 located within the City.

A summary of the total number of connections within each community and the total metered water consumption based on CRW records as of December 2015 is shown in Table 3-1. It should be noted that CRW took over billing and collections from the City in FY 2015 and is still in the process of confirming the number of active metered connections.

Table 3-1: FY 2015 Customer Accounts and Metered Water Use

Description	Accounts	Consumption (1,000 gal.)
City of Harrisburg:		
Residential	15,285	790,758
Commercial	1,804	580,237
Industrial	19	218,731
Public/Institutional	68	76,494
Total	17,176	1,666,220
Suburban Communities:		
Residential	3,443	196,811
Commercial	114	66,659
Industrial	1	33,380
Total	3,558	296,850
Combined Total	**20,734**	**1,963,070**

Source: FY 2015 customer and billing data provided by CRW.

3.3 Water Supply and Demand

Pursuant to its Water Allocation Permit (Permit # WA-22-53B) issued by PADEP, CRW maintains a 13.5 million gallons per day ("MGD") water supply allocation from the DeHart Dam and Reservoir and a 15.0 MGD secondary allocation from the Susquehanna River. However, the DeHart Dam has an estimated safe yield of 10.5 MGD. The design flow capacity of CRW's water treatment facility is 20.0 MGD. No changes to the water allocation permit or CRW's water treatment capacity are currently anticipated.

Average metered daily consumption was approximately 5.4 MGD in FY 2015, and has been trending downward in recent years. However, peak day water production remains high at approximately 12.9 MGD. In addition, non-revenue water ("NRW") also remains high at an average daily rate of approximately 3.95 MGD, or 42.0 percent of the average daily water production. It should be noted that the Pennsylvania Public Utility Commission considers losses greater than 20.0 percent of total water production to be excessive. Regardless, it appears that CRW currently has sufficient access to raw water supplies and has the storage and treatment capacity to meet demand. A summary of the current water supply and demand statistics are shown in Table 3-2.

Table 3-2: Water Supply and Demand

Description	Million Gallons Per Day	
Water Supply	**FY 2014**	**FY 2015**
Water Supply Yield		
-Primary	10.50 MGD	10.50 MGD
-Secondary	15.00 MGD	15.00 MGD
Water Treatment Capacity	20.00 MGD	20.00 MGD
Water Demand		
Average Metered Daily Consumption	4.90 MGD	5.38 MGD
Peak Day Water Production	9.44 MGD	12.90 MGD
Non-Revenue Water	3.55 MGD	3.95 MGD
Total Average Daily Water Production	8.45 MGD	9.33 MGD
Performance Ratios		
Average Daily Non-Revenue Water as % of total produced	42%	42%
Average Daily Demand as % of Treatment Capacity	42%	47%
Peak Demand as % of Treatment Capacity	47%	65%

Sources: 2015 Primary Facilities Report, 2015 Water Loss Audit, and FY 2015 billing data as provided by CRW.

3.4 Water Quality

Water quality is regulated by the Federal Safe Drinking Water Act and enforced through laws and regulations administered by the PADEP. CRW publishes an Annual Drinking Water Quality/Consumer Confidence Report as required by the EPA. The Drinking Water Quality Report provides general information on the Water System and the results of water quality tests on drinking water for that calendar year as compared to permitted maximum contaminant levels ("MCL's"). CRWs 2015 Drinking Water

Quality Report (which reports the results for calendar year 2015) concluded that CRW's treated water quality is good and continues to consistently exceed national quality standards.

In addition, the laboratory analyzes the DeHart Dam influent, the finished water, and the distribution system for the following parameters: pH, total alkalinity, temperature, iron, total dissolved solids, and total hardness. The DeHart Dam and finished water are also routinely monitored for turbidity and total organic carbon. Finished water is also tested for fluoride, aluminum, chlorine residual levels, and orthophosphate levels. Orthophosphate levels are also monitored in the distribution system. A summary of the key test results for 2015, as published in CRW's annual Drinking Water Quality Report and its comparison to established MCL's is provided in Table 3-3.

Table 3-3: Drinking Water Quality

Contaminant	Units	MCL	Levels Detected (2014)	Levels Detected (2015)
Barium	ppm	2	0.012	0.014
Chlorine	ppm	4	1.2	1.13
Fluoride	ppm	2	0.48	0.62
Nitrate	ppm	10	0.11	Not reported
Total Trihalomethanes	ppb	80	39.0	36.4
Haloacetic Acids	ppb	60	33.2	34.3
Arsenic	ppb	10	0	Not reported
Radium-226	pCi/L	5	0.117	Not reported
Chlorine Residual	ppm	Min. of 0.2 (1)	1.14 – 1.67	0.81 – 1.56
Total Organic Compounds	% removal	Min. 35-45% (1)	35.2 – 100%	32.0 – 60.9%
Total Coliform Bacteria	% positive monthly samples	5%	0%	1.12%
Fecal Coliform or E.coli	ppm	0	0	0
Turbidity	NTU % samples below 0.3 NTU	1 95%	0.121 100%	0.281 99.86%
Lead	% samples below 15 ppb	90%	Not reported	Not reported
Copper	% samples below 1.3 ppm	90%	Not reported	Not reported

Source: 2016 Drinking Water Quality Report

As shown in Table 3-3, the drinking water quality of the Water System consistently meets or exceeds permitted MCL's. In addition, it is important to note that the EPA has launched several initiatives including the Long-Term 2 Enhanced Surface Water Treatment Rule ("LT2") and Stage 2 Disinfectants and Disinfection By-Products Rule ("DBP2"). LT2 is designed to reduce disease incidence associated with Cryptosporidium and other disease-causing microorganisms, while DBP2 protects against exposure to by-products of the treatment process. As part of the LT2, CRW's two water sources, the DeHart Dam and the Susquehanna River, were previously tested for Cryptosporidium. Testing conducted to date

shows no indication of this organism in the water. Therefore, the Water System was classified as "Bin1" and no additional testing is required at this time. With respect to the DBP2 rules, water samples taken from the distribution system have historically shown little indication of the presence of Total Trihalomethanes and Five Haloacetic Acids.

CRW's copper and lead survey analysis, which have been completed once every three years since 2007, and which was scheduled to be completed again in 2016, have shown that copper and lead concentrations at residential taps remain well below MCL's. These results verify the success of CRW's corrosion control program, which includes the addition of soda ash and caustic soda to raise pH levels in water supply to promote corrosion control. Zinc Orthophosphate is also added to promote corrosion control due to the success of historic sampling results.

Based on these results it is no surprise that in 2015, CRW was once again honored with an award by the Partnership for Safe Water. This award marks 11 consecutive years of achieving voluntary water quality standards that exceed State and Federal water quality regulatory requirements.

3.5 Future Safe Drinking Water Regulations

Regulations affecting the Water System continue to become more stringent. The following serves to summarize the status of several key proposals that could impact CRW's operations, with each being described in more detail in the following paragraphs:

- Third Six-Year Review
- Final Regulatory Determination for the Contaminants on the Third Drinking Water Contaminant Candidate List
- Fourth Unregulated Contaminant Monitoring Rule ("UCMR4")
- Hexavalent Chromium ("Cr-6")
- Proposed Long-Term Lead and Copper Rule
- Proposed Carcinogenic Volatile Organic Compounds ("cVOC") Rule
- Proposed Perchlorate Rule
- Fluoride

3.5.1 Third Six-Year Review

The EPA is required to conduct a review of drinking water regulations every six years. The Third Six-Year Review is currently underway and is expected to be published in 2016. As part of this process, the EPA evaluates all of the existing drinking water regulations and determines if a revision is necessary based on new information regarding health effects, analytical methods, occurrence, and treatment data. The Third Six-Year Review is expected to focus largely on microbial and disinfection by-product rules. Additionally, given various waterborne outbreaks including Legionella and Naegleria fowleri, EPA is currently revisiting the Federal regulatory requirements for maintaining a disinfectant residual in the distribution system.

3.5.2 Final Regulatory Determination for Contaminants on the Third Drinking Water Contaminant Candidate List

The Safe Drinking Water Act requires EPA to make regulatory determinations (either positive or negative) on at least five contaminants every five years. In 2015, the EPA published the Final Third Regulatory Determinations. EPA decided not to regulate four organic contaminants, specifically dimethoate, 1,3-dinitrobenzene, terbufos, and terbufos sulfone. EPA also decided to delay the final regulatory determination for strontium as they felt additional health effect, occurrence, and treatment data are needed. As such, at this time, it is unknown at what concentration strontium will be regulated. EPA did, however, publish a paper on potential impacts of a strontium regulation on water utilities in 2014, and this document suggested that small groundwater systems are most likely to be impacted by a future strontium regulation.

