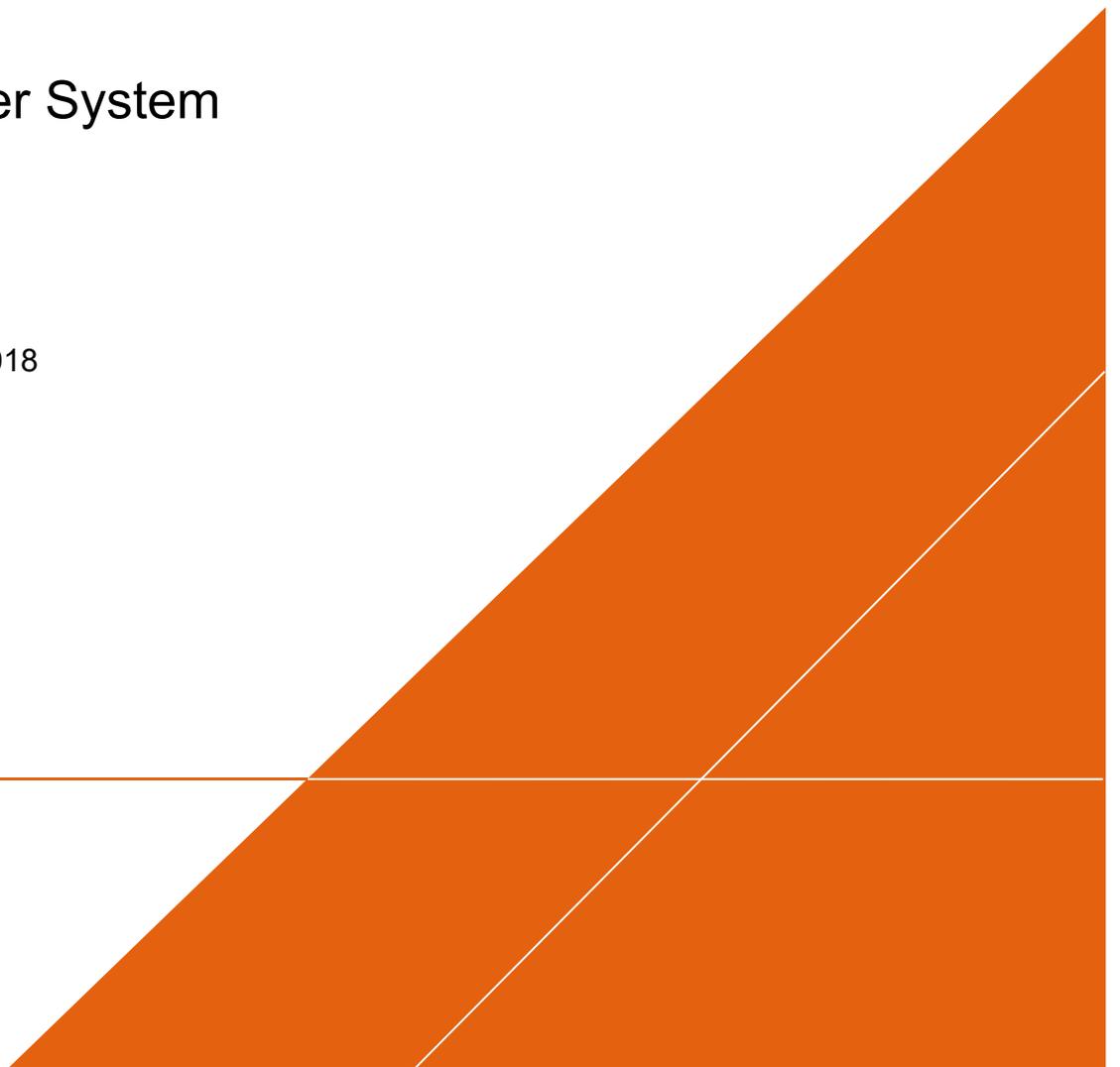


Capital Region Water

Consulting Engineer's Annual Report

Wastewater System

September 28, 2018



CONSULTING ENGINEER'S ANNUAL REPORT

Wastewater System



Anthony J. Dill, PE BCEE

Prepared for:

David Stewart, P.E., BCEE

Director of Engineering

Capital Region Water

212 Locust Street, Suite 302

Harrisburg, PA 17101

Prepared by:

Arcadis U.S., Inc.

1128 Walnut St.

Suite 400

Philadelphia

Pennsylvania 19107

Tel 215 625 0850

Our Ref.:

09059010.0000

Date:

September 28, 2018

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

CONTENTS

Acronyms and Abbreviations.....	v
1 Introduction	1
1.1 Report Methodology and Limitations	1
2 Wastewater System Management.....	4
2.1 Overview of the Wastewater System.....	4
2.2 Wastewater System Description.....	6
2.2.1 Wastewater Treatment	6
2.2.2 Wastewater Pump Stations	6
2.2.3 Wastewater Conveyance	7
2.3 Management and Staffing.....	7
2.3.1 Administration, Engineering, Finance, and Operations Departments	10
3 Wastewater System Performance	12
3.1 Service Area	12
3.2 Customer Base	12
3.3 Regulation and Compliance.....	13
3.3.1 Operational Performance	13
3.3.2 Permit Exceedances.....	13
3.3.3 Sewer Overflows and Bypass Events	14
3.3.4 Partial Consent Decree	15
3.3.5 Wet Weather Program Accomplishments	15
3.3.6 Nine Minimum Controls Plan.....	16
3.3.7 Operations and Maintenance Manual	18
3.3.8 Data Management Systems	18
3.3.9 LTCP Development	18
3.3.10 Industrial Pre-Treatment.....	19
4 Wastewater System Condition.....	20
4.1 Overview	20
4.2 Condition Assessment	20
4.2.1 AWTF	22

4.2.1.1	Biosolids Facility Review	23
4.2.2	Pump Stations	24
4.2.2.1	Front Street Pump Station	24
4.2.2.2	Spring Creek Pump Station	25
4.2.2.3	City Island Pump Stations	26
4.2.2.4	Market Street Pump Station	26
4.2.3	Collection System.....	27
4.2.3.1	Sewer Interceptors.....	28
4.2.3.2	CSO Outfalls and Regulators	29
5	Capital Improvement Plan.....	30
5.1	Overview	30
5.2	AWTF Upgrades	30
5.3	Pump Station Capital Improvements	31
5.4	Conveyance Capital Improvements.....	31
5.5	Discussion.....	31
6	Operations and Maintenance Expenses Review	34
6.1	Overview	34
6.2	Historical Wastewater System Expenses	34
6.3	Additional Operations, Maintenance, and Repair Costs.....	34
7	Conclusions.....	36

TABLES

Table 2-1:	Summary of Major Wastewater and Stormwater System Facilities	4
Table 3-1:	Customer Information.....	12
Table 3-2:	Sewer Overflows and Unauthorized Discharges (2017).....	14
Table 4-1:	Summary of the Rating System	21
Table 4-2:	Major Assets Risk Rating	21
Table 4-3:	AWTF Improvements	22
Table 4-4:	Pump Station Improvements.....	27
Table 5-1:	Capital Improvement Plan.....	33

Table 6-1: Historical Wastewater System Expenses 34
Table 6-2: Additional O&M and Repair Costs 35

FIGURES

Figure 2-1: Wastewater System Infrastructure Map..... 5
Figure 2-2: CRW Management Level Organizational Chart..... 9
Figure 2-3: Wastewater Operations Division Organizational Chart..... 11

APPENDICES

Appendix A – Wastewater System Service Area Map

ACRONYMS AND ABBREVIATIONS

AWTF	Advanced Wastewater Treatment Facility
BOD	Biochemical Oxygen Demand
CAMP	CSO Activation Monitoring Pilot
CEAR	Consulting Engineer's Annual Report
CIP	Capital Improvement Plan
CRW	Capital Region Water
CSO	Combined Sewer Overflow
FY	Fiscal Year
MGD	Million Gallons per Day
Mg/L	Milligrams per Liter
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OMM	Operation & Maintenance Manual
PADEP	Pennsylvania Department of Environmental Protection
PPC	Preparedness, Prevention, and Contingency
PRP	Pollution Reduction Plan
SSO	Sanitary Sewer Overflow
TMDL	Total Maximum Daily Load
VFD	Variable Frequency Drive

1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) prepared this Wastewater 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 May 1, 2017. This CEAR is being submitted to comply with the following requirements for Fiscal Year (FY) 2019, as outlined in the Indenture:

Section 7.11:

"It shall be the duty of the Consulting Engineers, in addition to the other duties prescribed 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 hereafter, a report setting forth the following:

- a. Their advice and recommendations as to the proper maintenance and repair of the operating and wastewater delivery infrastructure of the Sewer 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 necessary for such purpose; and*
- c. Their finding whether the operating and wastewater delivery infrastructure of the Sewer 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 wastewater 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. The wastewater system is owned and operated by CRW and includes an Advanced Wastewater Treatment Facility (AWTF), a conveyance system, and wastewater and stormwater collection systems located within the City of Harrisburg (City) limits. Overall, the wastewater system includes approximately 36 miles of sanitary sewers, 40 miles of stormwater sewers, and 101 miles of combined sanitary and stormwater sewers.

