Consulting Engineer’s Annual Report – Water System

Capital Region Water

September 30. 2021

Consulting Engineer's Annual Report

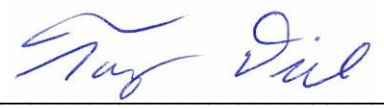
Water System

FINAL

Prepared By:
Arcadis U.S., Inc.
1600 Market Street, Suite 1810
Philadelphia
Pennsylvania 19103
Phone: 215 625 0850

Prepared For:
David Stewart, P.E., BCEE
Director of Engineering
Capital Region Water
3003 North Front Street
Harrisburg, PA 17110

Our Ref:
30003502



Anthony J. Dill, PE BCEE
Project Manager

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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
HAA	Haloacetic Acid
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
PFBS	Perfluorobutanesulfonic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
TBD	To be determined
TOC	Total Organic Compound
THM	Trihalomethane
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 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 as of April 1, 2014 and May 1, 2018. This CEAR is being submitted to comply with the following requirements, as outlined in the Indenture:

Section 7.12:

> *"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 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 and repair of the operating and water delivery infrastructure 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 operating and water delivery infrastructure 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 operating and water delivery infrastructure in such condition and the details of such expenditures and the approximate time required therefor."*

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, existing records and documents prepared by or on behalf of CRW were reviewed to understand, assess, and report on the technical information contained therein as it relates to the FY 2021 CEAR. The major relevant documents provided by CRW and reviewed as part of the CEAR include, but are not necessarily limited to, the following:

- 2020 Water Allocation Permit Compliance Report
- 2021 Drinking Water Quality Report
- 2020 DeHart Dam Preliminary Engineering Report
- 2020 Water Loss Audit for Finished Water
- 2020 and 2021 Drinking Water Division Monthly Reports

- Historic Actual Water System Expenses (FY 2019 and FY 2020)
- Budgeted FY 2021 Water System Expenses

In addition, limited visual site inspections of the following components of the Water System were conducted on August 20, 2021:

- 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
- Lower Finished Water 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 pending litigation related to its water 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, emergency, or routine short-term operational exercise. 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.

As was noted in the 2020 Drinking Water Quality Report and 2020 Water Allocation Permit Compliance Report, the Water System includes almost 230 miles of water mains ranging in size from 6-inches to 42-inches in diameter, approximately 1,800 fire hydrants, approximately 5,370 main valves, and approximately 20,140 service valves. The sources of supply, pumping and treatment facilities are summarized in **Table 2-1**.

Table 2-1: Sources of Supply, Pumping and Treatment 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 pump out of service)
Gate House Pump Station	Pumping Capacity	8,700 GPM (with one pump out of service)
Union Square Industrial Park Booster Station	Pumping Capacity at: -Triplex Constant Pressure -Fire Pump	 750 GPM 1,000 GPM

2.2 Management and Staffing

CRW is governed by a five-member Board of Directors. A management team headed by the Chief Executive Officer is responsible for 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 services. CRW operates as one entity; however, CRW separately tracks and records the provision of services associated with each of the utilities that it manages and operates.

CRW's organizational chart is made up of five departments as well as an Executive Team and Human Resources. Both Drinking Water and Wastewater Operations were combined in 2020 with a Director of Operations managing both departments. CRW did not previously have a Director of Operations for Drinking Water and had a vacancy in the Superintendent of Water Operations position, so this new position assists with managing reporting requirements and other higher level management tasks. The five departments are as follows: Finance, Engineering, Operations, Shared Services, and Strategic Initiatives. An overview of the current organization structure of CRW is shown in Figure 2-1.

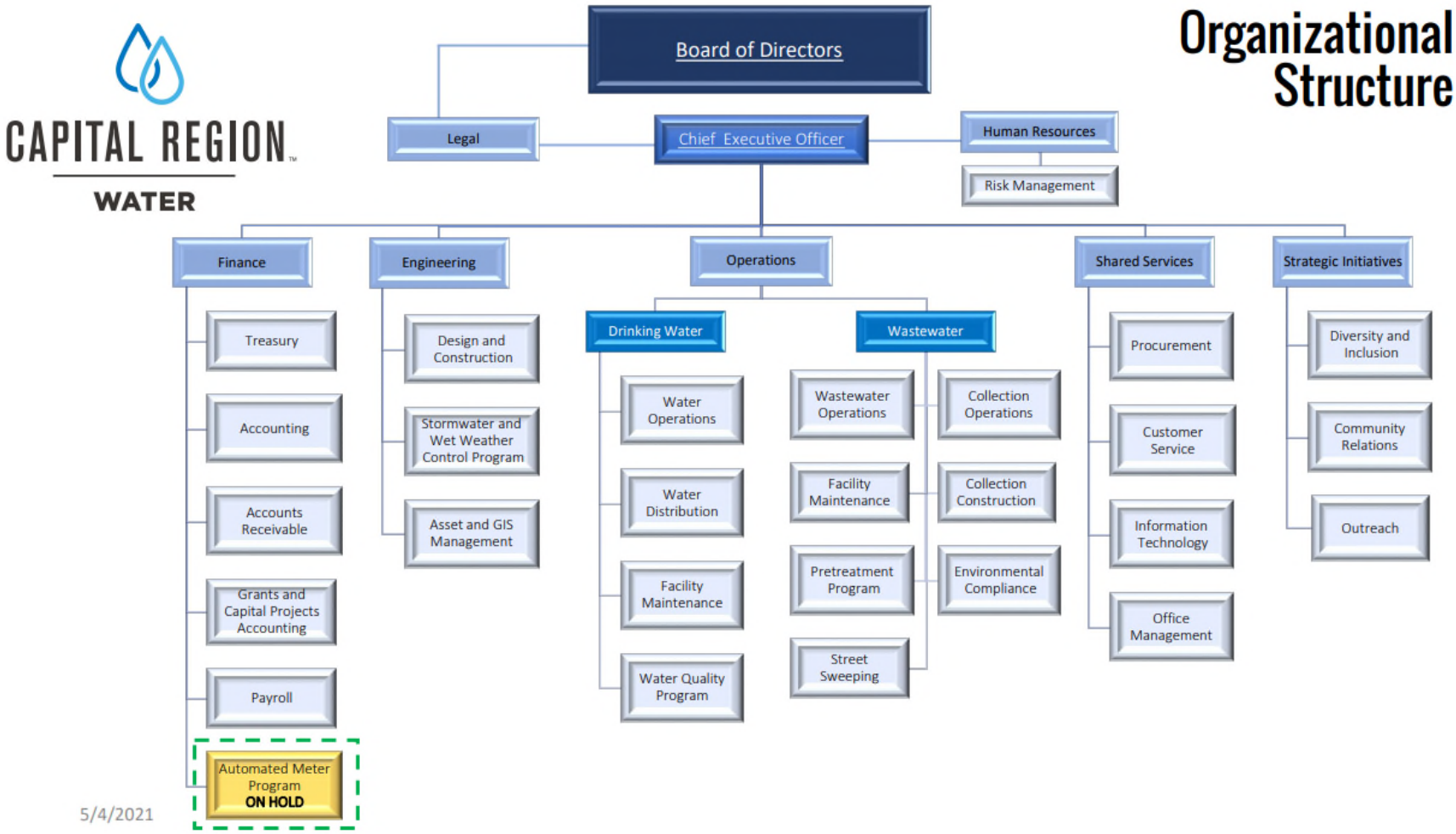

Figure 2-1: CRW Management Level Organizational Chart

2.2.1 Administration, Strategic Initiatives, Engineering, Finance, and Water/Wastewater Departments

The Drinking Water and Wastewater Departments are 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 Drinking Water Department includes plans for 35 positions, with 33 positions filled as of May 2021. The Drinking Water organizational chart is provided in **Figure 2-2**.