Additionally, EPA did not make regulatory determinations for chlorate and six nitrosamines, but elected to review these contaminants as part of the review of the existing microbial / disinfection by-product rules under the Third Six-Year Review.

3.5.3 Fourth Unregulated Contaminant Monitoring Rule

The Unregulated Contaminants Monitoring Rule was designed to evaluate and prioritize contaminants for inclusion in Federal drinking water regulations for the purpose of protecting public health. The rule intends to document the occurrence of the contaminants on the Candidate Contaminant List to determine whether or not future regulation is warranted.

A draft Fourth Candidate Contaminant List ("CCL4") was published in February 2015, and includes 100 chemicals or chemical groups and 12 microbiological contaminants. The list includes, among others, pesticides, disinfection by-products, chemicals used in commerce, waterborne pathogens, pharmaceuticals, and biological toxins. Manganese was also included in the list as a result of new health effect data even though EPA made a negative regulatory determination for manganese in 2003. Seventeen contaminants from the CCL4 were included in the draft UCMR4, which was released in December 2015. Ten cyantoxins plus three brominated haloacetic acids were also included in the draft, bringing the total to 30 contaminants. The UCMR4 is expected to be finalized in late 2016 or early 2017, with monitoring to begin in 2018.

3.5.4 Hexavalent Chromium

The EPA has an enforceable drinking water standard of 100 micrograms per liter ("µg/L") for total chromium, which is the sum of the concentrations of all states of the metal chromium, including chromium III and Cr-6. The EPA released a draft human health assessment for Cr-6 in 2010; however, the date for issuance of a final assessment has not yet been published. Issuance of a final assessment would be required prior to the EPA establishing a new drinking water regulation for Cr-6. It is likely that EPA will discuss a potential Cr-6 regulation as part of the Third Six-Year Review, which will include a review of the existing total chromium regulation. However, it is unclear at this time if EPA will develop a separate regulation for Cr-6. The State of California had proposed a MCL of 10 µg/L for Cr-6 in California.

In the interim, EPA is requesting voluntary Cr-6 sampling of finished water at points-of-entry and at maximum residence time sampling locations. It is recommended that during this time period, CRW

conduct voluntary Cr-6 sampling and gather relevant information to enable it to understand and respond to future requirements, as it is likely that a regulation for Cr-6 will be forthcoming. However, as it is uncertain if Cr-6 will be regulated separately in the future and at what level, the potential impact on the Water System is not known at this time.

3.5.5 Proposed Long-Term Lead and Copper Rule

In 2014, the EPA engaged a group of stakeholders, the Lead and Copper Rule Working Group, to provide advice and recommendations on key areas related to the Lead and Copper Rule. The working group released final recommendations in August 2015. Key recommendations from the working group include:

- Separating the requirements for copper.
- Establishing a voluntary tap sampling program and household action level for lead.
- Requiring proactive lead service line replacement programs.
- Developing stronger public education for lead and lead service lines.
- Strengthening corrosion control treatment and water quality parameter monitoring requirements.

The report was approved by the full National Drinking Water Advisory Council in November. The EPA is now considering those recommendations as they develop a draft regulation, which is anticipated to be published in early 2017, with a possible final rule in 2018 or 2019.

3.5.6 Proposed Carcinogenic Volatile Organic Compounds Rule

In 2011, the EPA discussed regulating several cVOC's as a group. The preliminary list consisted of sixteen cVOC's, including trichloroethylene and perchloroethylene. However, it appears that this concept has posed several challenges, and EPA may not move forward with a cVOC Rule as originally anticipated. The EPA is, however, actively assessing 1,2,3 trichloropropane, which is extremely carcinogenic. They are currently waiting on occurrence data from small systems before making a regulatory determination.

3.5.7 Proposed Perchlorate Rule

In 2011, the EPA announced that it is going to move forward with plans to develop a national standard for perchlorate in the near future. Perchlorate is both a naturally occurring and man-made chemical that is used to produce rocket fuel, fireworks, flares, and explosives. It can also be present in bleach and in some fertilizers. Perchlorate removal is most often achieved using ion exchange. The EPA recently initiated a peer review process on the Biologically Based Dose Response Model, which will help EPA decide if and at what level perchlorate is to be regulated. As such, a draft perchlorate rule is likely to be released no earlier than 2017, but could easily be delayed depending on the schedule and outcome of the peer review process.

3.5.8 Fluoride

In January 2011, the U.S. Department of Health & Human Services proposed lowering the recommended level of fluoride in drinking water from a range of 0.7 to 1.2 milligrams per liter ("mg/L") to 0.7 mg/L. This

recommendation was finalized in April 2016. Despite the benefits of tooth decay prevention, some research has shown that fluoride can lead to mild to moderate mottling of teeth, particularly in formula-fed infants. The purpose of revising the recommended fluoride level is to balance the benefits of preventing tooth decay, while limiting any unwanted health effects. The EPA is currently reviewing both the primary and secondary maximum contaminant levels for fluoride; however, it is currently unknown when this review will be complete.

3.5.9 Summary

Discussions with CRW indicated that it is not aware of any proposed regulation which would have a material impact on its operations. CRW has been in discussion with the PADEP regarding the potential need to increase the spillway of the Dam to meet 1990 regulations, which require spillway capacity equal to the maximum storm flow. PADEP is currently evaluating requirements and once finalized, CRW would have 10 years to implement any necessary improvements. As such, the spillway project remains on CRW's capital improvement plan ("CIP"); however, no compliance cost or schedule has been developed.

The review of potential future regulations indicate that at this time the potential known impacts of currently proposed regulations are not anticipated to have a material impact on CRW operations.

4 WATER SYSTEM CONDITION

4.1 Overview

Arcadis conducted a limited condition assessment of the key components of the Water System on September 13-14, 2016, which included a review of existing information provided by CRW, discussions with CRW staff, and visual observations during field visits. Based on the type of facilities, available documents related to the facilities, and our experience with similar facilities, a representative sample of facilities was inspected on a limited basis to visually confirm the information provided, identify any apparent capital improvement needs, and discuss reliability and O&M performance with the operation and maintenance staff. No field investigations were conducted for buried infrastructure.

4.2 Condition Assessment

The condition assessment of the facilities in the Water System was based on numerical ratings for the following criteria:

- Appearance of mechanical, structural, and electrical components
- Reliability
- O&M performance
- Capacity
- Regulatory compliance

Based on the evaluations using the above categories, an overall risk rating was assigned to each of the major assets. The risk ratings for each of the five categories above are outlined in Table 4-1.

Table 4-1: Summary of the Rating System

Numerical Rating	Interpretation of Rating	Description
1	Little to no risk	Relatively new and in good physical and operating condition.
2	Some risk	Good condition, no known capital requirements.
3	Moderate risk	Aged or worn but generally in good operating condition may require capital investment within five years.
4	Significant risk	Operational but nearing end of life and / or requires investment to bring to full operating condition.
5	High risk	Should be on high priority for renewal and / or replacement.

The following presents a summary of the risk ranking for each of the major facilities based on a review of the available information and limited visual inspections.

Table 4-2: Major Assets Risk Rating

Major Asset	Risk Rating
DeHart Dam and Reservoir	3
Dr. Robert E. Young Water Services Center	2
Upper Reservoir	3
Lower Reservoir #1	2
Lower Reservoir #2	2
Susquehanna River Pump Station	1
Gate House Pump Station	2
Union Square Booster Station	1
Transmission Mains • Mountain Line • Susquehanna Line • Plant-Gate-House-Reservoir Line	 3 1 2
Distribution System	3
Overall System Rating	2.1

Overall the Water System is in good condition and the risk rating slightly improved from 2015; however, some components are aged and will require investigation and capital investment to preserve the asset and maintain high quality water and adequate delivery of services. The following subsections provide a summary of the current condition of the major components, the rationale for the risk scores assigned, and the improvements needed to address moderate, significant, and high risks.

4.2.1 DeHart Dam, Reservoir Control Building, and Chemical Feed Facility

CRW routinely monitors and evaluates the DeHart Dam in order to ensure operational efficiently and regulatory compliance. These regulations include annual inspections, followed by a PADEP on-site review. CRW submitted its last Dam Inspection Report to the PADEP in December 2015. Based on a review of the 2015 Dam Inspection Report, it appears that the Dam is being properly maintained and that the Dam and Carsonville Weir are stable and in good condition. Recommendations resulting from the report were insignificant in nature and included monitoring of two seepage sites, managing vegetation on upstream and downstream embankment faces, and installing permanent survey monuments to provide controls for monitoring dam and structure movement. Past correspondence with PADEP indicates there has been discussions with regard to spillway capacity, embankment stability, the installation of monuments and piezometers, the preparation of an emergency action plan, seepage, and the need for an outlet system inspection. In the past, PADEP had also authorized repairs to the concrete spillway, which were completed, according to the 2015 Dam Inspection Report.