The wastewater collection system services customers located within the City. The conveyance and treatment systems provide wastewater conveyance and treatment services to the City and Suburban wholesale customers. Suburban wholesale customers are located in Susquehanna Township, Lower Paxton Township, Swatara Township, Paxtang Borough, Penbrook Borough, and Steelton Borough.

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 CEAR. The major relevant documents provided by CRW and reviewed as part of the CEAR include, but are not necessarily limited to the following:

- Chapter 94 Municipal Wasteload Management Report and Semi-Annual Report on Consent Decree Implementation, March 2018.
- 2015 Operation and Maintenance Manual (Version 1.0).
- Nine Minimum Control Plan, August 2017.

Consulting Engineer's Annual Report – Wastewater System

- City Beautiful H₂O Program Plan, March 2018.
- The Harrisburg Authority 2005 Long-Term Control Plan.
- Monthly Treatment Plant Operating Data (2015, 2016, 2017, and January 2018 through July 2018).
- Historic Wastewater System Expenses (FY 2015, FY 2016, FY 2017)
- Budgeted FY 2017 and 2018 Wastewater System Expenses.
- Correspondence to/from the Pennsylvania Department of Environmental Protection (PADEP), as related to inspection reports, bypass events, unauthorized discharges (UD), and sanitary sewer overflow (SSO) events.
- Biosolids Facilities Improvement Plan Existing Conditions Report, March 2018.
- Biosolids Facilities Improvement Plan Draft, prepared by WRA, June 2017.
- CAMP Study Evaluation Report, prepared by CDM Smith, December 2016.
- Combined Sewer System Characterization Report, prepared by CDM Smith, March 2017.
- Separate Sanitary Sewer Capacity Assessment Report, prepared by CDM Smith, March 2017.
- Collection System Rapid Assessment Findings and Recommendations, prepared by CDM Smith, April 2017.
- Primary Digester Facilities Rehabilitation, Basis of Design Report, prepared by WRA, May 2017.
- Sewer Replacement Project Study Phase – Report of Findings, prepared by HRG, June 13, 2017.
- Memorandum from CDM Smith to CRW entitled “Capital Region Water Interceptor Cleaning and Rehab Improvements Update”, dated May 3, 2017.
- Pipeline Inspections and Investigations Phase I Recommendations Report prepared by WRA, June 2018.

In addition, on August 30, 2018, Arcadis conducted limited visual site inspections of the following components of the Wastewater System:

- Advanced Wastewater Treatment Facility
- Front Street Pump Station
- Spring Creek Pump Station
- City Island North Pump Station
- City Island South Pump Station
- Market Street Pump Station

The review also included discussions with representatives of CRW and performance comparisons to other comparable wastewater 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, it is believed 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 review did not include any pending or threatened litigation against CRW. CRW has stated that there is no significant litigation that is believed to have any material impact on its operations.

Consulting Engineer's Annual Report – Wastewater System

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 WASTEWATER SYSTEM MANAGEMENT

2.1 Overview of the Wastewater System

CRW is a municipal authority that owns and operates an Advanced Wastewater Treatment Facility (AWTF), a conveyance system, and wastewater and stormwater collection system within City limits. The AWTF is one of the largest publicly owned treatment facilities in the Commonwealth and currently the largest in Pennsylvania within the Chesapeake Bay Watershed. The AWTF employs biological nutrient removal technology in an activated sludge plant to achieve nitrogen and ammonia requirements. Overall, the wastewater system includes approximately 33 miles of sanitary sewers, 40 miles of stormwater sewers, and 87 miles of combined sanitary and stormwater sewers. A summary of the major wastewater system facilities is provided in Table 2-1. The wastewater collection system provides service to customers located within the City. The conveyance and treatment systems provide wastewater conveyance and treatment services to City and Suburban wholesale customers. Suburban wholesale customers are located in Susquehanna Township, Lower Paxton Township, Swatara Township, Paxtang Borough, Penbrook Borough, and Steelton Borough. The Suburban wholesale customers account for approximately 50% of the revenues of the wastewater system.

Table 2-1: Summary of Major Wastewater and Stormwater System Facilities

Facility	Description	Design Peak Capacity	2017 Average Flow	2017 Peak Flow
Advanced Wastewater Treatment Facility	High Purity Oxygen Activated Sludge Plant	45.0 MGD	20.9 MGD	24.8 MGD ¹
Front Street Pump Station	Pump Station	43.2 MGD	14.0 MGD	37.2 MGD ²
Spring Creek Pump Station	Pump Station	28.9 MGD	5.38 MGD	25.9 MGD ³
City Island North Pump Station	Pump Station	0.432 MGD	0.006 MGD	0.014 MGD ² Total
City Island South Pump Station	Pump Station	0.432 MGD		
Market Street Pump Station	Pump Station	Unavailable	Unavailable	Unavailable

¹Maximum monthly flow, which occurred in April 2017.

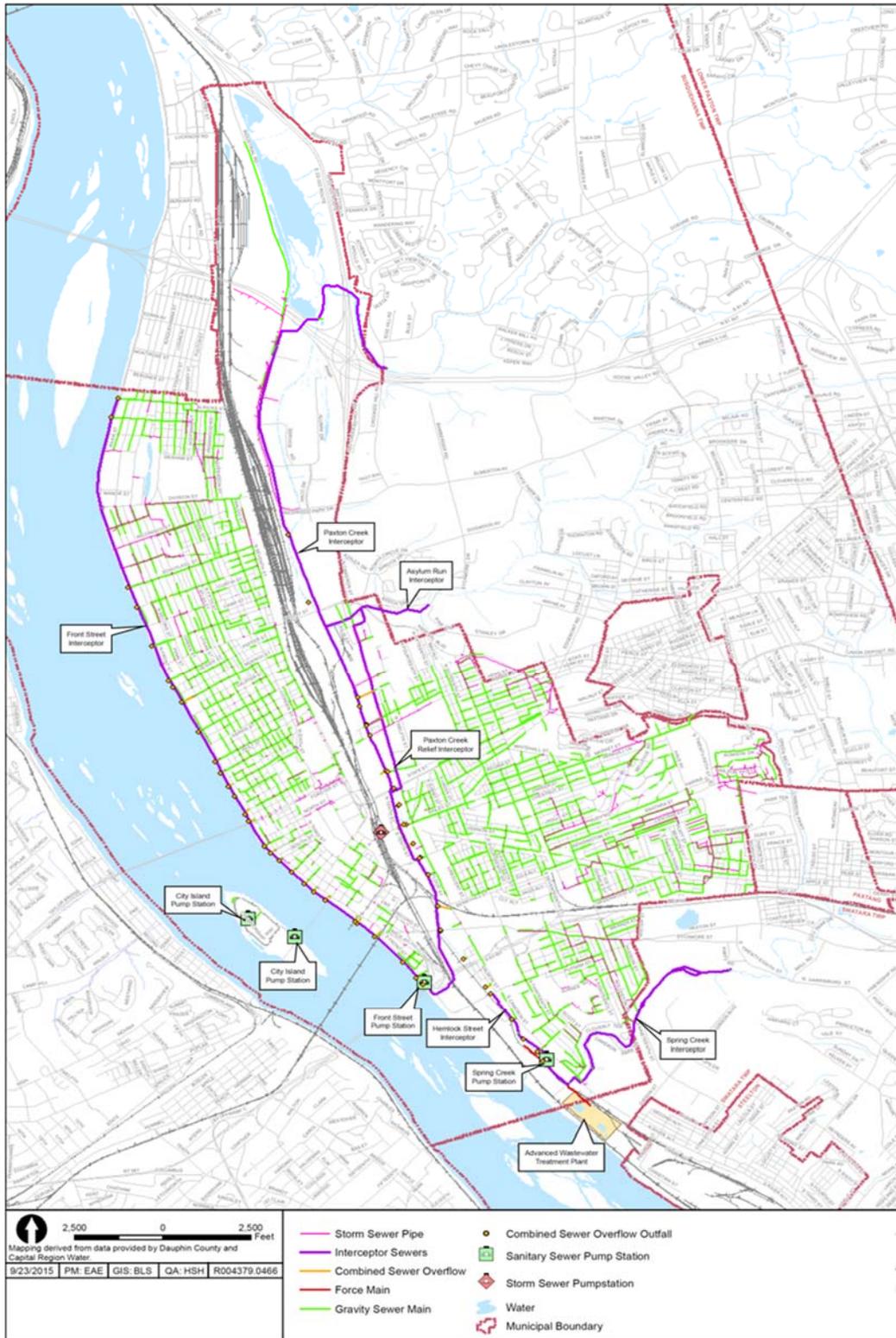
²Peak day flow.