The Administrative Department provides office management, information technology, customer service, and procurement 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. The Executive Team provides legal and human resources services. A Strategic Initiatives Department provides diversity and inclusion as well as community outreach and communications.

It is understood that CRW plans to staff the Administrative Department, Engineering Department, Finance Department, Strategic Initiatives, and Executive Team with a total of 53 positions (17 for Administration, 9 for Engineering, 14 for Finance, 5 for Strategic Initiatives, and 8 for Executive), and as of May 2021, 47 of the 53 positions have been filled. Personnel expenses associated with these departments are allocated to each of the utilities based on budgeted time allocated to each of the services.

In summary, CRW's FY 2021 Drinking Water System budget includes estimated costs associated with the current and planned employees dedicated to the Drinking Water System and the Water System's share of costs associated with the planned positions under the Administrative, Engineering, Strategic Initiatives, and Finance Departments as well as the Executive Team, which all provide support to CRW's water and wastewater utilities. These employees are all employees of CRW, with the majority belonging to a collective bargaining unit.

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

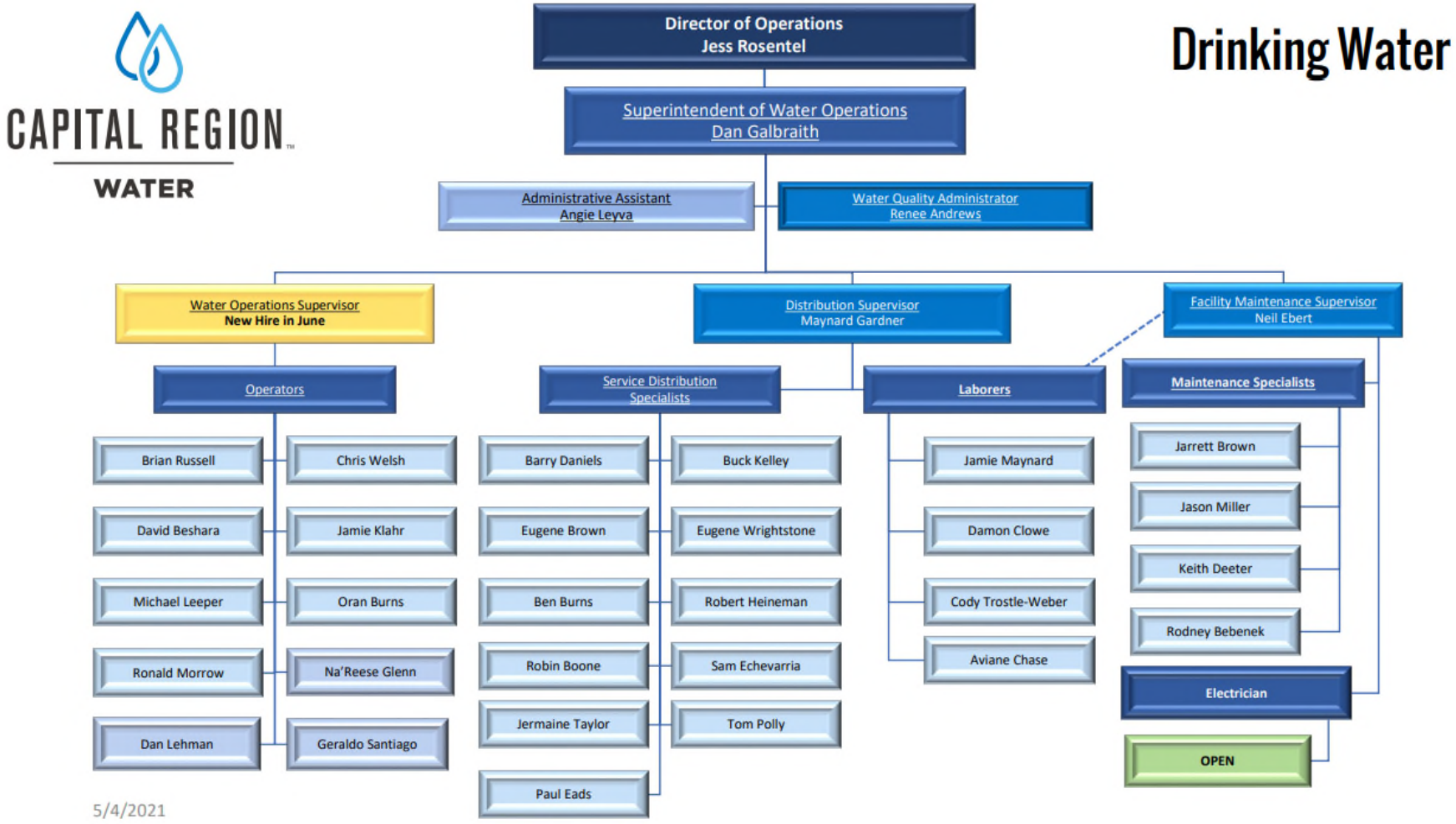

Figure 2-2: Drinking Water Operations Division Organizational Chart

3 Water System Performance

3.1 Service Area

The service area of the Water System includes the City and portions of Penbrook Borough, Lower Paxton Township, Swatara Township and Susquehanna Township. Except for some distribution system piping and related equipment, the majority of CRW's water assets are located within the municipal boundaries of the City. **Figure 3-1** below shows the water system infrastructure map.