The recommended projects for the DeHart Dam that have been included in the CIP are shown in Table 4-3.

Table 4-3: DeHart Dam Improvement Needs

Description	Classification
Provide survey monuments for monitoring dam	Capital Addition
Repair bridge over spillway	Capital Maintenance
Paint piping or dehumidify control building basement	Capital Maintenance
Repair parapet and cracks on control building	Capital Maintenance
Repair spillway (FEMA) if required	Capital Addition

4.2.2 Dr. Robert E. Young Water Services Center Treatment Facility

The Dr. Robert E. Young Water Services Center, located at the intersection of Pine Drive and Stanley Drive on the City of Harrisburg's municipal border with Susquehanna Township, treats raw water conveyed from either the DeHart Reservoir or the Susquehanna River. It also contains CRW's customer services office and maintenance garage. It utilizes chemical addition, flocculation, coagulation, sedimentation, filtration, and disinfection to produce the Water System's finished water.

The 2016 Drinking Water Quality Report was reviewed, which showed that the water provided by the plant was of high quality and consistently exceeded performance requirements as determined by State and Federal regulations. In addition, PADEP gave the filter plant a "satisfactory" performance rating for its ability to consistently produce high quality water and provide long term reliability in its 2012 Filter Performance Evaluation Report; however, PADEP identified many issues and concerns requiring investigations or improvements.

The EPA inspected the plant in 2015 and noted a potential violation of the Section 112(r)(7) Risk Management Program Regulations under the Code of Federal Regulations, where CRW had not verified, at least every three years, that procedures and practices developed under this subpart were adequate

and being followed. However, in March 2016, in correspondence to the EPA, CRW certified that the procedures and practices developed under the rule were adequate and being followed.

The plant appears to be in good overall physical condition. However, some capital investments will be required within the next five years in response to PADEP comments and some additional O&M expenditures should be incurred to improve the resiliency of its operation and satisfy the expectations of the regulatory agency. The recommended capital and incremental O&M needs for the plant are shown in Table 4-4. The recommended capital projects have been included in the CIP.

Table 4-4: Water Treatment Facility Improvements

Description	Classification
Annual Confined Space Entry Training	O&M
Secondary Source Operations Plan/Training	O&M
Emergency Table Top Drills	O&M
WSC Inspect clear well	O&M
WSC Filter media replacement/refurbishment	Capital Addition
WSC Tube settler replacement	Capital Addition
WSC Influent streaming current meter	Capital Addition
Auxiliary Power (permanent solution)	Capital Addition

4.2.3 Finished Water Reservoirs

The Water System utilizes three reservoirs to store finished water for distribution throughout its service area. The reservoirs are located at Reservoir Park within the City and serve two different pressure districts.

The Lower Reservoir consists of two six million gallon circular tanks constructed in 2002. This facility serves consumers who are generally located west of Eighteenth Street within the City. The Lower Reservoir has an overflow elevation of 504 feet and connects to the distribution system through a supply pipe which ranges in size from 30 to 36 inches in diameter. The last interior inspection of the Lower Reservoir tanks was in 2010 and no further inspections had been scheduled as of the date of our site visit. We did not visit the vault containing the discharge piping because the vault is a confined space. The tanks appear to be in good overall condition based upon our exterior inspection; however, the concrete on the exterior walls has extensive hairline cracks with effervescence and also extensive discoloration caused by a biological film. The tanks should be power washed within the next five years and may require recoating to prevent further deterioration of their exteriors. CRW should monitor the cracks to ensure that water is not penetrating to the wire wrapping.

The Upper Reservoir is an underground reinforced concrete reservoir constructed in 1927. It has a storage capacity of 28.0 million gallons and is divided into two compartments. The Upper Reservoir serves the Water System's high pressure zone. It supplies water to customers located east of Eighteenth Street within the City and in portions of Penbrook, Susquehanna, Swatara, and Lower Paxton. The last

interior inspection of the Upper Reservoir tanks was in 2008. CRW plans to rehabilitate the upper reservoir pending the results of inspections planned to occur in 2017.

Arcadis did not visit the vault containing the discharge piping because the vault is a confined space. Arcadis could not observe the condition of the tank vents or overflows because the hatches were spot welded closed for security. However, it was noted that the Upper Reservoir has multiple leaks. CRW makes monthly estimates of leakage that surfaces in the vicinity of the reservoir. The leakage reported by CRW for calendar year 2015 was 5.7 million gallons, which is approximately the quantity of water produced in a single day by CRW. The PADEP cited CRW for a violation in July 2015 because the leakage resulted in chlorinated water being discharged to a storm drain on River Side Drive. The Upper Reservoir is operational but nearing the end of its expected service life. Rehabilitation work at this reservoir has been included in the CIP.

The recommended capital and incremental O&M needs for the Finished Water Reservoirs are shown in Table 4-5. All recommended capital projects were included in the CIP.

Table 4-5: Finished Water Reservoir Improvements

Description	Classification
Upper Reservoir - Line interior to eliminate leaks. Make additional repairs identified by inspections.	Capital Maintenance
Regular Reservoir Inspections	Capital Maintenance
Lower Reservoir - Clean and recoat exteriors. Make additional repairs identified by inspections.	Capital Maintenance
Regular Reservoir Inspections	Capital Maintenance

4.2.4 Susquehanna River, Gate House, and Union Square Pump Stations

CRW's Water System utilizes three pumping stations to convey water and maintain adequate distribution system pressure. The Susquehanna River Pump Station is located within the City, between Front and River Streets, north of Graham Street, and is used to transfer raw water from the Susquehanna River to the Dr. Robert E. Young Water Services Center. The facility draws water from the river via an inlet tunnel connected to four wedge wire screens located in the river. It was constructed in 1994. CRW typically exercises the equipment at the facility one day a year because of CRW's preference for utilizing water from the DeHart Reservoir. Overall, the facility appears to be in good condition and able to perform adequately.

The Gate House Pump Station is located at the City's Reservoir Park and is used to transfer finished water from the Lower Reservoir or the Dr. Robert E. Young Water Services Center to the Upper Reservoir. It was constructed in the 1920's. The most recent significant upgrade was in 1994. CRW typically operates at least one pump for 12 hours each day. The facility appears to be in good condition and able to perform adequately.

The Union Square Industrial Park Booster Station is located within Susquehanna Township along Susquehanna Township's municipal border with Lower Paxton Township and is used to increase the water pressure within the outer reaches of CRW's distribution system, which serves the Union Square Industrial Park. It was constructed in the mid 1990's. CRW rarely operates the facility because the system pressure is adequate for normal demands. The facility appears to be in good condition and able to perform adequately.

One additional O&M item for these facilities were identified and included in Table 4-6.

Table 4-6: Pump Station Improvements

Description	Classification
Recoat piping at lower level of Susquehanna River Pump Station.	O&M

4.2.5 Water Transmission System

CRW has several water transmission mains. The most important transmission mains are the DeHart Dam raw water line, known as the Mountain Line, the raw water transmission main connecting the Susquehanna River Pump Station to the Dr. Robert E. Young Water Services Center, and the finished water transmission main connecting the Dr. Robert E. Young Water Services Center to Reservoir Park.

The Mountain Line is a reinforced concrete and pre-stressed concrete cylinder pipe pipeline that was placed into service in 1940. The portion of the pipeline though the Dauphin Narrows was relocated by the Pennsylvania Department of Transportation in 1965 when it was widening State Route 22 / 322.

CRW retained Pure Technologies Ltd. To investigate the Mountain Line in 2016 using its Smartball™ leak detection technology. The report on the investigation was unavailable at the time of preparation of this report. CRW has also begun to make repairs along the line to ensure uninterrupted service to its customers.

The Susquehanna River transmission main is a pre-stressed concrete cylinder pipeline that was placed into service in 1994. Its current state of repair and ability to deliver an adequate supply of raw water cannot be verified from the available information. The PADEP is requiring CRW to operate the Dr. Robert E. Young Water Services Center using Susquehanna River water for an extended period in the near future, which will provide CRW with information on the pipeline's performance.

The materials of construction and age of the finished water transmission main from the Dr. Robert E. Young Water Services Center to Reservoir Park were unavailable at the time of preparation of this report. It could be inferred that some portion of the main might have been constructed when the original lower reservoir was placed in service in 1873 and that the portion connecting to the Dr. Robert E. Young Water Services Center was probably constructed when the treatment plant was placed in service in 1994. Its current state of repair and ability to continue delivering an adequate supply of finished water cannot be verified from the available information. This main is arguably the most critical main in the entire Water System.

One incremental O&M need for the transmission mains was identified and is shown in Table 4-7.