³Peak instantaneous flow.

Source: Chapter 94 Municipal Wasteload Management Report for Calendar Year 2017, and Semi-Annual Report on Consent Decree Implementation for July 1, 2017 to December 31, 2017, dated March 2018.

A map of the wastewater system's infrastructure, including stormwater pipe, interceptor sewers, force mains, gravity sewer mains, and pump stations, is shown in Figure 2-1.

Figure 2-1: Wastewater System Infrastructure Map



2.2 Wastewater System Description

2.2.1 Wastewater Treatment

The AWTF is a 45 million gallon per day (MGD) capacity, high purity, oxygen activated sludge plant. The plant consists of preliminary treatment, including vortex grit removal, followed by primary clarifiers, high purity oxygen secondary treatment, secondary clarifiers, and chlorine disinfection. The plant was recently upgraded to implement biological nutrient removal, and this process began operation in April of 2016. This upgrade consisted of new side-stream treatment, 4.5-million-gallon biological reactor tankage and numerous associated appurtenances to upgrade treatment capabilities for nitrogen removal.

2.2.2 Wastewater Pump Stations

The Front Street Sewage Pump Station, located at 830 South Front Street, receives combined sewage flows from the 42-inch by 42-inch Front Street interceptor and 60-inch diameter Paxton Creek interceptor. The Pump Station was constructed in the late 1950s. Minor upgrades in 1973 included ventilation and valve control improvements; replacement of the screenings compactor and belt conveyors occurred in 1986. Annual average daily flow ranges between 14 and 16 MGD with peak daily flows exceeding 40 MGD.¹ The Pump Station has four (4) 200 horsepower vertical shaft solids handling pumps in the dry well which are each rated for 10,000 gpm at 56 feet of head. Two pumps are constant speed and two pumps are equipped with variable frequency drives (VFD). Dry weather flows are typically conveyed with one pump operating while wet weather flows result in two to three pumps operating simultaneously. Four pumps in simultaneous operation occurs only during extreme flooding events. The Pump Station conveys flow approximately 6,100-feet to the AWTF through a 48-inch diameter cast iron force main joined by the contribution of Spring Creek Pump Station into the force main approximately 2,000-feet upstream of the AWTF. There are two redundant primary electrical feeds to the Pump Station.

The Front Street Pump Station is nearing the end of its useful life, and CRW has proceeded with the design for upgrades of the pump station, and the project is currently scheduled for construction.

The Spring Creek Pump Station was originally constructed in 1959, and it currently conveys average daily flows of 5.3 MGD to the AWTF with a peak discharge flow of 28.9 MGD. The pump station is located just south west of the intersection of South Cameron Street and Magnolia Street and serves the southern portions of the wastewater collection system. Wastewater enters the station through a 24-inch diameter cast iron interceptor on the east side of the station and a 27-inch diameter reinforced concrete pipe interceptor on the south side. The station is equipped with three sewage pumps that discharge through a 24-inch diameter cast iron line, which ultimately connects to the 48-inch diameter force main from the Front Street Pump Station. The Spring Creek Pump Station also has a permitted combined sewer overflow (CSO) chamber that relieves the system during high flow events. The Spring Creek Pump Station is nearing the end of its useful life, and CRW is evaluating options for upgrading or replacement/relocation of the pump station.²

¹Front Street Sewage Pumping Station Improvements prepared by CRW in November 2015

²Screening Study prepared by Hazen & Sawyer in April 2015

There are also two small pump stations that convey wastewater flow from City Island to the Front Street Interceptor and eventually to the Front Street Pump Station. CRW also operates the Market Street Pump Station, which conveys stormwater from a railroad underpass to Paxton Creek.

2.2.3 Wastewater Conveyance

CRW operates and maintains 59 CSO regulator structures located along the Front Street, Paxton Creek, and Hemlock Street interceptor sewers, which ultimately direct combined wastewater (sanitary wastewater and stormwater) to the AWTF. During dry weather conditions, the CSO regulator structures divert all of the combined wastewater from the trunk sewer lines to the interceptor sewers. During wet weather, the rate and volume of the sanitary and stormwater flow from the system of collector sewers increases significantly and can exceed the capacity of the downstream interceptor sewers and the AWTF. When this occurs, the CSO regulator structures (oftentimes called diversion structures) divert a controlled volume of flow to the interceptor, while untreated excess combined wastewater is discharged to receiving waters. The receiving waters are the Susquehanna River for regulator structures along the Front Street interceptor and Paxton Creek (a tributary of the Susquehanna) for regulators along the Paxton Creek and Hemlock Street interceptors.

There are also CSO outfalls at the Front Street Pump Station and the Spring Creek Pump Station. These are permitted emergency outfalls (CSO-002 and CSO-003) that only activate during a mechanical failure of the pump stations or if the station capacities are exceeded during large storms. Each regulator has a dedicated outfall, except in one case where two regulators serve a common outfall. Therefore, there are a total of 60 outfalls (including those from the pump stations) in the system.

In addition, the wastewater conveyance system also includes approximately 33 miles of sanitary sewers, 40 miles of stormwater sewers, and 87 miles of combined sanitary and stormwater sewers.

2.3 Management and Staffing

The Wastewater System was originally managed, owned, and operated by the City of Harrisburg. The wastewater conveyance system was acquired by, and the Advanced Wastewater Treatment Facility was constructed by The Harrisburg Authority and a Conveyance and Treatment System Lease provided for the City's operation of those assets. While the City continued to own and operate the sewer collection system, both the City of Harrisburg and The Harrisburg Authority were party to a Collection System Lease providing for leasing of assets related to the collection system.

In 2011, a fiscal emergency was declared for the City of Harrisburg due to severe financial distress and a state receiver was appointed. Financial distress resulted in operational challenges for the Wastewater System, including a loss in access to capital markets. As a result, the Commonwealth's Office of Receiver, the City, and The Harrisburg Authority agreed to transfer the sewer collection system to The Harrisburg Authority and the Conveyance and Treatment System Lease was terminated. With this termination, codified by the Transition Agreement dated November 4, 2013, The Harrisburg Authority (later renamed Capital Region Water) accepted full ownership and operation of the Wastewater System.

CRW is governed by a five-member Board of Directors and is managed by a team, headed by the Chief Executive Officer, which 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

Consulting Engineer's Annual Report – Wastewater System

the Board. In addition to providing wastewater services, CRW also provides water 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, which include Drinking Water Operations, Wastewater Operations, Administration, Engineering, and Finance as well as an Executive team. Departments are all headed by their respective department directors, as shown in Figure 2-2.

Figure 2-2: CRW Management Level Organizational Chart



Organizational Structure



9/26/2018

2.3.1 Administration, Engineering, Finance, and Operations Departments

The Drinking Water Operations and Wastewater Operations 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 Wastewater Operations Department includes plans for 49 positions, with 45 positions filled as of September 2018. The Wastewater Operations organizational chart is provided in Figure 2-3.