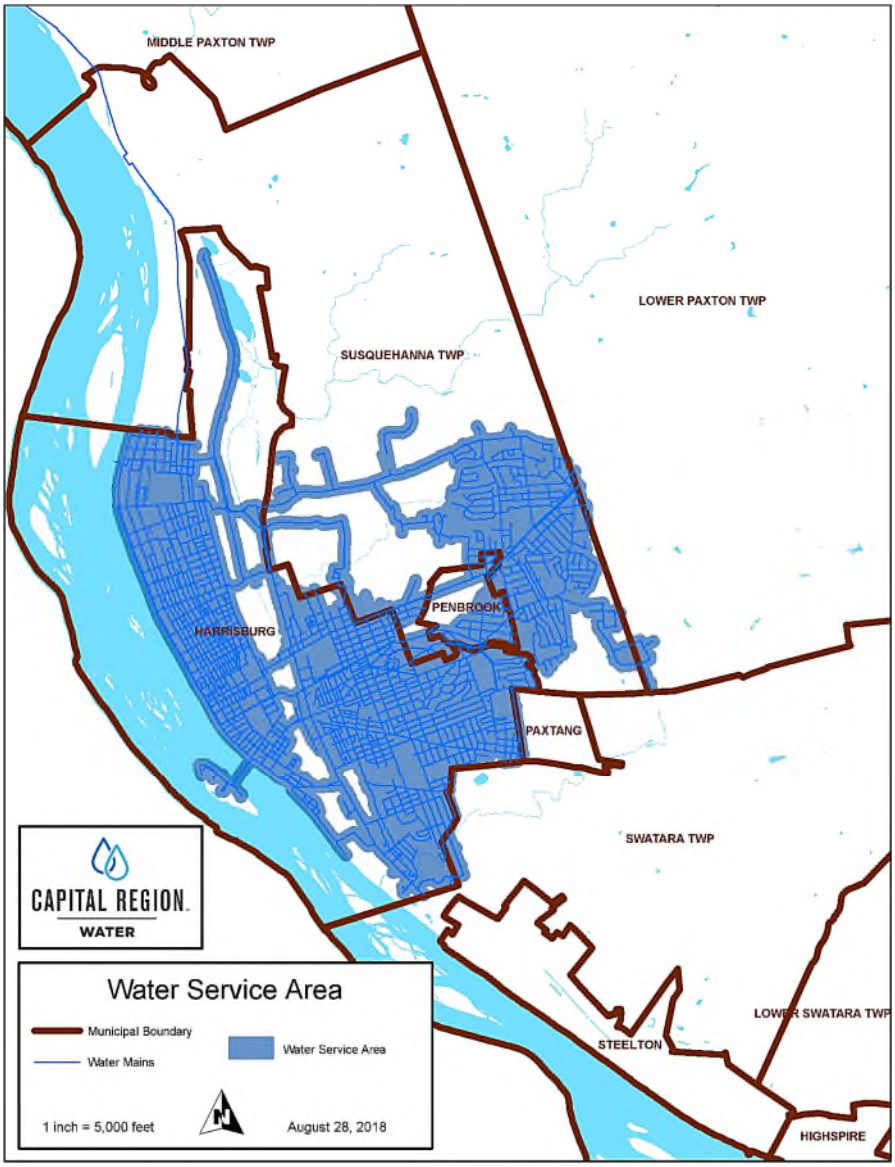

Figure 3-1: Water System Infrastructure Map

3.2 Customer Base

CRW maintains approximately 20,150 active meter connections within its service area, with the majority located within the City. The remainder are primarily located in Susquehanna Township and Penbrook Borough. CRW maintains only one domestic connection in Lower Paxton Township. The total estimated population served by the Water System is approximately 61,300.

A summary of the total number of connections and the total metered water consumption based on CRW records for fiscal year 2020 is shown in **Table 3-1**.

Table 3-1: FY 2020 Customer Accounts and Metered Water Use

Description	Accounts	Consumption (1,000 gal.)
City of Harrisburg:		
Residential	14,789	756,327
Commercial	1,718	403,524
Industrial	24	252,351
Public / Institutional	73	78,538
Total	16,604	1,490,740
Suburban Communities:		
Residential	3,403	183,806
Commercial	121	54,784
Industrial	1	36,290
Public / Institutional	3	125
Total	3,528	275,005
Total	**20,132**	**1,765,745**

Source: FY 2020 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 gallon 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 6.61 MGD in FY 2020 and peak day water production was 6.96 MGD in FY 2020. In addition, non-revenue water (NRW) has increased from 21 percent in FY 2019 to 26 percent in FY 2020 and remains high at an average daily rate of approximately 1.72 MGD of the average daily finished water production. This increase was due to a large water main break in February 2020 where 17,563,812 gallons of water was lost. The flow of water from the break caused the reservoir levels to drop until crews were able to close enough valves to steady the level at the

reservoirs. 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 2019	FY 2020
Water Supply Yield		
-Primary	10.50	10.50
-Secondary	15.00	15.00
Water Treatment Capacity	20.00	20.00
Water Demand		
Average Metered Daily Consumption	5.19	4.86
Peak Day Water Production	9.56	8.74
Non-Revenue Water	1.39	1.72
Total Average Daily Water Production	6.55	6.57
Performance Ratios		
Non-Revenue Water as a % of Water Production	21%	26%
Average Daily Production as % of Treatment Capacity	33%	33%
Peak Day Production as % of Treatment Capacity	48%	44%

Sources: FY 2020 Customer and Billing Data, 2020 Water Loss Audit Report and 2020 CRW Annual Water Supply Report

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 United States Environmental Protection Agency (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 (MCLs). CRW's 2021 Drinking Water Quality Report (which reports the results for calendar year 2020) concluded that CRW's treated water quality is good and continues to consistently exceed national quality standards.

In addition, water samples are taken and tested by a certified laboratory for 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, aluminium,

chlorine residual levels, and orthophosphate levels. Orthophosphate levels are also monitored in the distribution system. A summary of the key test results for 2020, as published in CRW's annual Drinking Water Quality Report or reported by CRW's certified laboratory, and their comparison to established MCLs is provided in **Table 3-3**.

Table 3-3: Summary of Key Test Results for 2020

Contaminant	Units	MCL	Levels Detected (2019)	Levels Detected (2020)
Barium	ppm	2	0.0155	0.012
Chlorine (Distribution Disinfectant Residual)	ppm	4	0.99 – 1.34	0.21 – 2.12
Fluoride	ppm	2	.53	.53
Nitrate	ppm	10	.23	.23
Total Trihalomethanes	ppb	80	47.08	47.08
Haloacetic Acids	ppb	60	39.43	35.20
Arsenic	ppb	10	Not detected	Not detected
Radium-226	pCi/L	5	Not detected	Not detected
Chlorine (Entry Point Disinfectant Residual)	ppm	Min. of 0.2	0.6	0.83
Fecal Coliform or E.coli	ppm	0	0	0
Turbidity	NTU % samples below 0.3 NTU	1 95%	.084 100%	.091 100%
Lead	% samples below 15 ppb	90%	100%	100%
Copper	% samples below 1.3 ppm	90%	100%	100%

Sources: 2021 Drinking Water Quality Report

As shown in Table 3-3, the drinking water quality of the Water System consistently meets MCLs. CRW had one monitoring violation in 2020 for turbidity on one individual filter due to an equipment failure on Filter #5 for about 18 hours. The system did not conduct turbidity grab samples at least every 4 hours during the time the equipment was not running, and Filter #5 was in service.

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 (DBP). 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 at the DeHart Dam, and as such is classified as "Bin1". Data from the second round of LT2 monitoring detected higher levels of *Cryptosporidium* in the Susquehanna River, and as such, was classified as "Bin 2" in 2019 and requires an additional 1-log treatment when the river is in use. With respect to the DBP 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 analyses, which have been completed once every three years since 2007, have shown that copper and lead concentrations at residential taps remain well below MCLs. 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. Orthophosphate is a key component of corrosion control in combination with the pH control strategy as evidenced by historic sampling results.

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 regulatory actions that could impact CRW's operations, with each being described in more detail in the following paragraphs:

- Third Six-Year Review
- Fourth Unregulated Contaminant Monitoring Rule (UCMR4)
- Fifth Unregulated Contaminant Monitoring Rule (UCMR5)
- Lead and Copper Rule Revisions
- Potential Per- and Polyfluoroalkyl Substances (PFAS) Rule
- Hexavalent Chromium (Cr-6)
- Potential Carcinogenic Volatile Organic Compounds (cVOC) Rule
- 1,4-Dioxane

3.5.1 Third Six-Year Review

The EPA is required to conduct a review of drinking water regulations every six years. As part of this process, the EPA evaluates all 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 results from the Third Six-Year Review were published in January 2017. The EPA determined that eight contaminants were eligible for regulatory revision: chlorite, *Cryptosporidium*, *Giardia lamblia*, haloacetic acids (HAA5), heterotrophic bacteria, *Legionella*, total trihalomethanes (TTHMs), and viruses. Each of these contaminants is related to the balance between pathogen control and disinfection

byproducts (DBPs). For example, higher disinfectant residuals may be required to address some of these contaminants, particularly in premise plumbing; however, this would need to be balanced with potentially increased DBP formation and lower maximum contaminant levels (MCLs) for DBPs.

The EPA is currently holding meetings with stakeholders and will propose regulations that may augment and/or revise requirements for the following by July 31, 2024:

- Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules,
- Surface Water Treatment Rule,
- Interim Enhanced Surface Water Treatment Rule, and
- Long Term 1 Enhanced Surface Water Treatment Rule.

In conjunction with this effort, the EPA is also considering regulatory action for additional haloacetic acids (e.g., additional brominated species) and nitrogenous DBPs (e.g., nitrosamines, haloacetonitriles, and halonitromethanes). Final revised regulations are expected to be published in the Federal Register by September 30, 2027.