Table 4-7: Transmission Main Improvements

Description	Classification
Water Service Center Finished Water Transmission Main – Compile information on construction, improvements, and operating history for the main.	O&M

4.2.6 Water Distribution System

CRW's water distribution system includes approximately 250 miles of pipe, 1,780 fire hydrants, 5,300 valves, and 20,700 active services.

Delivered Water Quality:

CRW provides the PADEP with monthly reports on the quality of its delivered water and publishes an Annual Drinking Water Quality / Consumer Confidence Report, as required by the EPA. The Drinking Water Quality Report provides the results of water quality tests on CRW's drinking water for the year as compared to permitted MCL's. CRW's 2016 Drinking Water Quality Report (which reports the results for calendar year 2015) concluded that CRW's water quality continues to consistently exceed national quality standards.

CRW has a routine sampling plan. Its day-shift plant operators collect more than the minimum number of routine total coliform samples required from sites of commercial customers including customers located where the longest detention time is expected. CRW also maintains a detectable disinfection residual in its distribution system verified by the same sampling program used to monitor the absence of total coliform organisms in the water. It also monitors for disinfection by-products as required by the EPA and has been in compliance since 2012.

CRW maintains records of aesthetic water quality complaints and their resolution. It reports the number of water complaint calls in the Water Division Monthly Report. Aesthetic complaints are infrequent and most often a consequence of CRW's hydrant flushing program.

CRW monitors 30 sites triennially in accordance with a sampling plan as required by the EPA for systems complying with the lead and copper rule. In addition, CRW flushes its distribution system at all hydrants beginning in the spring of each year, and starting with high capacity mains before moving toward lower capacity mains.

CRW's delivered water quality program appears to be consistent with Section 4.1 of American Water Works Association ("AWWA") Standard G200 - Distribution Systems Operation and Management, based upon a limited review of documentation and an interview with the Superintendent on September 14, 2016.

Distribution System Management:

CRW maintains the water in its finished water storage reservoirs at levels high enough to avoid low pressure complaints from customers. It monitors the water levels in the reservoirs but does not otherwise monitor the pressure in the distribution system. It posts "boil water" notices on its web site for repairs or maintenance causing loss of pressure to customers. The minimum pressure of the system has been located at 39th Street and Walnut Street in the Penbrook Borough at 30 pounds per square inch. CRW

has planned further investigations of pressure readings in the surrounding area during the next hydrant flushing cycle.

CRW does not have a comprehensive backflow prevention program complying with Part VII, Cross-Connection Control / Backflow Prevention of the PADEP Public Water Supply Manual. Program implementation requires appropriate municipal ordinances and up to five years to educate customers, have customers install backflow preventers as appropriate, and to initiate a backflow device testing program. CRW is unconcerned about organic solvents permeating into the system through PVC piping because it does not have any PVC piping in its system.

CRW is searching its distribution system for leaks and working to correct a water meter recording problem in response to the significant NRW noted in Section 3.3 of this report. It does not have an explicit water loss goal or a formal action plan to address NRW; however, it has utilized the AWWA Water Audit software to prioritize its effort to reduce NRW. It does report estimated volumes for several categories of water losses in Exhibit K, Miscellaneous Water Usage of its Water Division Monthly Report. A three-year comparison of the amount of NRW, as well as the number of water main breaks for the Water System is shown in Table 4-8.

Table 4-8: Non-Revenue Water and Water Main Breaks

Year	Water Produced (MGD)	Non-Revenue Water (MGD)	Non-Revenue Water %	# of Water Main Breaks
2013	8.45	3.15	37.3%	13
2014	8.45	3.55	42.0%	32
2015	9.33	3.95	42.3%	30
Average	**8.74**	**3.55**	**40.6%**	**25**

Sources: FY 2015 billing data as provided by CRW, 2015 Water Loss Audit, and December 2015 Water System Report

The amount of NRW includes authorized usage attributable to fires, line flushing, street cleaning, lab testing, etc., as well as NRW attributable to a number of factors such as meter accuracy, finished water reservoir leaks, water main leaks, private service connection leaks, and potential theft or unmetered connections.

CRW does not have a valve exercising program in place to satisfy AWWA G200 Paragraph 4.2.5. It does report valves replaced, valves exercised, and valves repaired on Exhibit I, Distribution System Activities, in its Water Division Monthly Report. CRW has identified valve replacement among the projects in its CIP. The total numbers reported for these categories for 2014 indicate that a more aggressive maintenance and replacement program could be justified. Approximately 90.0 percent of the valves in the system are thought to be operational.

CRW does attempt to test all hydrants annually. It does report hydrants tested, hydrants replaced and hydrants repaired on Exhibit I, Distribution System Activities, in its Water Division Monthly Report. Approximately 99.0 percent of the hydrants in the system are thought to be operational.

CRW does ensure that only NSF / ANSI Standard 61 approved coating and linings are used throughout its distribution system whenever new material is installed. However, much of the system predates the standard. Many service connections still have lead goose necks where they connect to the mains. Further review of CRW records are needed to establish the number of lead goose necks and assess the cost of eliminating the lead goose necks in order to achieve "lead free" status either in response to a future regulatory mandate or as a proactive measure.

CRW does meter the finished water entering the distribution system to determine peak flows and maximum day peak flows. Most of the customer meters in the system were replaced between 1999 and 2002. CRW believes that a great deal of the NRW is attributable to under reporting of actual consumption caused by system wide meter radio-read transceiver battery failures and conservative estimates of bills where there were no meter reads. As of the date of our site visit, CRW had replaced most of the batteries in the meter radio-read transceivers. Standards for meters were not reviewed for this report and Arcadis did not confirm whether CRW's metering program conforms to AWWA Manual M6 as part of this report.

The distribution system is capable of delivering the maximum day demand and satisfying fire flow requirements based upon information obtained from records and interviews. However, no hydraulic model results or reports were reviewed. CRW does record information related to main breaks including location, pipe material, diameter, type of break, and soil type. Most breaks are reported to be random except for one particular neighborhood that has aggressive soils. CRW does not have an external corrosion monitoring plan.

CRW does review construction projects for potential impacts on its Water System. It has records for projects completed since the 1990's but not for earlier periods. CRW does not have an energy management program intended to anticipate new distribution system facilities because new facilities are a relatively minor component of its CIP.

CRW's distribution system management program appears to be consistent with Section 4.2 of AWWA Standard G200 - Distribution Systems Operation and Management, based upon a limited review of documentation and an interview with the Superintendent on September 14, 2016, with the except that more documentation is needed and programs for backflow prevention, valve exercising, and meter management need enhancements.

Facility Operation and Maintenance:

CRW has been inspecting storage reservoirs on a five to eight year cycle. CRW maintains the treated water in its finished water storage reservoirs at levels high enough to avoid low pressure complaints from customers. The reservoirs draw down and refill approximately 10.0 percent on a daily basis. This is relatively low turnover, but it is mitigated by the excellent quality of the water being delivered. CRW depth tested the chlorine residual of both reservoirs during the year and the results showed that the chlorine residual was consistent at all water levels tested, which indicated that there was no degradation of water quality within the reservoirs. Furthermore, CRW is capable of increasing the turnover rate of the reservoirs if it suspects there may be degradation of water quality in the reservoirs.

CRW has written operating procedures for the Susquehanna River Pump Station but not for its other pumping stations. Its SCADA system records operational conditions. It has written maintenance procedures for all three of its pumping stations. CRW has poor records as to the history of its distribution system pipelines. The average age of the distribution system is unknown as records regarding

installation dates of pipes is not available for about 40.0 percent of the distribution system. Where records are available, they indicate an aged system, with over 90.0 percent of the records showing an installation date prior to the 1960's, and almost half of those installations occurring over 100 years ago. A nominal replacement rate of 12,500 linear feet per year might be justified based upon the age and size of the system. However for a long-term program, more information is needed to prioritize main replacement locations.

CRW's distribution system operation and maintenance program appears to be consistent with Section 4.3 of AWWA Standard G200 - Distribution Systems Operation and Management, based upon a limited review of documentation and an interview with the Superintendent on September 14, 2016, with the exception that more documentation is needed and the program for water main replacement needs enhancements.

Documentation:

CRW continues to update and expand its GIS system including integration with its City Works asset management program. CRW's plan is consistent with Section 5.1 "Documentation required" of AWWA Standard G200. It is recommended that CRW continue to expand this program.

The recommended capital and incremental O&M needs for the distribution system are shown in Table 4-9. All capital items have been included in the CIP.

Table 4-9: Distribution System Improvements

Description	Classification
Water Main Assessment to Prioritize Replacements	Capital Addition
Water Main Replacement	Capital Addition
Water Meter Replacement Program	Capital Addition
Meter Read Auditor	O&M
Valve Exercising Program	O&M
Backflow Prevention	O&M
"Lead Free" plumbing assessments	O&M

Note: See narrative prior to this table for added descriptions.