The Administrative Department provides office management, information technology, human resources, insurance, risk management and safety programs, 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. An Executive Team provides sustainability and strategic planning as well as community outreach and communications.

It is understood that CRW plans to staff these departments with a total of 47 positions (10 for Administration, 9 for Engineering, 23 for Finance, and 5 for Executive), and as of September 2018, 38 of the 47 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.

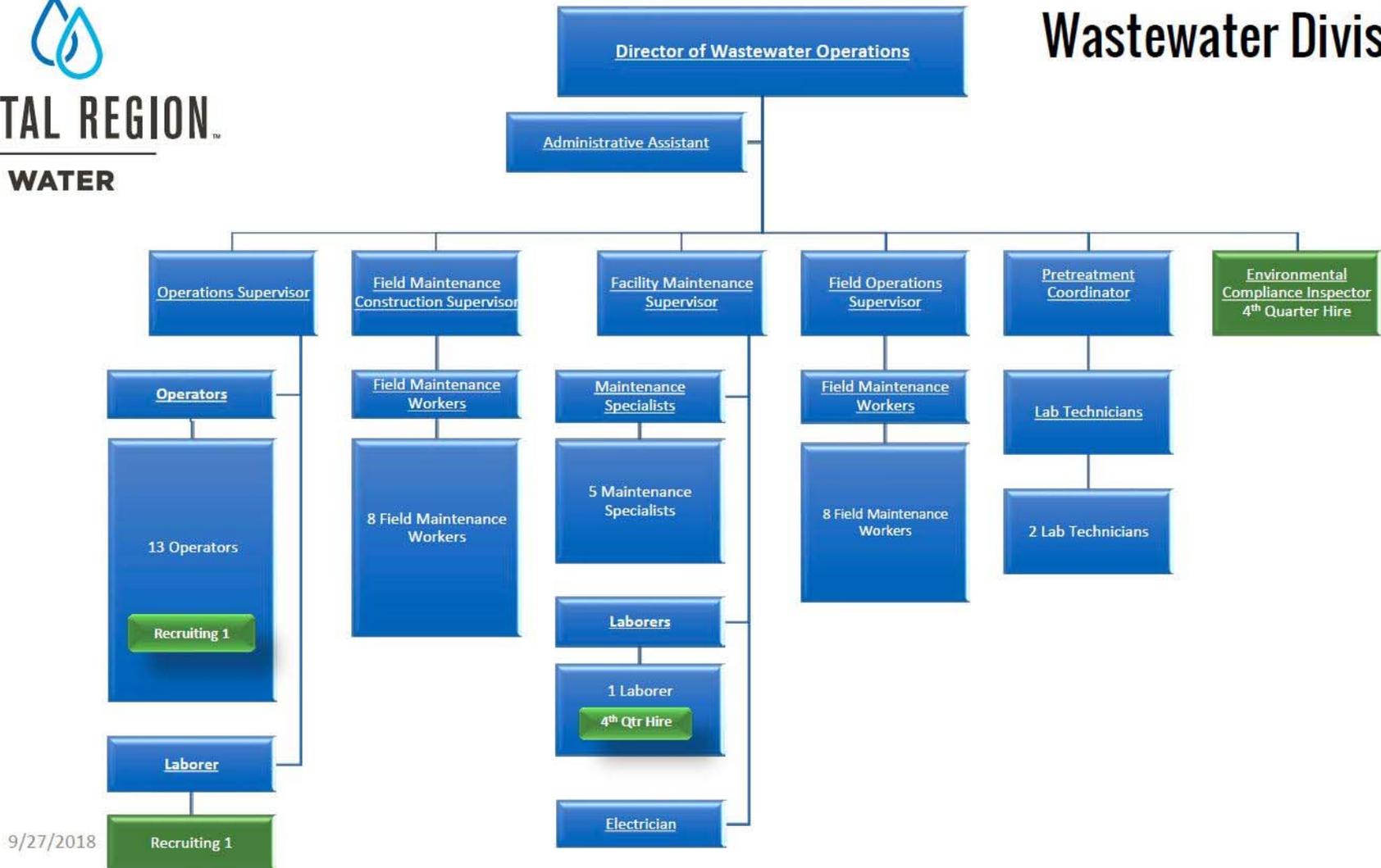
In summary, CRW's FY 2018 Wastewater System budget includes estimated costs associated with the current and planned employees dedicated to the Wastewater System and the Water System's share of costs associated with the planned positions under the Administrative, Engineering, and Finance Departments as 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 Wastewater System functions of CRW are adequately staffed.

Figure 2-3: Wastewater Operations Division Organizational Chart



Wastewater Division



3 WASTEWATER SYSTEM PERFORMANCE

3.1 Service Area

The wastewater system provides service to City retail customers and suburban community wholesale customers. The suburban communities account for approximately half of the revenues of the conveyance and treatment systems and include Susquehanna Township, Lower Paxton Township, Swatara Township, Paxtang Borough, Penbrook Borough, and Steelton Borough, all of which are located in Dauphin County. A map of the wastewater system's service area is included in Appendix A.

3.2 Customer Base

CRW maintains approximately 17,000 active connections within the City. Suburban communities are billed on a wholesale basis with their allocation based on an estimate of individual account data for customers located in these communities. Some suburban customers are billed based on metered water consumption, while others are billed based on the estimated number of equivalent dwelling units within their customer base. For 2017 billing purposes, one equivalent dwelling unit has been assumed to equal 65,000 gallons of annual water consumption. During FY 2017, suburban communities were billed for approximately 2.62 billion gallons of wastewater flow.

The number of customers and billed wastewater flow by class for customers located within the City are down in Table 3-1. The total billed wastewater flow for Suburban communities is also shown in the table.

Table 3-1: Customer Information

Description	Accounts	Billed Wastewater Flow (1,000 gal.)
City of Harrisburg:		
Residential	14,909	771,303
Commercial	1,720	543,608
Industrial	14	23,969
Public / Institutional	60	84,789
Total	16,703	1,423,668
Suburban Communities:		
Penbrook Borough	n/a	95,245
Paxtang Borough	n/a	48,771
Swatara Township	n/a	450,598
Lower Paxton Township	n/a	1,032,877
Susquehanna Township	n/a	867,105
Steelton Borough	n/a	126,478
Total	n/a	2,621,074
Combined Total	n/a	4,044,742

Source: FY 2017 customer and billing data provided by CRW.

3.3 Regulation and Compliance

CRW's AWTF is permitted to discharge to the Susquehanna River under National Pollutant Discharge Elimination System (NPDES) Permit No. PA0027197. CRW's permit renewal application was submitted in July 2014 and is currently under review.

3.3.1 Operational Performance

In FY 2017, the average annual wastewater flow received at the AWTF was 20.9 MGD, with the highest month being April with an average flow of 24.8 MGD, and the maximum 3-month average of 23.6 MGD during March through May. The permitted design hydraulic capacity flow for the AWTF is 45.0 MGD. No hydraulic overloads were recorded in 2017, as the monthly average flow at the AWTF did not exceed the design capacity of 45.0 MGD in any month during the year. In addition, the average flow at the AWTF in FY 2018 (through July), was approximately 26.8 MGD and the highest average flow on a per month basis occurred in February and was 33.8 MGD. Based on flow projections for the City, and contributing municipalities, no hydraulic overload conditions are projected through FY 2022, as the annual average flow in that year is projected to be 24.9 MGD.³

In FY 2017, annual average biochemical oxygen demand (BOD) loading was 23,058 pounds per day with a maximum month loading of 26,910 pounds per day. The permitted average daily organic loading for the AWTF is 68,257 pounds BOD per day. No organic overloads were recorded in 2017 and no overload conditions are expected through 2022, as the annual average organic loading is projected to be increased to 23,630 pounds per day over the period from 2017 to 2022.⁴ Furthermore, the average pounds of BOD loadings at the AWTF in FY2018 (through July), was 27,598 pounds per day and the highest average loadings on a per month basis occurred in May and was 30,358 pounds per day. Over the past five years, the average organic waste strength of the sewerage received at the AWTF has averaged less than 136 milligrams per liter (mg/L). The organic waste strength of the sewerage is not expected to increase significantly over the next five years.⁵

With the completion of the AWTF Nutrient Removal Upgrade (BNR) project, CRW has realized a significant decrease in the concentration of nitrogen in the effluent from the AWTF. For example, in 2015, the average concentration of nitrogen as sampled from effluent was 22.4 mg/L; however, once the BNR facilities had become operational in April 2016, the concentration of nitrogen decreased to 7.1 mg/L in May, 5.5 mg/L in June, and 2.5 mg/L in July. In FY 2017 the average concentration of nitrogen in the effluent was 5.6 mg/L, and in FY 2018 (January to July) the average concentration of nitrogen in the effluent was 7.6 mg/L.