3.5.2 Fourth Unregulated Contaminant Monitoring Rule

The Unregulated Contaminants Monitoring Rule (UCMR) framework was designed to enable evaluation and prioritization of contaminants for inclusion in federal drinking water regulations to protect public health. The ongoing series of rule documents the occurrence of the contaminants on the most recent version of the Candidate Contaminant List (CCL) to determine if future regulation is warranted. The UCMRs require designated water systems (including all large systems exceeding a threshold size and a select group of smaller systems) to conduct sampling for the included contaminants over a finite period of time (e.g., 12 consecutive months over a 3-year window).

The Fourth Candidate Contaminant List (CCL4) was finalized in November 2016 and includes 97 chemicals or chemical groups and 12 microbiological contaminants. The list includes, among others, pesticides, disinfection byproducts, chemicals used in commerce, waterborne pathogens, pharmaceuticals, and biological toxins.

Seventeen contaminants from the CCL4 were included in the Fourth UCMR (UCMR4), which was finalized in December 2016. Nine cyanotoxins, one cyanotoxin group, plus three brominated haloacetic acid groups were also included in the draft, bringing the total to 30 contaminants. The most recent UCMR4 data set (i.e., 2018 – 2020) was released in July 2021. Seven of the thirty contaminants monitored were detected at levels above the reference concentration. The data are subject to review and change pending the final publication, expected in early 2022.

3.5.3 Fifth Unregulated Contaminant Monitoring Rule

The proposed Fifth Unregulated Contaminant Monitoring Rule (UCMR5) was released in pre-publication version on January 14, 2021. It includes the monitoring of 29 per- and polyfluoroalkyl substances (PFAS) and one metal, lithium. All large systems serving more than 10,000 people, all small systems serving between 3,300 and 10,000 people, and 800 small systems serving fewer than 3,300 people would be required to monitor for the contaminants. Monitoring is expected to include 12 consecutive months between January 2023 and December 2025. Systems could potentially experience increased sampling

costs and stakeholder pressure to address PFAS, if detected. Though not required, many systems proactively implemented PFAS treatment based on findings from the Third Unregulated Contaminant Monitoring Rule (UCMR3).

3.5.4 Proposed Lead and Copper Rule Revisions

In December 2020, the EPA released final revisions to the Lead and Copper Rule (LCR) in a pre-publication version. Due to changes in the administration, the EPA extended the effective promulgation date of the LCR revisions (LCRR) from January 15, 2021, to December 6, 2021, to allow for additional review. This change also extends the compliance date to October 16, 2024, to ensure systems have time to act and comply with the new rule. The revisions aim to reduce risks from lead exposure in drinking water to children and families by requiring earlier action and increased transparency and communication around lead. These revisions have a strong potential to impact all community water systems (CWSs) and non-transient non-community water systems (NTNCWs), though the largest impact will occur to systems containing lead service lines (LSLs). The LCRR includes over fifty significant changes in all areas from monitoring and treatment to service line inventories and customer communication. Key changes include:

- **Action Level (AL) and Exceedances.** Although the existing lead AL of 0.015 mg/L would be maintained, the LCRR includes a new "trigger" level (TL) of 0.010 mg/L for lead, which would initiate requirements if exceeded at the 90th percentile. This approach initiates upfront action for systems, including additional requirements for monitoring, corrosion control treatment (CCT), LSL replacement, and public education to reduce lead in drinking water before exceeding the AL.
- **Lead Service Line Definition.** The LCRR provided additional information around the definition of a LSL. Per 40 CFR part 141, a LSL is a portion of pipe that is made of lead, which connects the water main to the building inlet. A galvanized service line is considered a LSL if it ever was or is currently downstream of any LSL or service line of unknown material. If the only lead piping serving the home is a lead gooseneck, pigtail, or connector, and there is no galvanized downstream it is not considered a LSL.
- **Lead Service Line Inventory and Replacement.** Systems with known or possible LSLs must develop and maintain a publicly accessible inventory and a LSL replacement plan within the first three years of the published rule. Systems with LSLs that exceed the lead TL or AL at the 90th percentile would be required to conduct full LSL replacement at a goal-based rate agreed upon by the primacy agency/EPA or at a 3-percent rate per year based on a 2-year rolling average, respectively.
- **Tap Sampling.** The LCRR shifts tap compliance sampling to locations with the highest lead, requiring systems to collect from 100% LSL sites, if available. Sampling protocols for sites served by a LSL are also updated – the rule requires a first liter copper sample and fifth liter lead sample.
- **Corrosion Control Treatment.** Systems with existing CCT that exceed the AL or TL would be required to conduct a CCT study and comply with new study requirements including the evaluation of pH/alkalinity adjustment, and orthophosphate doses of 1 and 3 mg/L as PO4-3 in a CCT study. Additionally, systems would not be allowed to exclude orthophosphate from testing solely based on expected downstream impacts (i.e., open reservoirs, publicly owned treatment works) due to increased phosphorous loading.

- **Public Notification.** Systems with a 90th percentile lead level exceeding the AL must notify customers within 24 hours, and systems with customers whose individual lead tap samples exceed 0.015 mg/L must notify customers not later than three days after obtaining results.
- **Find-and-Fix Assessment.** New to the LCRR, for any lead sample (compliance or voluntary) that exceeds 0.015 mg/L, systems would be required to sample water quality parameters within five days and collect a follow-up lead tap sample within 30 days to "find" the cause and then "fix" it if within the utilities control.
- **Schools and Childcare Facilities.** New to the LCRR, CWSs would need to collect lead samples at 20 percent of all schools and childcare facilities per year.

3.5.5 Per- and Polyfluoroalkyl Substances (PFAS) Rule

Per- and polyfluoroalkyl substances (PFAS) are man-made chemicals that are used in a variety of industries and consumer products such as carpeting, apparels, upholstery, food paper wrappings, fire-fighting foams, and metal plating. PFAS are prevalent in the environment, and studies have shown adverse human health effects at extremely low levels. Under the UCMR3, EPA collected data for six PFAS compounds, including:

- perfluorooctanesulfonic acid (PFOS)
- perfluorooctanoic acid (PFOA)
- perfluorononanoic acid (PFNA)
- perfluorohexanesulfonic acid (PFHxS)
- perfluoroheptanoic acid (PFHpA)
- perfluorobutanesulfonic acid (PFBS)

Monitoring information collected under UCMR3 supports the regulatory determination process. In February 2019, the EPA released a PFAS Action Plan to address PFAS in the environment and protect public health. Key actions from the plan related to drinking water include the following: 1) Establishing MCLs for PFOA and PFOS u; 2) Conducting nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle (i.e., UCMR5); and 3) Developing risk communication materials for federal, state, and local partners for use in interacting with the public.

In February 2020, the EPA released updates to the PFAS Action Plan and confirmed that it is proposing to regulate PFOA and PFOS under the Safe Drinking Water Act (SDWA) and will include more PFAS under UCMR5. Additionally, EPA has validated Method 533, which complements Method 537.1 and now allows laboratories to measure 29 different PFAS analytes (all of which are included in UCMR5). More recently as of June 2020, EPA finalized a Significant New Use Rule that requires manufacturers (including importers) of products or chemicals containing PFOA and certain PFOA-related chemicals to notify EPA 90 days before manufacturing, selling, or importing in the United States. The EPA also finalized the list of 172 PFAS chemicals that are subject to Toxic Release Inventory reporting; this requirement is included in the National Defense Authorization Act for Fiscal Year 2020.