5 CAPITAL IMPROVEMENT PLAN

5.1 Overview

CRW maintains a long-term CIP that identifies the major planned projects and initiatives for the Water System. The CIP includes projects that are required to meet future regulations, replace aging infrastructure, enhance or expand services to customers, provide resiliency and redundancy, and increase cost effectiveness and efficiency. As such, while certain projects are required by regulations or needed to maintain proper operations others are discretionary in that the project is being undertaken to

meet CRW's established goals, but are not necessarily critical to the continued operation of the Water System. As such, the schedule for implementation of discretionary projects is often subject to change.

A review of CRW's long-term CIP, its past accomplishments, and the current observed condition of key assets was completed to assess the overall condition of Water System, and to identify potential capital improvements that should be considered for implementation by CRW in FY 2017. The following presents a summary of the findings of our review.

5.2 CRW Updated Five-Year Capital Improvement Plan

A summary of the recommended CIP for CRW for the period FY 2017 through FY2021 that reflects capital project delays in FY 2016 and all capital improvements that were identified and recommended based on the document reviews, visual inspections, and discussions with CRW as part of this report, are shown in Table 5-1.

5.3 Discussion

The estimates of probable costs included in the CIP are preliminary and were developed based on visual analysis, without detailed review. As individual studies are prepared, costs shown in the CIP may increase or decrease based upon further definition of project scope.

CRW is currently aware of the condition of the Water System and the capital projects needed to address the issues that were identified. As with any water utility, there is a need to prioritize capital projects given limited funds. Changes to the capital plan should be communicated to the finance department so as to not delay the acquisition of funding to support the required capital projects. In addition, CRW should aim to implement the CIP projects that it identifies and includes in its capital budget each year.

Table 5-1: Capital Improvement Plan

Location	Description	Type	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Dam	Repaving at DeHart Complex	CM	$ 645,000	$ -	$ -	$ -	$ -	$ -
Dam	Provide survey monuments for monitoring dam	CA	-	-	-	-	-	-
Dam	Repair bridge over spillway	CM	-	110,000	-	-	-	-
Dam	Paint piping or dehumidify control building assessment	CM	-	50,000	-	-	-	-
Dam	Repair parapet and cracks on control building	CM	-	50,000	-	-	-	-
Raw	Mountain Line and secondary transmission main investigation	CM	-	-	-	-	-	-
Raw	Mountain Line repairs	CA	-	1,500,000	1,000,000	-	-	-
WSC	WSC permanent auxilliary power	CA	-	1,300,000	-	-	-	-
WSC	WSC filter media replacement	CA	-	50,000	-	-	-	-
WSC	WSC tube settler replacement	CA	-	4,000,000	-	-	-	-
WSC	WSC influent streaming current meter	CA	30,000	-	-	-	-	-
Storage	Inspect and clean upper reservoir	CM	-	300,000	-	-	-	-
Storage	Inspect lower reservoirs	CM	-	30,000	-	-	-	-
Storage	Line and rehabilitate upper reservoir	CM	-	800,000	-	-	-	-
Storage	Clean and coat lower reservoirs	CM	-	200,000	-	-	-	-
T&D	Progress Ave main extension (design)	CA	-	200,000	-	-	-	-
T&D	Progress Ave main extension (construction	CA	-	-	1,200,000	-	-	-
T&D	Water main replacement	CA	500,000	1,000,000	1,500,000	2,000,000	2,500,000	-
Misc	Water meter replacement	CA	148,400	500,000	1,000,000	1,000,000	851,660	-
Misc	Miscellaneous projects	CA	-	-	1,000,000	1,000,000	1,000,000	-
Misc	Pickup Trucks	CA	100,000	-	-	-	-	-
Misc	Valve Turning Equipped Vehicle	CA	100,000	-	-	-	-	-
Misc	Extraordinary Repair	CM	200,000	-	-	-	-	-
	Total		**$ 1,723,400**	**$10,090,000**	**$ 5,700,000**	**$ 4,000,000**	**$ 4,351,660**	**$ -**

CA = Capital

CM = Capital Maintenance

6 OPERATIONS AND MAINTENANCE EXPENSE REVIEW

6.1 Overview

The Trust Indenture (Section 7.11) requires CRW to adopt a Water System budget each year sufficient to meet all of CRW's projected financial obligations for the upcoming fiscal year. CRW typically adopts a finalized budget in November, two months prior to the start of the new fiscal year. CRW utilizes the capital plan and O&M recommendations in this CEAR to assist in establishing the budget. However, it should be noted that this CEAR only serves to provide advice and recommendations regarding capital additions and the amount of funds that should be expended to meet incremental O&M expenses.

6.2 Historical Water System Expenses

A review of CRW's historical actual O&M expenses for FY 2014 and FY 2015 and the budgeted O&M expenses for FY 2016 are shown in Table 6-1. These expenses were reviewed to assess general alignment of overall system costs with the O&M needs of the Water System.

Increases in Administrative Fee costs have resulted from staff additions that occurred as a result of CRW's take back of operations from the City with the termination of the 1990 Management Agreement, in March 2014. Shared Services represents costs incurred by CRW for certain administrative and operational services that were provided by the City; however, as of FY 2015, the Water System no longer receives such services from the City.

Table 6-1: Historical Water System O&M Expenses

Description	Historical FY 2014	Historical FY 2015	Budget FY 2016
O&M Expenses:			
Salaries and Wages	$ 1,428,895	$ 1,548,688	$ 1,769,550
Benefits and Taxes	929,406	819,470	972,070
Contracted and Professional Services	161,034	266,949	477,800
Repairs and Maintenance	335,791	333,117	519,200
Supplies	341,069	219,514	591,800
Electricity	266,857	279,228	267,738
Chemicals	212,998	212,041	209,518
Sewerage	334,824	418,553	462,000
Insurance	269,455	323,523	346,046
Administrative Fee	1,263,467	2,404,134	2,877,419
Shared Services	376,130	-	-
Other Operating Expenses	133,970	234,868	386,234
Total Annual O&M Expenses	**$ 6,053,896**	**$ 7,060,085**	**$ 8,879,375**

Source: Historical actual expenses in FY 2014 and FY 2015 and budgeted expenses in FY 2016 provided by CRW.

6.3 Additional Operations, Maintenance, and Repair Costs

Several recommendations regarding the addition of O&M expenses in FY 2017 for the proper maintenance, repair, and operation of the Water System should be considered for implementation by CRW for FY 2017, as discussed in Section 4 of this report. The estimated annual cost associated with these recommended items is shown in Table 6-2.

Table 6-2: Summary of Additional O&M Costs

Location	Description	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
WSC	Annual Confined Space Entry Training	$ -	$ -	$ -	$ -	$ -
WSC	Secondary Source Operations Plan Training	-	-	-	-	-
WSC	Emergency table top drills	-	-	-	-	-
WSC	Inspect clear well	5,000	-	-	-	-
T&D	Re-coat piping at Susquehanna River pump statio	-	-	-	-	-
T&D	Compile information on finished water transmission main	-	-	-	-	-
T&D	Add a Meter Read Auditor	100,000	100,000	100,000	100,000	100,000
T&D	Valve exercising consistent with AWWA Standard G-200	266,000	350,000	350,000	350,000	350,000
T&D	Backflow prevention consistent with PADEP Public Water Supply Manual Part VII	15,000	5,000	5,000	5,000	5,000
T&D	"Lead Free" plumbing assessments by reviewing CRW records to compile the number and locations of lead goose necks still in service	20,000	-	-	-	-
	Total	**$ 406,000**	**$ 455,000**	**$ 455,000**	**$ 455,000**	**$ 455,000**

7 CONCLUSIONS

Set forth below are the principal conclusions which Arcadis has reached regarding our review of the Water System:

1. The Water System is generally being managed in a professional and prudent manner, with an appropriate regard for the level of service afforded to its customers. Based on our review of the data and limited visual inspection, the Water System achieved an overall rating of 2.1, indicating that it is generally in good physical and operating condition. However, certain components are aged or worn and will require capital investment within the next five years.
2. The Water System has consistently produced high quality water and is currently in full compliance with its permits and State and Federal regulations.
3. CRW's water supply and treatment capacity is sufficient to meet the current and projected future needs of the service area.
4. CRW's CIP included capital improvement projects recommended as a result of the 2015 Water CEAR, which was prepared by Arcadis. No additional projects have been added based on our review of the information provided and the limited visual inspection.

   Therefore, CRW's long-term capital plan is in general alignment with Arcadis' observed requirements for the Water System. CRW has a good understanding of additional capital projects

needed, with the exception of the prioritization of specific water distribution line replacements, and it should endeavor to refine the list of projects based on ongoing engineering analysis.