3.3.2 Permit Exceedances

CRW had one National Pollutant Discharge Elimination System (NPDES) permit exceedance in 2017 which involved effluent fecal coliform levels exceeding 6,000 colony-forming unit (cfu)/100 millilitres (mL)

³Chapter 94 Municipal Wasteload Management Report for Calendar Year 2017, and Semi-Annual Report on Consent Decree Implementation for July 1, 2017 to December 31, 2017, dated March 2018.

⁴ Ibid, p.1-2.

⁵ Ibid, p.1-2.

for more than 10% of the sample days. The geometric mean for the month was 8 cfu/100 mL. This was attributed to inadvertent valve opening that modified the chlorine solution dosing point. The issue was resolved by locking the valve, adding additional signage, and re-training all 14 operators on proper chlorination valve positioning.⁶

3.3.3 Sewer Overflows and Bypass Events

There were 28 secondary bypass events during 2017. A secondary bypass event is where there is excess wastewater flow received at the secondary treatment train above 45.0 MGD, causing the wastewater flow to bypass secondary treatment. This includes one unanticipated bypass on July 28, 2017 due to a 4-hour complete power outage at the facility due to a propane leak at an adjacent facility. Three of the bypass events exceeded 12 hours in duration, with the longest bypass event lasting longer than 27 hours.

CRW has a combined sanitary and stormwater system, which conveys wastewater and stormwater runoff during wet weather periods. Regulators and diversion chambers divert excess flow to Paxton Creek or Susquehanna River during wet weather events. Wet weather events occur when the combined flow exceeds the dry weather peak flow capacity. CRW's discharge permit authorizes discharges from regulators and diversion chambers, however, it does not authorize overflows from sanitary sewers or discharges from other than identified combined sewer regulators and diversion chambers. A summary of the SSO events and combined sewer unauthorized discharges during the 2017 reporting period are listed in Table 3-2.

Table 3-2: Sewer Overflows and Unauthorized Discharges (2017)

Date	Location	Issue
1/24/17	1462 13 th Street	Basement Backup due to Blockage
3/3/17	2234 Adrian Street	Manhole Overflow due to Blockage
4/5/17	2705 5 th Street	Basement Backup due to Partially Collapsed Pipe
4/21/17	301 Cameron Street	Collapsed Main
4/28/17	301 Cameron Street	Defective Pipe Connection
8/29/17	2260 Kensington Street	Basement Backup due to Blockage
8/31/17	Rolleston Street & Cloverly Terrace	Overflow due to Debris and Potential Pool Draining
11/30/17	435 Hale Avenue	Basement Backup due to Blockage; Manhole Overflow

⁶ Ibid., p.1-4

3.3.4 Partial Consent Decree

In August 2015, CRW entered into a partial Consent Decree with the Department of Justice, the U.S. Environmental Protection Agency, and PADEP concerning the operation of its collection system, pump stations, and AWTF. The Consent Decree requires CRW to complete a Long-Term Control Plan for its combined sewer system, update the Combined Sewer System Operations and Maintenance Manual and Nine Minimum controls, obtain a MS4 permit and establish a Stormwater Management Program, and implement early action projects. In 2017, CRW fulfilled its partial Consent Decree requirements for deadlines due during this reporting period, including the following:

- Completion of its Annual Update of the Nine Minimum Controls plan
- Completion of its Semi-Annual Report
- Completion of a Capacity Assessment Report
- Completion of its updated Long-Term Control Plan (City Beautiful H₂O Program Plan)
- Completion of its MS4 Individual Permit Application
- Completion of its Separate Sanitary Sewer Capacity Assessment Report

CRW has met compliance dates for the reporting period January 1, 2018 to June 30, 2018 corresponding to Sinkhole Remediation, Semi-Annual Report, Operations and Maintenance Manual Update, and the Long-Term Control Plan. The City Beautiful H₂O Program Plan was drafted to meet the Long-Term Control Plan and integrated stormwater/wastewater planning requirements of the Consent Decree.

CRW completed upgrades to its AWTF in 2016 with biological nutrient removal in order to comply with the Chesapeake Bay Tributary Strategy and meet new NPDES permit discharge requirements. This \$50 million project at the AWTF consisted of adding biological nutrient removal technology to the existing processes to achieve nitrogen and ammonia removal requirements associated with the new NPDES discharge permit. With the project now complete, CRW has the ability to generate nutrient credits. However, as reported by CRW, based upon the current market value of the credits, it is not cost-effective to generate credits at this time.

3.3.5 Wet Weather Program Accomplishments

CRW's progress during FY 2017 and FY 2018 under its Wet Weather Program included the following accomplishments:

- Reviewed the Nine Minimum Controls (NMC) Plan to develop recommendations for improvements in the August 2017 Annual Update.
- Installed 3 pilot CSO advisory signs in 2017 to receive public feedback and further coordinate signage plans with the City.
- Continued to expand the development of the sewer maintenance management system, including the GIS and Cityworks systems.
- Continued to conduct numerous public outreach activities.
- Submitted a new MS4 Individual Permit Application for submittal to DEP in September 2017.
- Conducted CSO/wet weather alternatives evaluation.

- Completed three Green Stormwater Infrastructure Pilot Projects.
- Completed and submitted the Separate Sanitary Sewer Capacity Assessment.
- Submitted the City Beautiful H₂O Program Plan per Long-Term Control Plan (LTCP) requirements.
- Submitted the Joint Pollutant Reduction Plan with Lower Paxton Township and Susquehanna Township which addresses Paxton Creek Watershed TMDL, Chesapeake Bay Pollution Reduction Plan (PRP), Wildwood Lake PRP, and Unnamed Tributary to Spring Creek PRP.

3.3.6 Nine Minimum Controls Plan

CRW developed a detailed approach to achieve future compliance with each of the Nine Minimum Controls (NMCs), which was submitted in the August 2015 NMC Plan. In many cases, the compliance measures have already been implemented, such as daily CSO regulator inspections. In other areas, additional information is required to implement some of the NMCs, and CRW has undertaken efforts necessary to collect the data. Efforts related to the NMC Plan that have been completed include the following:

- Prepared the 2016 NMC Plan Update to address EPA comments
- Identified critical trunk sewers and completed manhole inspection data review
- Refined the sewershed and catchment delineations using the manhole investigation data
- Updated the GIS system with collection system manhole investigation and rapid assessment data
- Completed the majority of the interceptor cleaning by December 31, 2016
- Completed an internal force main inspection and found no critical deficiencies
- Continued to implement and optimize Cityworks for the management of complaints and service requests
- Purchased a new vector truck
- Continued to perform daily regulator inspections at each regulator.

The following efforts are ongoing by CRW related to its NMC Plan:

Conduct proper operation and regulator maintenance of the conveyance and collection system:

- Development of a program to identify, prioritize, and schedule remedial works related to the sewer system.
- Identification of key equipment purchases
- Continued to provide training to staff
- Continued to perform daily regulator inspections
- Continued to implement practices outlined in the Operations and Maintenance Manual (OMM)
- Continued with an ongoing inlet cleaning and inspection program
- Continued to inspect and maintain pump stations as outlined in the OMM
- Continued to optimize Cityworks for data management and maintenance problems
- Continued to investigate and repair sinkholes in accordance with the OMM

Consulting Engineer's Annual Report – Wastewater System

Maximize use of storage in the collection systems:

- Proceeding with an engineering study as part of the system characterization and LTCP
- Continuing to clean interceptors

Maximize flow to the AWTF:

- Completed the design of the upgrades to the Front Street Pump Station
- Continued to operate the system in accordance with the OMM
- Continued flow monitoring work within the sanitary sewer system to quantify inflow and infiltration
- Inspected the MS4 and sanitary/combined sewer systems
- Evaluated the AWTF flows for the preparation of the Chapter 94 Report

Eliminate dry weather overflows:

- Reported dry weather overflows in accordance with regulatory guidelines
- Removed blockages and modified hydrant flushing operations to correct dry weather overflows.
- Conducted daily inspections as detailed in the OMM
- Removed waste material that accumulated on the stream banks.