The final regulatory determination of PFOA and PFOS was released in a pre-publication version on January 19, 2021, which indicated that the EPA would move forward with a primary standard for PFOA and PFOS, while continuing to prioritize regulatory determinations of additional PFAS in drinking water.

Determinations will be made when additional information is available, but before the fifth CCL deadline in 2026.

The EPA released the final report for human health toxicity values for PFBS in April 2021. Additionally, EPA is developing toxicity assessments for GenX and five additional PFAS (i.e., PFNA, perfluorobutyrate (PFBA), perfluorohexanoic acid (PFHxA), PFHxS, and perfluorodecanoic acid (PFDA)) and assessments are expected to be completed by 2023.

While there are no current federal MCLs for PFAS, the federal health advisory level for PFOA and PFOS is 70 ng/L, where the concentrations are regulated as a summation of the compounds. Several states have already taken action to regulate PFOA and PFOS and/or other PFAS in drinking water as shown in **Table 3-4**.

Table 3-4: Current or Proposed PFAS MCLs by State

Value (ng/L):	GenX	PFHpA	PFOA	PFNA	PFBS	PFHxS	PFHxA	PFOS	PFDA
Massachusetts		20x	20x	20x		20x		20x	20x
Michigan	370		8	6	420	51	400,000	16	
New Hampshire			12	11		18		15	
New Jersey			14	13				13	
New York			10					10	
Vermont		20x	20x	20x		20x		20x	

x. The concentrations are regulated as the summation of the compounds.

Other states have or are in the process of establishing non-MCLs (e.g., action, notification, or health advisory levels, guidelines) for PFAS in drinking water including Alaska, California, Connecticut, Delaware, Illinois, Minnesota, Ohio, North Carolina, Rhode Island, South Carlina, Washington, and West Virginia. The State of Pennsylvania follows the EPA health advisory levels (i.e., non-enforceable and non-regulatory) of 70 ng/L for PFOA and PFOS and does not plan to propose other levels.

CRW is aware of PFAS and the potential impacts to their system. CRW tested finished water for PFAS under the UCMR3 in December 2015 and independently in 2019. DEP performed tests in on February 24, 2021. All test results were below detection limits.

Other potential federal PFAS regulations that may affect drinking water systems are incorporated into the PFAS Action Act, which was passed by the House on April 13, 2021 and is current pending a vote in the Senate. In addition to requiring the EPA to establish primary drinking water standards within two years, the Act would also designate PFOA as a "hazardous substance" under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This provision of the bill could have a significant impact on the management of water treatment plant residuals (e.g., spent granular activated carbon (GAC) and ion exchange (IX) resin and associated costs.

3.5.6 Other

3.5.6.1 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 (Cr), including chromium (III) and chromium (VI) (i.e., Cr-6 or hexavalent chromium). The EPA released a draft human health risk assessment for Cr(VI) in 2010, and the date for issuance of a final assessment has not yet been published, a step that would be required prior to the EPA establishing a new drinking water regulation for Cr(VI). As a part of the Third Six-Year Review, the EPA declined to review the existing chromium standard due to the ongoing human health risk assessment. A draft assessment for Cr(VI) is expected in summer 2021. Within three years following completion of the assessment, the EPA will determine if the existing regulation is appropriate.

In the interim, EPA is requesting voluntary Cr(VI) sampling of finished water at points-of-entry and at maximum residence time sampling locations. CRW conducted voluntary Cr(VI) sampling in January and December of 2017; results were non-detect (LEVEL). On December 10, 2018 CWR completed Cr(VI) sampling of the finished water at AWTF and River Pump Station (the spot in the distribution system with high water age), and results were 0.39 µg/L and 0.15 µg/L, respectively. Sampling was repeated again on April 12, 2019, with both locations recording a non-detect (<0.10 µg/L) result. CRW performed two additional rounds of Cr(VI) sampling in May and December of 2019, with both locations recording a non-detect result in May and 0.11 µg/L and non-detect, respectively, in December. CRW performed one sample in November 2020 recording a non-detect.

3.5.6.2 Carcinogenic Volatile Organic Compounds Rule

In 2011, the EPA discussed regulating several cVOCs, some currently regulated and some unregulated, as a group. The preliminary list consisted of sixteen[1] cVOCs, and EPA later indicated that four[2] additional cVOCs were being considered as potential substitutes to the original sixteen. The EPA may not move forward with a cVOC Rule as originally anticipated, and there are no indications of additional progress to-date. Some states have established MCLs. Hawaii was the first state to establish an MCL for 1,2,3-trichloropropane of 0.6 µg/L in 2005. California adopted an MCL of 0.005 µg/L in late 2017, followed by New Jersey setting an MCL of 0.03 µg/L in late 2018. In November 2019, Washington state published a draft rule to establish an action level of 21 µg/L. It is unknown if other states with higher occurrence will follow suit.

3.5.6.3 1,4-Dioxane

The EPA has indicated that it has not determined if there is value to move forward with federal regulation of 1.4-dioxane in drinking water. However, some states have established or are moving forward with the process of establishing an MCL for 1.4-Dioxane in drinking water as described in **Table 3-5**.

[1] Includes benzene, carbon tetrachloride, PCE, TCE, vinyl chloride, 1,2-dichloroethane, 1,2-dichloropropane, dichloromethane, 1,1-dichloroethane, 1,3-butadiene, aniline, benzyl chloride, nitrobenzene, oxirane methyl, 1,2,3-trichloropropane, and urethane

[2] 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2-dibromo-3-chloropropane (DBCP), and 1,2-dibromoethane (EDB)

Table 3-5: Current 1,4-Dioxane Regulations by State

State	Value (µg/L)	Type	Status
Massachusetts	0.3	MCL	Promulgated
California	1, 35	Notification Level, Response Level	Promulgated
New York	1	MCL	Proposed
Virginia	n/a	n/a	In development

3.5.7 Summary

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 completed a state-wide precipitation study in March 2020 enabling CRW to proceed with plans to expand spillway capacity for storms of record. AECOM facilitated a Probable Failure Modes Workshop for the DeHart Facility with participation by PADEP Dam Safety Division and CRW in August 2020. The findings from that workshop are informing the design of improvements to CRW's DeHart Dam spillway and embankment. Design will continue through 2021 followed by construction of improvements between 2022-2024.

The review of potential future regulations indicated that at this time the proposed regulations are not anticipated to have a material impact on CRW operations. It is, however, recommended that CRW be ready for the Lead and Copper Rule Revisions to take effect October 2024. The revisions will have impacts to CRW, ranging from increased sampling to proactive public education and lead service line replacement. Though PADEP has not established any requirements for PFAS, it is recommended that CRW track any activity at the State level and closely follow Congress's actions particularly regarding several bills which could designate PFAS as a hazardous substance under CERCLA.

4 Water System Condition

4.1 Overview

CRW staff aim to ensure the entire Water System is properly operated and maintained. The cost to provide routine and preventative maintenance is included in CRW's annual operating budget. CRW uses a proactive preventative maintenance program and a systematic replacement policy for inventory parts to minimize downtime.

Additionally, CRW developed a comprehensive asset management program for the drinking water systems which will further enhance preventative maintenance and increase system reliability. Asset registries have been developed for all CRW treatment plants, pumping stations, storage facilities, and the DeHart Dam facility. CRW has developed a risk register for CRW's buried assets and established high-level replacement, rehabilitation, and condition assessment cost estimates. In 2019, CRW completed a pilot study of two water main condition assessment technologies and CRW plans to use both technologies in the future based on the criticality of the pipe. The results of the study concluded that one technology was appropriate for use in mains with high consequence of failure due to the high resolution defect finding ability while the other technology was appropriate for low consequence of failure mains and where the pipe material is known.