5. The Water System is generally being maintained and operated in accordance with generally accepted utility standards and overall the Water System is in good repair and operating condition. CRW has taken a number of steps and is working diligently to improve the condition of the Water System and the results are evident based on the improved operating performance.
6. Based on the available information, Arcadis recommends CRW implement additional O&M efforts as described in this report, including the following:
    a. At the Water Service Center Treatment Facility, completing confined space entry and secondary source operations plan training, and performing inspections of the clear well.
    b. Recoating the piping at the Susquehanna River Pump Station.
    c. Compiling information (i.e., construction, improvements, and operating history) on the finished water transmission main.
    d. Hiring a meter read auditor.
    e. Implementing a valve exercising program.
    f. Implementing a backflow prevention program.
    g. Completing a "lead free" plumbing assessment.
7. The additional O&M needs identified for the Water System are anticipated to require additional O&M budget funding in FY 2017. Depending on whether CRW completes those maintenance items in-house or with outside contractors, the cost of the items could range from $406,000 to $455,000 per year, beginning in FY 2017.

This CEAR summarizes the work completed up to the date of the issuance of this CEAR. Changed conditions occurring or becoming known after such date could affect the material presented to the extent of such changes. Arcadis has no responsibility for updating this CEAR for changes that occur after the date of this report.

In preparation of this CEAR, Arcadis has relied upon financial, engineering and operational data, and assumptions prepared by and / or provided by CRW. In addition, information and projections have been provided by other entities working on behalf of CRW. We believe such sources are reliable and the information obtained to be appropriate for the review undertaken and the conclusions reached in this CEAR. To the best of our knowledge, information, and belief, the information does not omit material facts necessary to make the statements herein. However, Arcadis has not independently verified the accuracy of the information provided by CRW and others. To the extent that the information is not accurate, the findings and recommendations contained in this CEAR may vary and are subject to change.

Arcadis devoted effort in making such opinions consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under same or similar circumstances and the time and budget available for its work in its efforts to endeavor to provide such opinions. The opinions are based on information provided by and consultations with CRW. No responsibility was assumed for inaccuracies in reporting by CRW or any third party data source used in preparing such

opinions. Arcadis' opinions represent its professional judgment. Neither Arcadis nor its parent corporation, or their respective subsidiaries and affiliates, makes any warranty, expressed or implied, with respect to such opinions.

APPENDIX A

Water System Description

Source of Supply, Transmission, Pumping, and Treatment:

The Capital Region Water's Water System includes two raw water supply sources. The DeHart Dam and Reservoir located in Rush Township, Dauphin County (primary water supply) and the Susquehanna River (secondary water supply). The DeHart Dam and Reservoir, lies within Clark Valley approximately twenty (20) miles northeast of the City of Harrisburg and impounds water flowing through the valley in Clark Creek and twenty-three (23) smaller tributaries producing a body of water with a 650 acre water surface area that extends four and one half (4.5) miles upstream of the dam. The DeHart Dam and Reservoir collects from a 21.62 square mile drainage area consisting of forest land between the ridges of Peters and Stony Mountains with a six (6) billion gallon storage capacity when full and a yield of ten and one half (10.5) million gallons per day.

The DeHart Dam and Reservoir's Control Building and Chemical Feed Facility, located on the southwest side of the dam and reservoir, provides flow metering and chemical addition to the raw water before it is conveyed by gravity via a combination of thirty-six (36) and forty-two (42) inch diameter transmission mains to the Dr. Robert E. Young Water Services Center in Susquehanna Township. Treatment of the raw water at the dam's Chemical Feed Facility consists of adding potassium permanganate.

The Susquehanna River, the water system's secondary water supply source, has an average flow of 34,410 cubic feet per second and an approximate drainage area of 24,100 square miles upstream of the City of Harrisburg. The river intake, constructed within the City of Harrisburg, north of the intersection of Front and Graham Streets, consists of a screened intake structure and a thirty-six inch diameter pipe with future provisions for chlorine dosing and air backwash capabilities to control zebra mussels and other aquatic organisms. Raw water flows by gravity through the river intake structure to the Susquehanna River Pump Station's intake well where it is then pumped to the Dr. Robert E. Young Water Services Center.

The Dr. Robert E. Young Water Services Center, located at the intersection of Pine Drive and Stanley Drive on the City of Harrisburg's municipal border with Susquehanna Township, treats raw water conveyed from either the William T. DeHart Dam and Reservoir or the Susquehanna River and houses the offices of the City of Harrisburg Department of Public Works, Bureau of Water. The Center utilizes chemical addition, flocculation, coagulation, sedimentation, filtration and disinfection to produce the water system's finished water.

The Dr. Robert E. Young Water Services Center has two parallel treatment process trains with a total design flow capacity of twenty million gallons per day. The process trains include two raw water flowmeters, two static mixers, four three-stage paddle wheel flocculators, four rectangular clarifiers, eight multi-media gravity filters with an air backwash system, two 150 HP centrifugal blowers, chemical feed equipment, two 9,400 gallon per minute backwash pumps, four 7,000 gallon per minute finished water pumps, and two finished water flowmeters. The Center's treatment capabilities include the chemical addition of alum; soda ash; powdered activated carbon; polyphosphate; hydrated lime; caustic soda;

ammonia and sodium silicofluoride to the process water. Disinfection is achieved with chlorine, chlorine dioxide or chloramines (chlorine and ammonia). The four finished water pumps at the Dr. Robert E. Young Water Services Center are used to transfer finished water to the Upper and Lower Reservoirs located at Reservoir Park for eventual distribution throughout the water system. Two of the finished water pumps at the Center are used for standby service.

The offices of the Bureau of Water, located at the Dr. Robert E. Young Water Services Center, include the Administration, Metering, and Maintenance Offices. A Personnel Training Center is included within the facilities of the Administration Office. The Dr. Robert E. Young Water Services Center also contains the Operators, Wet Chemistry, and Microbiology Laboratories. Operational control and jar tests are performed at the Operators Laboratory and water quality tests on the raw water from the DeHart Dam and Reservoir and the Susquehanna River are performed at the Wet Chemistry and Microbiology Laboratories.

Transmission:

The transmission system includes over twenty miles of forty-two inch diameter steel-reinforced concrete pipe which conveys water by gravity from the DeHart Dam and Reservoir in Clark Valley to the City of Harrisburg Dr. Robert E. Young Water Services Center. The forty-two inch diameter transmission main reduces to a thirty-six (36) inch diameter prestressed concrete cylinder pipe at the northwest side of the intersection of Division and Seventh Streets before it reaches the influent at Dr. Robert E. Young Water Services Center.

Storage:

The water system utilizes three reservoirs to store finished water for distribution throughout its service area. The reservoirs are located at Reservoir Park within the City of Harrisburg and serve two different pressure districts. The Lower Reservoir consists of two (6) Million gallon Natgun built concrete wire wound tanks. These reservoirs serve the water system's low pressure zone. The Lower Reservoir Replacement project was completed in 2002 replacing the existing facility that was built in 1873. This facility serves consumers who are generally located west of Eighteenth Street within the City of Harrisburg. The Lower Reservoir has an overflow elevation of 504 Feet and feeds the distribution system through a supply pipe which ranges in size from thirty to thirty-six inches in diameter.

Distribution:

The water system's distribution network includes more than 250 miles of cast-iron, ductile iron, and pre-stressed concrete cylinder pipe in various sizes ranging from 4 to 42 inches in diameter. In addition, there are approximately 1,780 fire hydrants and 5,340 valves in operation.

Interconnections:

There are four hydrant interconnections between the Capital Region Water's water system and the water distribution system owned by United Water Inc. United Water also has one raw water connection which allows them to draw raw water from the DeHart Reservoir during emergencies. The water system is not interconnected with any other privately or publicly owned water distribution system.

The four hydrant interconnections with the water distribution system owned by United Water, Inc. include:

- Intersection of Hoffman and Vaughn Streets within the City of Harrisburg.
- Intersection of Derry and Twenty-Ninth Streets within the City of Harrisburg.
- Interconnection located in the Edgemont area of Susquehanna Township along Edgemont Road.
- Intersection of Twenty-Eighth Street / Locust Lane in Susquehanna Township.

The final interconnection includes a forty-two (42) inch line near the Rockville Bridge which can supply raw water to United Water's Filtration Plant on an emergency basis.

Pumping Facilities:

The Capital Region Water's water system utilizes three pumping stations to convey water and maintain adequate distribution system pressure. The Susquehanna River Pump Station is located within the City of Harrisburg, between Front and River Streets, north of Graham Street, and is used to transfer raw water from the Susquehanna River to the Dr. Robert E. Young Water Services Center. The pump station houses three 400 HP vertical turbine pumps, each rated at 7,000 gallons per minute, to accomplish this transfer. Chemical treatment is provided at the Susquehanna River Pump Station and includes future provisions for chlorine dosing at the screened tee river intake structures. The chlorine dosing with air backwash provisions on the intake structure will be used for the control of zebra mussels and other aquatic organisms.