Operate and maintain the combined sewer system to control solid and floatable materials:

- Removed waste material that accumulated on the stream banks

Implement public notification procedures set forth in the NMC plan:

- Installed temporary signs at each CSO outfall and public stream access point that notify and alert the public.
- Continued to develop a public outreach and notification program as described in the NMC Plan
- Continued to increase public involvement activities, including monthly trash clean-ups, and presentations at community events.

Utilize a phased approach to characterize CSO impacts and control efficacy:

- Employed visual inspections of regulator and outfalls daily
- Continue to monitor rainfall at rain gauges

Evaluate the efficacy of the NMC Plan:

- Updated the NMC Plan

Submit MS4 Individual Permit Application with a Stormwater Management Plan:

- Continued implementing a TMDL Strategy in collaboration with two neighbouring municipalities
- Continued with field investigations to identify outfalls and a map of the MS4 system
- Continued to conduct stormwater management plan reviews through coordination with the City of Harrisburg
- Developed draft rules and regulations for stormwater management
- Pursuing an MOU with Dauphin County Conservation District

3.3.7 Operations and Maintenance Manual

CRW reviewed ongoing maintenance and operation efforts and developed improved practices for compilation in the new Operations and Maintenance Manual (OMM). The OMM defines the critical equipment and facilities for the AWTF and collection/conveyance systems. The OMM also includes detailed procedures, complete with checklists, for the following system components: CSO regulators, outfalls and backflow prevention gates, pump stations, interceptors, force mains, collection system and manholes, and inlets and catch basins. The OMM also outlines emergency procedures, citizen complaint tracking, sinkhole remediation, and education programs. The OMM document was originally submitted on August 10, 2015, and updated on March 29, 2018.

3.3.8 Data Management Systems

CRW has developed a Cityworks™ data management system for their sewer system. Cityworks was implemented in October 20, 2015. This software is the recordkeeping tool for maintenance activities and will assist in reporting requirements of the partial Consent Decree. From January to December 2017, the following items have been documented in Cityworks for sewer system maintenance and inspection activities:

- 1,145 inlets were cleaned and 284 were repaired
- 35 sinkholes were identified and addressed
- 106 service requests for backups and/or overflows
- 7.48 miles of collection pipe were flushed
- 13.77 miles of collection pipe were inspected with CCTV.

3.3.9 LTCP Development

In support of the LTCP development, CRW has completed several tasks, including the following:

- Revised the connectivity of the pipe network in GIS with manhole and rapid assessment data
- Continued to utilize the upgraded flow meters
- Continued to monitor rainfall data
- Continued to monitor the interceptor sites
- Continued to utilize the hydraulic model for system characterization
- Continued to develop the Green Infrastructure Plan
- Reported all SSOs within the collection system
- Continued to implement the OMM requirements and began incorporating revisions
- Completed flow monitoring of representative separate sanitary sewer catchments
- Completed the Capacity Assessment Plan
- Applied the hydraulic model to prepare the Separate Sanitary Sewer Capacity Assessment
- Completed the majority of the interceptor cleaning
- Advanced the early action outfall schedule in coordination with the hydraulic modelling, collaborative efforts with stakeholders, and development of the LTCP.
- Completed the CAMP Study

- Removed blockages to address dry weather overflows
- Continued to track and report unauthorized discharges

CRW has issued the City Beautiful H₂O Program as part of the LTCP, which was due on April 1, 2018.

3.3.10 Industrial Pre-Treatment

CRW maintains an Industrial Pre-Treatment Program to ensure that industrial users comply with federal state, and local pre-treatment program effluent discharge limitations and regulations. Industrial user compliance eliminates interference or possible damage to the conveyance and treatment system, untreated waste from passing through the AWTF to the receiving stream, the contamination of sludge which limits disposal and reuse options, and the exposure of personnel to chemical, explosion or fire hazards.

The total number of permitted industrial users in 2017 was eight. During FY 2017, no additional significant industrial users were permitted. Of the eight permitted industrial users, one is classified as categorical and seven as non-categorical industrial users. Inspection and sampling activities performed during the year included facility inspections, self-monitoring inspections, and compliance sampling. During 2017, no permitted industrial users were on a formal compliance schedule for non-compliance. However, during the 2017 calendar year, two violation notices were issued for noncompliance with effluent discharge limits. No notices of violation were issued for significant noncompliance in 2017.

4 WASTEWATER SYSTEM CONDITION

4.1 Overview

CRW staff aim to ensure the entire Wastewater 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 is developing a comprehensive asset management program for the wastewater system which will further enhance preventative maintenance and increase system reliability. KCI Technologies is supporting the asset management program development. 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.

Development of the Wastewater Collection System Asset Management Plan is underway, and completion is forecasted for September 2019. The plan will provide CRW with strategies for operations, maintenance, capital investments, and funding. A parallel Asset Management Plan for the drinking water system will follow.

4.2 Condition Assessment

Arcadis conducted a limited condition assessment of the key components of CRW Wastewater System, which included a review of existing information provided by CRW, discussions with CRW staff, and visual observations during field visits held on August 30, 2018. 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 Wastewater 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 5 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
AWTF	3.1
Front Street Pump Station	3.3
Spring Creek Pump Station	3.0
City Island North Pump Station	2.3
City Island South Pump Station	2.3
Market Street Stormwater Pump Station	2.2
Combined Sewer Overflow Regulators	2.0
Interceptor Sewers	
• Front Street Interceptor	4.1
• Paxton Creek Interceptor	4.1
• Hemlock Street Interceptor	3.0
• Spring Creek Interceptor	3.0
• Paxton Creek Relief Interceptor	3.0
• Asylum Run Interceptor	3.0
Collection System	3.0
Separate Stormwater Collection System	3.0
Overall System Rating	3.0

Overall the Wastewater System is in fair condition; however, some components are aged and will require investigation and capital investment to preserve the asset and maintain appropriate system performance and delivery of services.

An arc flash study is recommended for the wastewater system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. However, due to the current state of electrical

equipment at the AWTF and collection system pump stations, it is anticipated that a sizeable portion will be replaced in the next 2 to 5-years given the current CIP. Therefore, CRW intends to evaluate the need, scope, and budget for arc flash studies after completion of the improvement projects currently in the CIP.

The following provides 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 AWTF

The AWTF, located on Elliot Street off South Cameron Street on the City of Harrisburg's boarder with the Borough of Steelton, treats wastewater conveyed from the Front Street Pump Station, the Spring Creek Pump Station, and the Trewick Street Pump Station (Borough of Steelton). It also treats trucked in wastewater. The site also contains the CRW collection system maintenance garage. The AWTF utilizes grit removal, primary clarification, oxic/anoxic biological treatment, chemical addition, final clarification, and disinfection to treat wastewater prior to discharge to the Susquehanna River. Additionally, AWTF thickens, anaerobically digests, and dewateres residuals from the wastewater treatment processes prior to farm land application as Class B residuals. CRW completed major improvements to the biological treatment and final clarification processes at the AWTF in 2016 which were intended to achieve the effluent limits for nutrient removal contained in its discharge permit.

The AWTF appears to be in fair overall physical condition based on the available documents and an Arcadis inspection on August 30, 2018. However, some capital investments and minor additional O&M expenditures should be made within the next five years to ensure continued compliance with effluent limits and reduce operating costs. Table 4-3 identifies the anticipated additional capital and incremental O&M needs that have not been identified already in the previous CRW CIP.