Development of the Drinking Water System Asset Management Plan was completed in July 2020. The plan provides CRW with strategies for operations, maintenance, capital investments, and funding.

4.2 Condition Assessment

Arcadis conducted a limited condition assessment of the key components of the Water System on August 20, 2021, 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 previous 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.

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 **Table 4-2** 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	Change from Prior Year
DeHart Dam and Reservoir	3.0	No change
Dr. Robert E. Young Water Services Center	1.8	-0.3
Upper Reservoir	2.0	No change
Lower Reservoir #1	2.1	No change
Lower Reservoir #2	2.1	No change
Pump Stations • Susquehanna River Pump Station (1.0) • Gate House Pump Station (1.4) • Union Square Booster Station (1.2)	1.2	-0.3
Transmission Mains • Mountain Line (3.0) • Susquehanna Line (1.1) • Plant-Gate-House-Reservoir Line (1.7)	1.9	No change
Distribution System	2.9	No change
Overall System Rating	**2.1**	**-0.1**

Overall the Water System is in good condition and the risk rating had little change over the year prior; 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 Water Services Center improved due to changes made to chemical treatment, filtration processes, and replacement of high lift pumps, and the Gate House Pump Station improved due to the recent painting project and rebuild of both pumps.

An arc flash study is recommended for the water system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. CRW intends to implement arc flash studies in 2022 out of the water treatment plant O&M budget.

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 to ensure operational efficiency and regulatory compliance. These regulations include annual inspections, followed by a PADEP on-site review. The implemented O&M tasks include the management of vegetation encroaching the embankment on the upstream and downstream faces of the dam and vegetation clearing along the mountain line pipeline route. Out of the approximately 12 to 16 miles of pipeline that require vegetation clearing, all vegetation clearing has been completed. Crews are upgrading the pathway along the pipeline for improved vehicle and equipment access. Crews replaced multiple panels in the spillway in late 2019/early 2020. A spillway project will begin by the end of 2021 to increase the spillway capacity.

Following the pH chemical upgrades at the Water Services Center, the pH chemical options for DeHart application will be vetted to choose the best option for Transmission Main corrosion control while working to also benefit the Water Services Center Treatment. This work is currently on hold while CRW evaluates the need for corrosion control in the transmission main.

In addition to O&M items above, AECOM completed a Preliminary Engineering Report which was used to aid in the development of design alternatives to address the current deficiencies at DeHart Dam. Deficiencies previously noted in past reports included the following:

- Lack of Embankment Seepage Control and Collection System. The existing embankment does not have a comprehensive system to filter and collect all seepage, and adjacent soils need to meet filter compatibility requirements to prevent soil particle migration or internal erosion that can lead to failure of the dam embankment under certain reservoir level and associated seepage conditions. In the summer of 2018, a comprehensive geotechnical evaluation was conducted on the existing embankment to determine its filter compatibility requirements. A report including the geotechnical evaluation findings was submitted April 2019.

- Insufficient Spillway Capacity. The existing spillway at Dehart Dam is not capable of passing the Probable Maximum Flood (PMF) Spillway Design Flood. Evaluation of the hydrologic and hydraulic analysis was completed in February 2020. It is scheduled to be designed starting in late 2020.
- Questionable Structural Adequacy of the Spillway Channel. Due to the use of channel slab construction that is no longer common practice, and the limited footprint of the existing underdrain system, the structural integrity of the slabs can be compromised if water from spillway channel flows is able to penetrate beneath the slabs. Evidence of undermining and deterioration of the existing spillway slabs and walls was noted during the inspection.
- Insufficient Drawdown Capacity. The Dehart Dam does not have adequate drawdown capacity per the PA code that is intended to ensure that the reservoir could be lowered as a risk reduction measure in the event of a developing incident or failure mode.

Additional items requiring action from the site visit include:

- Repair or replace broken window panes on intake house.
- Repair or replace broken cap stones along roof edge of outlet pump house to reduce safety risk.

AECOM's December 2020 Preliminary Engineering Report developed three alternatives for modification to the spillway crest structure in order to pass the spillway design flood with adequate freeboard. The alternatives were developed with the understanding that improvements to the spillway chute, stilling basin, embankment dam, and outlet works would be made that are common to each spillway crest alternative. An engineer's opinion of construction cost was prepared for each alternative in this report.

Currently, the rehabilitation of the spillway crest and chute is scheduled to begin in late 2021. The DeHart Dam rehabilitation project consist of preliminary design and laboratory investigations, along with permitting, final design, bidding, and construction. The CIP shows $20M for rehabilitation through FY 2024 with project completion that year.

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

The Dr. Robert E. Young Water Services Center (WSC), located at the intersection of Pine Drive and Stanley Drive on the City'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.

Based on the calendar year 2019 and 2020 Drinking Water Quality Reports, 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 2016 Filter Performance Evaluation Report, an improvement from their previous rating of "needs improvement" in the 2012 Report. Nonetheless, PADEP identified the following issues and concerns requiring investigations or improvements:

- Post backwash turbidity spike; include data for post backwash turbidity on backwash data sheet.

A Filter Upgrade Project was completed in 2020 which repaired underdrain deficiencies and replaced all filter media to improve operational performance of the Filtration Process. The controls associated with the filters are scheduled to be replaced in late 2021/early 2022.

The chlorine disinfection system at the WSC has several safety features, including automatic shut-off valves, exhaust fans and a chlorine gas scrubber capable of collecting and neutralizing chlorine gas from an accidental 1-ton tank discharge.

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.

During the site inspection, a variety of improvements were noted to have been performed in the last year. The plant upgraded all the lighting to LED. CRW also completed the installation of finish pump C (605A) and the rebuild of both Gate House Pump Station pumps, maintenance to the hydro-turbine was completed and brought back on-line, preventative maintenance performed on the "A" and "B" side water basins on the motors, bearings, and flocculation system as well as upgrades to the Claritrac suction hoses and control panels. CRW also repaired the chimney caps at the Susquehanna River PS. CRW's 10-year plan includes seal coating the walls in the pipe gallery and pipe tunnel areas to prevent efflorescence build-up on walls.

During the site inspection CRW indicated several recommended/planned O&M improvements at the facility including the following: all valves/actuators to be replaced on finish water pipes (most have been completed to date), construction for a new soda ash feeder system with two Scaletron Volumetric/Gravimetric feeder systems to begin in December 2021. Additionally, the clear well at the facility is planned for inspection (concurrent with Lower Reservoir inspection) in 2022.

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 completed in 2010. A subsequent inspection of the Lower Reservoir and WSC Clear Well is scheduled for 2022. The inspection is intended to review and document the condition of the tanks. Arcadis 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 exterior inspection; however, the concrete on the exterior walls has extensive hairline cracks with efflorescence and extensive discoloration caused by a biological film. The tanks are scheduled for power washing in 2022 and may require recoating to prevent further deterioration of their exteriors. Power washing had not been completed at the time of the site visit. 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, Paxtang Borough, and Lower Paxton. A rehabilitation project of the upper reservoir was completed in early 2019.

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 once per year for a ten-day period 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. Piping in the lower level of the pump station is showing signs of minor corrosion; it is recommended that this piping be visually inspected annually and painted at the first signs of structural corrosion. CRW plans to paint the pumps and associated piping in house over the winter in 2021/2022. Additionally, CRW had the damaged stone caps on the chimney repaired and pinned in late 2020.

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 1920s. The most recent significant upgrade was in 1994. CRW typically operates at least one pump for 12 hours each day, and the lead pump is rotated on a quarterly basis to balance pump runtime between the pumps. The facility appears to be in good condition and able to perform adequately. Painting of the pump station interior walls was completed in late 2020. Additionally, both pumps were rebuilt and completed in late 2020.