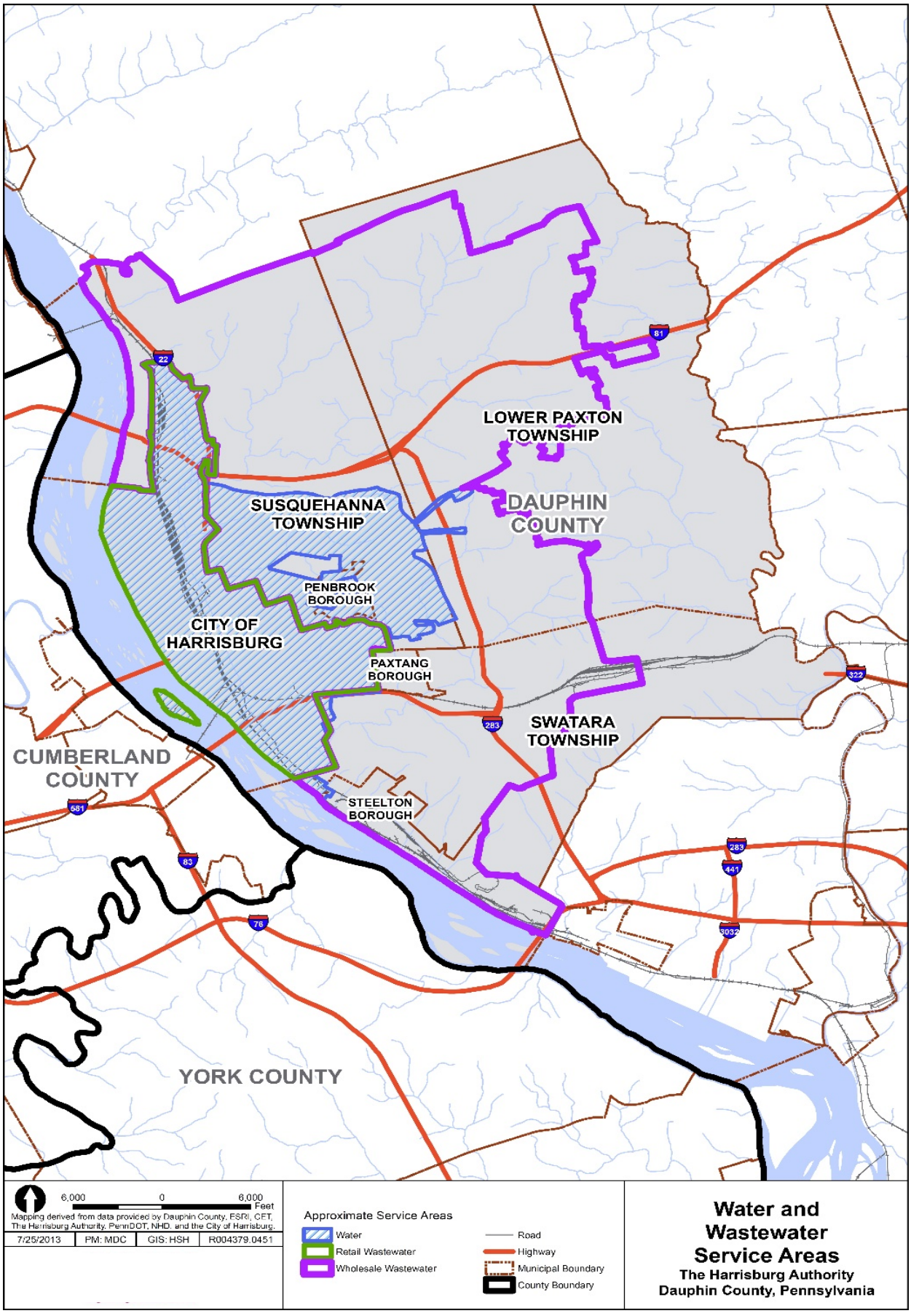
The Gate House Pump Station is located at the City of Harrisburg's Reservoir Park and utilizes two 400 HP horizontal split case centrifugal pumps, each rated for 8,700 gallon per minute, to transfer finished water from the Lower Reservoir to Upper Reservoir. Piping capabilities at the Gate House Pump Station also allow water to be pumped directly to either the water system's high or low pressure zones.

The Union Square Industrial Park Booster Station is located within Susquehanna Township along Susquehanna Township's municipal border with Lower Paxton Township and is used to increase the water pressure within the outer reaches of the Capital Region Water's distribution system which serves the Union Square Industrial Park. The Union Square Industrial Park Booster Station includes a dual parallel pumping system consisting of a 750 gallon per minute triplex constant pressure booster pumping system and a 1,000 gallon per minute fire pump. The triplex constant pressure booster pumping system consists of one end suction centrifugal jockey pump and two end suction centrifugal pumps. The jockey

pump is 7 1/2 HP rated 150 gallons per minute and the main pumps are each 15 HP rated at 300 gallons per minute. The fire pump is a horizontal split case pump with a 62 HP diesel driven engine.

Service Area:

The service area of the Water System includes the City of Harrisburg and portions of Penbrook Borough, Lower Paxton Township, and Susquehanna Township. A map showing the Water System's service area is included below.


LOWER PAXTON TOWNSHIP
DAUPHIN COUNTY
SUSQUEHANNA TOWNSHIP
PENBROOK BOROUGH
CITY OF HARRISBURG
PAXTANG BOROUGH
SWATARA TOWNSHIP
CUMBERLAND COUNTY
STEELTON BOROUGH
YORK COUNTY
22
81
283
322
581
83
76
441
3032
6,000 0 6,000 Feet
Mapping derived from data provided by Dauphin County, ESRI, CET, The Harrisburg Authority, PennDOT, NHD, and the City of Harrisburg.
7/25/2013
PM: MDC
GIS: HSH
R004379.0451
Approximate Service Areas
Water
Retail Wastewater
Wholesale Wastewater
Road
Highway
Municipal Boundary
County Boundary
Water and Wastewater Service Areas
The Harrisburg Authority
Dauphin County, Pennsylvania

APPENDIX B

History of the Water System

The water system was originally formed in 1839, when the Commonwealth of Pennsylvania granted Harrisburg permission to withdraw water from the Susquehanna River to serve roughly 20,000 City residents. Over the years, the system gradually expanded. In 1843, construction of the original Waterhouse was completed near Front and State Streets and a distribution reservoir was constructed in the vicinity of Sixth and North Streets.

In 1860, Harrisburg was incorporated as a Third Class City, and rapid expansion into the Hill and Uptown districts required a larger water distribution system. The original Lower Reservoir, located at Reservoir Park, was constructed in 1873 with a twenty (20) million gallon storage capacity. The elevation of the Lower Reservoir's location provided the City with the ability to feed the water system by gravity. A Pumping Station was built in 1874 at Front and North Streets, for the purpose of pumping water into the new reservoir. In 1903, the Pumping Station was re-equipped with new steam boilers, engines and pumps capable of meeting the demands of the more than 50,000 residents. The Filter Plant on City Island was completed in 1904, consisting of filtration, chemical treatment equipment and three fifteen million gallon per day steam driven pumps. Finished water from this facility was pumped to the Lower Reservoir in Reservoir Park for distribution.

In 1924, a number of improvements were completed to extend and enlarge the water system including increased capacity of the Filter Plant, addition of two turbine pumping units, installation of boiler equipment at the Pumping Station, installation of a new thirty-six inch transmission main from the Pumping Station to Sixth Street and a new covered twenty-nine million gallon capacity reinforced concrete reservoir, was constructed at Reservoir Park to supply areas which developed further away from the central part of the City and at higher elevated sections within the Hill District.

On March 19, 1936, the City of Harrisburg endured a devastating flood. The level of the Susquehanna River reached more than twenty-nine feet that inundated City Island and the southern section of the City with water. To avoid future disruption to water supply as a result of river flooding, City Council approved development of a new mountain supply in Clark Creek, approximately twenty miles northeast of the City. The construction consisted of DeHart Dam, an impounding reservoir, and a large transmission main to deliver raw water from the Dam to the City. The State and Federal governments assisted with funding of the facilities. The reservoir and transmission line were completed during 1940. The new water supply gave the City's residents a natural supply of fresh water as well as an alternative supply source. On January 23, 1948, the old system consisting of the Pumping Station and Filter Plant were placed on a standby for use in an emergency.