Table 4-3: AWTF Improvements

Description	Classification
Repair/Replace Non-Functioning First Floor Lighting in Settled Sewage Pump Station	Capital Maintenance
Replace Damaged Exterior Man Doors on Settled Sewage Pump Station	Capital Maintenance
Replace Bent Shaft on Chlorine Contact Tank Effluent Sluice Gate	Capital Maintenance
Repair Damaged Section of Handrail on Chlorine Contact Tank	Capital Maintenance

CRW is currently in the process of constructing an influent screening facility at the AWTF and anticipates completion of construction by the end of 2018. The implemented improvements at the AWTF are based on a Screening Study completed by Hazen and Sawyer in April 2015. The Study evaluated the screening equipment at the AWTF, Front Street Pump Station, and Spring Creek Pump Station. The study recommended that fine screens be installed at the AWTF and course screens be installed at Front Street Pump Station. The design for the AWTF screen improvements includes two screening units, with a third bypass channel containing a manually-cleaned bar rack. Each channel will have with the ability to pass 40 MGD, providing a total of 120 MGD of capacity and 80 MGD (peak design flow) with one unit out of

service. The total project cost for the AWTF screening facility is estimated to cost approximately \$3.6 million.

An energy audit was performed for the AWTF in July 2017. The purpose of the audit was to provide a comprehensive list of energy efficiency improvements that CRW could perform to reduce overall energy consumption. Based on the results of the audit, CRW plans to implement various energy efficiency improvements at the AWTF. Already completed by CRW was the installation of a dissolved oxygen (DO) probe in the final effluent channel that measures the oxygen in the effluent and reduced the number of blowers in operation to maintain adequate DO without over aerating. In 2019, CRW plans to implement waste activated sludge (WAS) improvements by modifying existing piping in the WAS pump station to allow for return activated sludge (RAS) to be wasted instead of mixed liquor suspended solids (MLSS). By wasting RAS instead of MLSS, the pumping requirements are significantly reduced due to the increased solids concentration of the RAS compared to the MLSS.

Additionally, CRW is in the process of implementing improvements to the existing primary clarifiers. Whitman, Requardt & Associates, LLP (WRA) was retained to provide design services for primary clarifier improvements. The recommended improvements based on WRA's evaluation include the following:

- Structural repairs and rehabilitation of all clarifier tanks
- Primary clarifier mechanism replacement of all tanks (inclusive of main and cross collector drive units, chain and flight scrapers, influent gates, effluent weirs).
- Replacement of miscellaneous piping, valves, and actuators.
- Primary sludge pump replacement (2 units).
- Replacement of decant pump in the decant pump vault.

However, based on the engineering cost estimate prepared by WRA, the construction cost was too high and therefore CRW elected to perform the replacement of the primary clarifier mechanism and pumps in-house in an effort to reduce cost.

4.2.1.1 Biosolids Facility Review

In March 2017, a Biosolids Facilities Existing Conditions Report was completed by WRA. The purpose of this report was to provide an assessment of the current conditions of the solids treatment and handling systems at the AWTF. Based on the Biosolids Facilities Existing Conditions Report, WRA submitted in June 2017, a Preliminary Biosolids Facilities Improvement Plan for CRW, which included several recommendations as part of the improvement plan, including:

- Process modifications to separately thicken waste activated sludge and primary sludge
- Upgrade of the primary digesters
- Replacement of gravity thickener facilities
- Upgrade of the dewatering facilities
- Construction of a hauled waste facility
- Replacement of the boiler building
- Replacement of the combined heat and power (cogeneration) system equipment
- Replacement of the gas collection, storage and pretreatment systems

The opinion of probable construction costs for the biosolids facility improvements total \$52.3 million, with a low estimate of \$42.4 million and a high estimate of \$75.5 million. The report provides phased schedule for construction beginning in 2017 for the primary digester improvements and extending to 2024 for the dewatering facility improvements. CRW has proceeded with the primary digester improvements which is currently under construction. The Primary Digester Improvements project is based upon the May 2017 Basis of Design Report prepared by WRA for the Rehabilitation of the Primary Digester Facilities. The improvements include the rehabilitation of the primary digester facilities equipment to replace old components with new, and upgrade the digester mixing system. In addition, the project includes an electrical building to help facilitate the replacement of old electrical gear and provide a central power distribution facility to serve the southern part of the AWTF. The engineer's opinion of probable construction cost was \$10.1M, however the awarded construction contract value is \$8.8M. Currently construction is under way, having started in the summer of 2018.

CRW is allow planning to move forward with replacement of the combined heat and power (CHP) system; the design phase will be performed in 2019 and followed with design implementation in 2020. CRW intends to prioritize work on the secondary digesters following completion of the primary digester improvements. Remaining biosolids facility projects will be evaluated for priority as the above projects are completed.

Additionally, from 2013 to present, nearly all of the biosolids generated by CRW have been land applied for beneficial use by agriculture. Biosolids hauling to the farms is provided by a contracted hauler. The 13,250 wet tons of biosolids produced by CRW requires approximately 623 acres of beneficial use. CRW has approximately 703 qualified acres, which provide a buffer of only 80 acres. WRA recommended that an additional 230 acres of qualified acreage be added to the current land base over the next 1 to 5 years for beneficial biosolids disposal. In 2018, CRW acquired a 90-acre farm for land application and is currently investigating a 500-acre site in Dauphin County.

Recommendations from WRA's regulatory biosolids review include a recommendation that CRW should periodically have a phosphorous source coefficient test performed as part of routine monitoring, which can be used in the future in site index calculations of phosphorous management is implemented by PADEP. Further, WRA notes that there are several regulatory and non-regulatory drivers that could potentially affect biosolids land application programs, including limiting phosphorous application, odor considerations, and farmland availability. While there are no federal biosolids regulatory changes planned, PADEP indicated that the new General Permit would include new phosphorous management and hauled waste requirements. CRW may want to consider conducting an assessment of their current qualified acreage to determine the impact of phosphorous management.

4.2.2 Pump Stations

CRW maintains five wastewater or stormwater pump stations: Front Street, Spring Creek, City Island North, City Island South, and Market Street.

4.2.2.1 Front Street Pump Station

The Front Street Pump Station is located at 830 South Front Street in the City of Harrisburg, and receives combined sewage flows from the 42-inch by 42-inch Front Street interceptor and 60-inch diameter Paxton

Creek interceptor. The station appears to be in fair to poor overall physical condition based on the available documents and an inspection by Arcadis on August 30, 2018. It was noted during the inspection that two pump shafts were sheared due to cone valve failure. The pump shafts have been since replaced, and the valve is now manually operated.

Many of the pump station components are near the end of their useful life, including the screens, pumps, HVAC system, and electrical and control systems. Capital investments should be made within the next five years to ensure continued operation and to reduce operating costs as described below.

CRW has completed a design for the upgrade of the Front Street Sewage Pump Station based on the Draft Preliminary Engineering Report entitled Front Street Sewage Pump Station Improvements, prepared by Johnson, Mirmiran and Thompson (JMT) dated November 2015. The pump station upgrade includes: replacement of pumps, bar screens, screenings conveyance equipment, controls, and associated improvements to electrical, HVAC, and building systems to meet current code requirements. The total project cost for the recommended improvements to the Front Street Pump Station was estimated to be \$14M. The project is currently out to bid.

Additionally, the April 2015 Screening Study completed by Hazen and Sawyer evaluated the existing screening equipment at Front Street Pump Station and recommended replacement. The screening equipment replacement is included in the Front Street Pump Station upgrade project.

4.2.2.2 Spring Creek Pump Station

The Spring Creek Pump Station is located southwest of the intersection of South Cameron Street and Magnolia Street in the City. It conveys combined sewage from the Spring Creek Interceptor and the Hemlock Street Interceptor to the AWTF. Hazen and Sawyer prepared an engineering report dated April 21, 2015 that assessed the condition of the station as part of an investigation into improving wastewater screen performance at all CRW's major wastewater facilities. The station appears to be in fair overall physical condition based on the available documents and an inspection by Arcadis on August 30, 2018. Many of the pump station components are near the end of their useful life, including the screens, pumps, HVAC system, and electrical and control systems. Capital investments should be made within the next five years to ensure continued operation and to reduce operating costs.

Miscellaneous improvements were made since the previous site inspection. The variable frequency drives (VFDs) were sent to be cleaned and have since been returned and installed in the pump station. Pump No. 1 is being rebuilt and the spare pump is currently installed. Miscellaneous maintenance is recommended to the bar screen in order to allow for continued operation of the existing equipment until it can be replaced.