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-1990s. 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. The piping, pump, supports, and fuel tank were painted in July 2020. Some paint chipping in interior of building was observed on the ceiling and appears to be in the same condition as the previous site inspection. It is recommended that ceiling be visually inspected annually and painted at the first signs of further deterioration.

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 pipeline that was placed into service in 1940. The portion of the pipeline through 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 draft Condition Assessment 42- and 36-Inch Raw Water Transmission Main Report, dated August 2017 was reviewed. The report noted that three leaks were identified in the inspected portions of the Primary Transmission Main, and zero leaks were found on the A-Line and B-Line. Recommendations for the long-term management of the transmission main were included in the condition assessment and included the following:

- Calibration testing including excavation of pipe segment with anomalies to qualify the distress detected.
- Complete an electromagnetic inspection of the B-Line.
- Confirm the air release valve in Chamber #4 at Station 118+55 on the B-Line is properly working.
- Verify there is a pipeline feature located at Penwood Road and Antoine Street where a Type 3 anomaly was identified.
- Electromagnetically re-inspect the Raw Water Transmission Main every 5 to 7 years to monitor the rate of distress.

Following the condition assessment in 2017, CRW performed the recommended calibration testing to address the identified anomalies; however, the recommendations that involved destructive testing of the pipeline were not performed due to being detrimental to operations.

The Susquehanna River transmission main is a pre-stressed concrete cylinder pipeline that was placed into service in 1994. The Susquehanna River PS and associated transmission main are operated once per year for a 10-day period to exercise the equipment as recommended by PADEP. In 2017 the Susquehanna River PS was operated for 10 days and provided the full flow to the WTP. The 2017 operational exercise was helpful in draining and maintaining the Mountain Line. In December 2020 CRW operated the Susquehanna River PS to provide 50% of the capacity to the WTP with the remaining 50% capacity coming from the DeHart Dam. This strategy is an operational exercise for reliability during a potential emergency.

The finished water transmission main from the Dr. Robert E. Young Water Services Center was installed in 1994 and constructed out of 36-inch diameter prestressed concrete cylinder pipe. The transmission main is approximately 3,400 feet in length and connects to the existing 30-inch diameter ductile iron pipe transmission main to Reservoir Park at the intersection of 18th Street and State Street. This main is arguably the most critical main in the Water System. CRW has indicated that there are no known issues with the pipe and that it has corrosion control measures in place. The physical condition of this pipe is unknown. CRW is committed to annual execution of condition assessment utilizing internal workforce and contracted specialty services (currently $100,000/year).

4.2.6 Water Distribution System

CRW's water distribution system includes approximately 213 miles of water main distribution pipe, 1,750 fire hydrants, 5,180 main valves, and 20,884 service valves.

4.2.6.1 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 MCLs. CRW's 2021 Drinking Water Quality Report (which reports the results for calendar year 2020) 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 the finished water storage and working to the outskirts of the distribution system.

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 Water Operations Supervisor on August 20, 2021.

4.2.6.2 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.

CRW has updated its Cross-Connection Control Manual in compliance 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 will be implementing a backflow prevention program in 2022.

In 2016 CRW initiated a leak detection program that includes full system leak detection on an annual basis. The leak detection program involves evaluation of mains and service lines and preparation of meter calibration reports to summarize findings. Small and Large Meter Testing Programs are incorporated as part of the leak detection program to ensure accurate readings are being taken and water loss is minimized. Small meters are calibrated by CRW staff on a certified calibration stand while large meters are calibrated by a contracted calibration service and is assisted and witnessed by CRW staff.

Programs have indicated most meters are in good calibration and do not require replacement; however, some large meters with performance issues are prioritized for replacement. Large meters that are expected to be replaced that have turbine technology, are of Neptune brand, are older than 15 years of age, or otherwise have a condition that makes replacement financially favourable over testing. On average, CRW can replace approximately 25 large meters per year. In addition, CRW replaces between 300 and 400 small meters per year due to inaccurate readings, freezing, and theft. It is anticipated that CRW will utilize most existing small meters for at least several more years before a larger scale replacement project is initiated.

It is recommended that CRW conduct a compliance field audit of all 250 large meter accounts and all accounts with fire meters within the system with the primary purpose of ensuring compliance with CRW's Rules and Regulations. The Rules and Regulations require a properly working accurate and testable meter that cannot be by-passed without notification. The Water Distribution Supervisor is currently assuming the duties of Meter Account Supervisor and will be improving enforcement within the program until a full time Meter Account Supervisor is hired.

A four-year comparison of the amount of NRW, as well as the number of water main breaks for the Water System is shown in **Table 4-3**. CRW has demonstrated a trend in reducing NRW, however there was a large water main break in February 2020 that released 17,563,812 gallons.

Table 4-3: Non-Revenue Water and Water Main Breaks

Year	Water Produced (MGD)	Non-Revenue Water (MGD)	Non-Revenue Water %	# of Water Main Breaks
2017	7.16	1.91	26.7%	23
2018	6.72	1.49	22.2%	19
2019	6.55	1.39	21.2%	18
2020	6.57	1.72	26.2%	18
Average	**6.75**	**1.63**	**24.1**	**20**

Sources: 2020 Water Loss Audit Report for Finished Water and 2020 Main Break Water Loss 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. Additionally, CRW is currently using the Water Distribution Supervisor to assume the duties of Meter Account Supervisor, which is currently vacant. Once filled, the auditor may further reduce NRW.

CRW implemented a valve exercising program and has acquired new equipment to exercise valves. This program will help CRW satisfy AWWA G200 Paragraph 4.2.5. Currently two staff members, working four days per week work to exercise the valves in the system. Since this program started, CRW has exercised 200 valves in 2016, 397 valves in 2017, 401 in 2018, 103 valves in 2019, and 428 valves in 2020 totalling to 1,529 valves of the approximately 5,180 valves in the system. CRW reports 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. Approximately 90 percent of the valves in the system are thought to be operational.

CRW attempts to test all hydrants annually. Hydrants tested, replaced, and repaired are shown in Exhibit I, Distribution System Activities, in its Water Division Monthly Report. More than 99 percent of the hydrants in the system are thought to be operational. In 2020, 62 damaged hydrants were returned to normal operating condition by either repair or replacement.

CRW ensures 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. CRW has completed the Lead Assessment (incorporating their water service line index cards into their GIS) to allow for reporting and analysis of materials and assumptions based on dates and locations. The lead gooseneck replacement consists of CRW's internal policy to remove them when they are excavated for any reason regardless of if they are private or not, that includes a long-term plan of removing them with new main installations, which CRW is actively doing. There is no program for any removals beyond that because CRW does not have confirmation of any locations, just assumptions and they are privately owned.

CRW meters 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 reduction in NRW is attributable to in-house leak detection and repair program that began in January 2016. Small and large meters were tested according to the AWWA Manual M6 and replacement protocols for no lead brass are being followed.

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 reviews construction projects for potential impacts on its Water System. It has records for projects completed since the 1990s but not for earlier periods.

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 Water Operations Supervisor on August 20, 2021.

4.2.6.3 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. In 2018 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 significant 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 did not depth test the chlorine residual in 2020.