Subsequent major improvements were made to the system including reinforced concrete lining of the lower reservoir in Reservoir Park in 1950, and erection of a wall around the open reservoir. In 1954, the spillway at the DeHart Dam and Reservoir was raised, to provide storage for an additional one billion gallons of water. In 1958, the Pumping Station was overhauled and the old steam engines and boilers were converted to new electric-powered equipment. The standby system for water from the Susquehanna River was ready to operate immediately in the event of emergency. In 1958, a new

Chlorine Building was constructed at the DeHart Dam and Reservoir and lime feed and chlorine equipment were installed.

In 1965, the forty-two inch diameter water transmission main was relocated in the Dauphin Narrows due to the Pennsylvania Department of Transportation's widening of State Route 22/322 from two to four lanes. In 1967, electricity was provided to the Filter Plant and the three steam driven pumps, air blower and wash water pumps installed in 1902 and other equipment installed in 1922 were replaced with new electrical equipment. This filter plant was later destroyed in 1972 by the Agnes Flood and the DeHart Dam and Reservoir became the City's sole water supply source.

There were no major improvements projects performed on the water system between the years of 1968 and 1987 other than small maintenance projects. In 1988, however, the Lower Reservoir was rehabilitated at an approximate cost of $810,000. The Lower Reservoir rehabilitation included the installation of a hypalon lining and floating cover to prevent the entry of contaminants into the water system and allow operational flexibility.

The ownership of the City of Harrisburg's water system was transferred to The Harrisburg Authority (now known as the Capital Region Water) in 1990 and The Harrisburg Authority entered into the 1990 Management Agreement with the City of Harrisburg for the operation and maintenance of the water system beginning January 1, 1991. At the same time, The Harrisburg Authority initiated the *Water that Works* capital improvements program which was the most comprehensive and extensive improvements and upgrading project ever undertaken on the water system. The *Water that Works* program provided the water system with filtration and treatment, and virtually guaranteed an adequate water supply even during droughts. It also addressed the present and future water service and supply needs of population in the service area.

The *Water that Works* program included the following distribution and transmission system improvements:

- Replacement of thirty-six (36) Inch Diameter Water Transmission Main

  The project included the replacement of approximately 750 linear feet (LF) of a previously broken section of thirty-six (36) inch diameter pipe with thirty-six (36) inch diameter pre-stressed concrete cylinder pipe. The pipe was replaced along the State Street Ramp between Twelfth and Fourteenth Streets within the City of Harrisburg. The project cost was approximately $571,000 and was completed in September of 1991.

- Phase I - Miscellaneous Water Distribution System Improvements

  The project included the replacement of the existing water mains with 8,700 LF of new eight (8) inch and twelve (12) inch diameter ductile iron water pipe within Green, Susquehanna, Muench, Fifth, Reily, Briggs and Calder Streets in the City of Harrisburg. The project cost was approximately $750,000 and was completed in September of 1991.

- Phase II - Miscellaneous Water Distribution System Improvements

  The project included the replacement of the existing water main with 10,130 LF of new sixteen (16) inch diameter ductile iron water pipe within Seventh Street in the City of Harrisburg. The project cost was approximately $1,300,000 and was completed in August of 1992.

- Phase III - Miscellaneous Water Distribution System Improvements

  The project included the replacement and cleaning of the existing six (6) diameter water mains within Levan and Walnut Streets in Susquehanna Township. The project cost was approximately $111,000 and was completed in July of 1992.

- Phase IV - Water System Improvements: Water Transmission Mains

  The project included the installation of 26,300 LF of new thirty-six (36) inch diameter pre-stressed concrete cylinder pipe and six (6) tunnels under Conrail and PennDOT rights-of-way within the City of Harrisburg and Susquehanna Township. The project cost was approximately $7,000,000.

- Phase V - Miscellaneous Water Distribution System Improvements

  The project included the replacement of the existing six (6) and eight (8) inch diameter water mains with 5,282 LF of new twelve (12) inch diameter ductile iron water pipe within the Shipoke Area of the City of Harrisburg. The project cost was approximately $639,000 and was completed in August of 1994.

- Phase VI - Miscellaneous Water Distribution System Improvements

  The project included the replacement of the existing water mains with 249 LF of new eight (8) inch and 281 LF of new ten (10) inch diameter ductile iron water pipe within Second Street in the City of Harrisburg. The project cost was approximately $351,000 and was completed in November of 1992.

- Phase VII - Miscellaneous Water Distribution System Improvements

  The project included the replacement of existing four (4) and six (6) inch diameter water mains with 1,750 LF of new eight (8) inch diameter ductile iron water pipe within Ninth, Tenth, and Walnut Streets in the City of Harrisburg. The project cost was approximately $223,000 and was completed in May of 1994.

The *Water that Works* program included the following major improvements to the water system's infrastructure:

- Dr. Robert E. Young Water Services Center (REYWSC)

  The project included the construction of a new water filtration facility with a design capacity of twenty (20) million gallons per day and a computerized process control system. The project cost was approximately $18,000,000 and went on-line in July of 1994.

- Administration Building

  The project included the construction of an Administration Building at the Dr. Robert E. Young Water Services Center. The project cost was approximately $450,000 and was completed in August of 1993.

- Maintenance Building

  The project included the construction of a Maintenance Building at the Dr. Robert E. Young Water Services Center. The project cost was approximately $819,000 and was completed in October of 1993.

- Susquehanna River Pump Station in the City of Harrisburg

  The project included the installation of a new raw water intake and pumping facility. The new river water intake included tee intake screens with a chlorination and air backwash system. The new raw water pumping facility included pumping equipment, chemical feed equipment, instrumentation, piping, and valves. The project was completed in September of 1994 and the project cost was approximately $2,600,000.

- Gate House Building Improvements at Reservoir Park in the City of Harrisburg

  The project included general building renovations and the replacement of the existing pumps, piping, valves, and instrumentation. The project cost was approximately $783,000 and was completed in the summer of 1994.

- DeHart Dam Reservoir Control Building Improvements at the William T. DeHart Dam and Reservoir in Rush Township

  The project included general building renovations and the replacement of the existing chemical feed systems, chlorination system, hydropneumatic tank, pumps, piping, and valves. The project cost was approximately $680,000 and was completed in the summer of 1994.

The water system was also augmented with a booster station and a water main extension at the Union Deposit Industrial Park during 1993. This project was not part of the *Water that Works* capital improvements program. However, the project included the installation of a new 6,400 LF twelve (12) inch diameter ductile iron water main extension and a new booster station with a 1,000 gallon per minute fire

pumping system and a new 750 gallon per minute domestic water pumping system. The project was completed in November of 1993.

Beginning in 1999, Capital Region Water installed the Sensus Radio Read AMR automated meter reading system that allows for remote reading of water meters by simply driving or walking past the property served. The system consists of a transmitter unit attached to the outside of the building that is wired to the meter inside the building. The meter is being read by CRW employees using a radio receiver. In addition, the system is capable of reading a majority of meters from Reservoir Park; however, some follow-up is still needed for meters not able to be read in this manner or where read errors are reported limiting the usefulness of this option. As of calendar year ending 2014, approximately 98 percent of all meters are remotely read. Certain large meters continue to be read manually.

In 2002, an in-line hydro-turbine generator was installed at the REYWSC. The generator utilizes flow from the reservoir to produce electricity thereby conserving energy and decreasing the amount of purchased electricity used to run the system. In 2012, Capital Region Water completed an upgrade of the of the Supervisory Control and Data Acquisition (SCADA) system at the REYWSC in addition to telemetry upgrades at remote facilities including DeHart Dam, Gate House Pump Station, Riverfront Pump Station and City Island. These upgrades allow for important process information to be logged and for data to be conveyed between facilities.

The history of the water system clearly indicates that its development is based upon meeting the needs of the City of Harrisburg and its surrounding communities, by providing the area's population with an adequate and pure water supply. The Capital Region Water remains committed to supplying high quality water and maintaining regulatory compliance. This is evidenced by the 2010 development of a Capital Improvement Plan and annual Plan updates which are used to evaluate repair, replacement, and upgrade needs over a 20-year future period to adequately plan and implement projects that keep the system in good repair and working order.

The transition of operating services from the City of Harrisburg to the Capital Region Water upon termination of the 1990 Management Agreement on November 4, 2013 provides the Capital Region Water with distinct benefits. It enables system operation and maintenance to be performed in an efficient manner and provides expanded opportunities for Capital Region Water to access the capital market for future system improvement needs. The Capital Region Water’s name change from The Harrisburg Authority was officiated in March 2014.

Development and implementation of the Capital Region Water’s Geographic Information System (GIS) in 2013/2014 integrated highly accurate GPS locations of system components, essential for monitoring, operating, and maintaining and modeling a system of this size. The mapping is linked to custom databases which store vital information on system components, such as type, age and state. Information is being used to better maintain the water facilities, understand weaknesses and vulnerability issues, and prioritize future upgrades.

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