CRW maintains a standard operating procedures document binder where all written standard operating procedures are compiled in one location. It 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 percent of the distribution system. Where records are available, they indicate an aged system, with over 90 percent of the records showing an installation date prior to the 1960s, and almost half of those installations occurring over 100 years ago. A nominal replacement rate of 12,500 linear feet per year (~1% of the system) might be justified based upon the age and size of the system. In July 2020 CRW completed a Water Transmission and Distribution System Asset Management Plan that will be used to inform future water main and water meter rehabilitation and replacement strategies. In 2021, CRW performed an evaluation of its water meter replacement program budget to begin implementing full meter replacement over a 10-20 year timeframe starting in 2022. CRW will continue to invest in annual distribution system assessments while developing a long-term strategic approach for the distribution system.

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 Water Operations Supervisor on August 20, 2021.

4.2.6.4 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.

5 Capital Improvement Plan

5.1 Overview

CRW prepares a 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. 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 2022. 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 2022 through FY2026 that reflects the 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

CRW's capital plan is in general alignment with Arcadis' observed requirements for the Water System. CRW generally has a good understanding of capital project needs and should prioritize projects based on urgency and affordability. CRW may proceed to reschedule and reprioritize various projects to balance the capital needs over the next several years. It is recommended that CRW update its cost estimates and capital funding plans for these projects as additional information becomes available.

Table 5-1: Capital Improvement Plan

Location	Description	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
Raw	Mountain Line Repairs	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000
Raw	DeHart Evaluation & Construction (Embankment, Spillway, Chute, & Bridge)	$ 5,000,000	$ 10,000,000	$ 5,000,000	-	-
Raw	Alternative DeHart Power (AWIA)	-	-	-	$ 200,000	-
Raw	DeHart to DWSC Bypass (AWIA)	$ 200,000	$ 200,000	$ 50,000	-	-
Treatment	WSC Sedimentation Basin Railings	-	$ 190,000	-	-	-
Treatment	Upper Reservoir Valve Vault Improvements	$ 200,000	-	-	-	-
T&D	West Reservoir Water Main Solution	$ 300,000	-	-	-	-
T&D	Transmission Main Check Valve	$ 125,000	-	-	-	-
T&D	Cameron Street Water Main	$ 7,000,000	$ 7,000,000	$ 7,000,000	-	-
T&D	Water Main Assessment	$ 100,000	$ 100,000	$ 100,000	$ 150,000	$ 150,000
T&D	Water Main Replacement	$ 2,634,000	$ 2,832,000	$ 3,044,000	$ 3,272,000	$ 3,517,000
Misc	Equipment Garage	-	-	$ 500,000	-	-
Misc	Black Sky Connection	-	-	-	$ 180,000	
Misc	Large Water Meter Replacement	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Misc	Main Break Truck	-	-	$ 350,000	-	-
Misc	Kill Switches	$ 165,000	-	-	-	-
Misc	PennDOT I-83 Expansion DW Impacts	$ 900,000	$ 900,000	$ 900,000	$ 125,000	$ 125,000
Misc	Street Restoration	$ 309,000	$ 318,270	$ 327,818	$ 337,653	$ 347,782
Misc	Minor Capital Improvement Plan	$ 355,000	$ 275,000	$ 200,000	$ 307,000	$ 345,000
	Total	**$ 17,513,000**	**$ 22,040,270**	**$ 17,696,818**	**$ 4,796,653**	**$ 4,709,782**

[1] Project costs are presented in 2021 dollars.

6 Operations and Maintenance Expense Review

6.1 Overview

The Trust Indenture (Section 7.12) 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 summary of CRW's historical actual O&M expenses for FY 2019 and FY 2020 and the budgeted O&M expenses for FY 2021 are shown in **Table 6-1**. These expenses were reviewed to and determined to be in general alignment with overall O&M needs of the Water System.

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

Description	Historical FY 2019	Historical FY 2020	Budget FY 2021
O&M Expenses:			
Salaries and Wages	$ 2,023,096	$ 2,153,113	$ 2,306,359
Benefits and Taxes	$ 885,589	$ 922,914	$ 1,150,836
Contracted and Professional Services	$ 548,268	$ 558,648	$ 519,387
Repairs, Maintenance, and Supplies	$ 567,242	$ 542,612	$ 706,195
Electricity	$ 169,512	$ 172,952	$ 177,000
Chemicals	$ 317,720	$ 227,400	$ 285,000
Sewerage	$ 443,953	$ 454,995	$ 411,620
Insurance	$ 304,507	$ 316,534	$ 389,887
Administrative Fee	$ 2,778,510	$ 2,744,411	$ 3,085,510
Other Operating Expenses	$ 326,208	$ 356,678	$ 553,405
Total Annual O&M Expenses	**$ 8,364,605**	**$ 8,450,257**	**$ 9,585,199**

Source: Historical actual expenses in FY 2019 and FY 2020 and budgeted expenses in FY 2021 provided by CRW

6.3 Additional Operations, Maintenance, and Repair Costs

Several recommendations regarding the addition of O&M expenses in FY 2022 for the proper maintenance, repair, and operation of the Water System should be considered for implementation by CRW, as discussed in Section 4 of this report. The estimated costs associated with these recommended items is shown in **Table 6-2**.

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

Location	Description	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
DD	Dehart Intake Windows	$2,000	-	-	-	-
DD	Dehart Pump House Cap Stone Replacement	$10,000	-	-	-	-
USPS	Union Station Pump Station Monitor and Repaint Ceiling of Building	$7,500	-	-	-	-
T&D	Lower Reservoirs - Pressure Wash, Inspect, and Repair Deficiencies from Inspections	$10,000	-	-	-	-
T&D	Backflow Prevention Consistent with PADEP	$5,000	$5,000	$5,000	$5,000	$5,000
	Total	**$34,500**	**$5,000**	**$5,000**	**$5,000**	**$5,000**

Note: All amounts shown in Table 6-2 are in 2021 dollars.

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 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 zero non-compliant quarters in 2020 but received one monitoring violation in 2020 for turbidity on one individual filter due to an equipment failure on Filter #5 for about 18 hours. The system did not conduct turbidity grab samples at least every 4 hours during the time the equipment was not running, and Filter #5 was in service.
3. CRW's water supply and treatment capacity is sufficient to meet the current and near-term projected needs of the service area.
4. CRW's capital plan is in general alignment with Arcadis' observed requirements for the Water System. CRW has a good understanding of additional capital projects needed. Lack of historical records creates challenges for the exception of the prioritization of specific water distribution line replacements, and CRW should endeavor to refine the list of projects based on ongoing engineering analysis.
5. CRW is working diligently to maintain the condition of the Water System. 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.
6. It is recommended that CRW be ready for the Lead and Copper Rule Revisions to take effect October 2024. The revisions will have impacts to CRW, ranging from increased sampling to proactive public education and lead service line replacement. Though PADEP has not established any requirements for PFAS, it is recommended that CRW track any activity at the State level and closely follow Congress's actions particularly regarding several bills which could designate PFAS as a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
7. Based on the available information, Arcadis recommends CRW implement additional O&M efforts as described in this report, including the following:
    - At the DeHart Dam, replace the broken windows on the intake house and cap stone replacements on the outlet pump house.
    - At the Union Station Pump Station, continue to monitor the paint peeling along the ceiling and repaint.
    - At the Lower Reservoirs, pressure wash the exteriors and perform an inspection along with any required repairs resulting from inspections.

- Implement a backflow prevention program. CRW intends to implement this program in 2022.

8. An arc flash study is recommended for the water system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. CRW intends to perform the arc flash study in 2022.
9. It is recommended that a CRW compliance field audit of all 250 large meter accounts and all accounts with fire meters is conducted within the system with the primary purpose of ensuring compliance with CRW's Rules and Regulations.

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.

Arcadis U.S., Inc.

1600 Market Street, Suite 1810
Philadelphia
Pennsylvania 19103
Phone: 215 625 0850

www.arcadis.com