In addition, the April 2015 Screening Study completed by Hazen and Sawyer evaluated the existing screening equipment at Spring Creek Pump Station and recommended replacement. The total project cost for screening improvements at the Spring Creek Pump Station was estimated to be \$7.5 million. It is anticipated that construction would not take place until 2023. However, it has yet to be determined if the improvements will be made to the existing Spring Creek Pump Station or if a new Pump Station will be constructed along with CSO storage.

4.2.2.3 City Island Pump Stations

The City Island North Pump Station is located at the north end of City Island in the City of Harrisburg. Sewage is conveyed from the City Island South Pump Station and elsewhere on City Island to the CRW collection system in Harrisburg proper. The station appears to be in good overall physical condition based on the available documents and an inspection by Arcadis on August 30, 2018. During the inspection, it was noted that a sewage pump and associated check valve, along with the dry well ventilation fan were replaced since the previous site inspection. However, it is recommended that CRW replace the following at the pump station: the wood platform, due to warping and splitting, the electrical control box due to corrosion, and electrical gear due to its age. It is estimated that the cost to replace the platform and the electrical equipment would be approximately \$100,000. It is anticipated that construction would not take place until 2020. Currently CRW operates the pump station but has not accepted ownership of the pump station and therefore improvements are on hold pending resolution of ownership with the City.

The City Island South Pump Station is located near the center of City Island in the City. It conveys sewage from elsewhere on City Island to the CRW collection system in Harrisburg proper. The station appears to be in good overall physical condition based on the available documents and an inspection by Arcadis on August 30, 2018. It was noted during the inspection that the pump station has been bypassed for several months and flow is being directed to the City Island North Pump Station. This is due to the lack of pumping requirements out of both facilities as pumping is not required at both stations to accommodate service flow requirements. It is recommended that CRW replace the following at the pump station: repair the broken weld on the railing of the pump station, the wooden platform needs to be replaced due to warping and splitting, the electrical control box needs to be replaced due to corrosion, and electrical gear needs to be replaced due to its age. It is estimated that the cost to replace the platform and electrical gear would total approximately \$100,000. It is anticipated that construction would not take place until 2020. Currently CRW operates the pump station but has not accepted ownership of the pump station and therefore improvements are on hold pending resolution of ownership with the City.

4.2.2.4 Market Street Pump Station

The Market Street Pump Station conveys stormwater from a railroad underpass to Paxton Creek. The station appears to be in good to fair overall physical condition based on the available documents and an inspection by Arcadis on August 30, 2018. However, some additional O&M expenditures should be made within the next five years to ensure continued operation and to reduce operating costs. For example, concrete cracks were observed at the following locations: floor surfaces in the generator building, along the east side of the exterior of the building, and at the stairs leading to the entrance to the Pump Station. CRW has replaced two vertical shaft centrifugal pumps since the previous inspection with dry pit submersible pumps and continues the process to replace the two remaining pumps and associated piping and valves.

Table 4-4 identifies the anticipated additional capital and incremental O&M needs for the pump stations that have not been identified already in the previous CRW CIP.

Table 4-4: Pump Station Improvements

Description	Classification
Spring Creek PS – Perform Maintenance on the Bar Screen (replace drive chain)	O&M
Spring Creek PS - Replacing Missing Railing Section Between Screening Enclosure and Pump Station	O&M

4.2.3 Collection System

CRW wastewater system includes approximately 33 miles of sanitary sewers, 40 miles of stormwater sewers, and 87 miles of combined sanitary and stormwater sewers. Approximately 80% of the collection system was installed prior to 1940. Regulators and diversion chambers serve to divert excess flows to the Paxton Creek or the Susquehanna River during wet weather events.

While the collection system was not inspected by Arcadis during its August 2018 field visit, CRW has completed several inspection efforts associated with its collection system. In April 2017, CRW issued a Collection System Rapid Assessment Findings and Recommendations Report, where the findings of the assessments performed in 2012, 2015, and 2016 were summarized and recommendations were provided. The Report recommended that CRW complete the immediate sewer repairs that were identified and to continue to televise the collection system over the next 4 to 6 years.

CRW completed a rapid assessment of its collection system from July through December 2015 by using zoom cameras to inspect every manhole and the connected pipes (by zoom camera, not CCTV). This data is being used by CRW to complete an initial condition assessment and mapping of the collection system to allow for better management of the system and allow for prioritization of maintenance and repairs. In 2017, CRW began using this information to develop a prioritized schedule for early action maintenance and repair of sewers and manholes, and the prioritization of CCTV inspections of the collection system. CRW continues with the design and implementation of recommended collection system rehabilitation and improvements.

CRW has continued a comprehensive inlet cleaning and repair program over the last three years, which in 2017 include the cleaning of 1,145 inlets and repairing 284 of them.

In December 2016, CRW began cleaning and CCTV inspection of nearly 10,000 linear feet of combined sewer along Third Street. CRW’s collection system experienced several sanitary sewer overflows and unauthorized discharges in 2017, as summarized in Table 3-2. Many of these events included backups in basements on private property that were attributable to issues with the collection system. Others included general blockages or manhole surcharge events.

The Collection System Rapid Assessment Findings and Recommendations Report prepared by CRW in April 2017 documented the assessment of CRW’s sewer collection system that was conducted via pole camera inspections of every known manhole and connecting pipe within the collection system. The results indicated that 17% of the pipes that were inspected were in excellent condition, 19% in good condition, 25% in fair condition, 21% in poor condition, and 17% in very poor condition. This report highlighted the highest priority pipes to address. The remedies range from light to heavy cleaning to point repairs and pipe replacement. Remedial program costs were developed, which estimated the cost to

address immediate priority issues at \$2.3 million, high priority issues at \$16 million, medium priority issues at \$32.2 million, and low priority issues at \$35.6 million. The report also provided a schedule for remedial repairs, cleaning and inspection on an annual basis, which consisted of an annual cost of between \$4.0 million and \$4.9 million in years 1-5, and \$4.0 million per year thereafter through 2026.

In June 2018, WRA prepared "Pipeline Inspection and Investigations Phase I, Recommendations Report" for CRW following the review of CCTV inspection services performed by TFE Resources and a memorandum prepared by EBA Engineering, Inc. to recommend sewer rehabilitation projects within the City system. CCTV reports/videos were reviewed, sewer segments were scored for rehabilitation, recommendations were made, and projects were prioritized.

Phase 1 of this project includes inspection of approximately 15,143 LF of sewer. WRA prioritized repair and replacement projects for Phase I on the order of 22 projects for an approximate total cost of \$1.7 million. Prioritization was done to assist in the Long-Term Control Plan and identify the key components of the system. Prioritizing projects helps in identifying choke points in the system, where failure would impact the greater service area.

Of the 22 projects, 3 require excavated point repair, 6 require complete pipe replacement, 7 require heavy cleaning, and 6 require lining point repairs. Phase 1 recommends that for the 22 projects, approximately 4,112 LF of pipe is rehabilitated. Further recommendations for the system are summarized below:

- Locate and uncover manholes to permit inspection and condition assessment of 2,325 LF of sewers to determined rehabilitation requirements.
- Update the GIS database with CCTV conditions/comments recorded in the field. During the CCTV inspection, there were a significant number of defects noted. Having this knowledge readily available will assist future users.
- Continued investigation of remaining pipe segments in the system due to the poor conditions observed under this investigation.

Inspection efforts to date have focused on the sanitary and combined sewers. CRW should develop an inspection and rehabilitation program for the separate storm sewers. It is anticipated that inspection of the storm sewers will identify repair needs that should be included in a future CIP.

4.2.3.1 Sewer Interceptors

CRW operates and maintains a total of six (6) interceptor sewers. Four of these interceptors convey combined wastewater, including the Front Street Interceptor, Paxton Creek Interceptor, Paxton Creek Relief Interceptor, and the Hemlock Street Interceptor. Each of these interceptor sewers receive combined wastewater from trunk lines, and each trunk line has an associated CSO regulator structure and outfall. Two of the interceptors convey sanitary wastewater, including the Spring Creek Relief Interceptor and the Asylum Run Interceptor. As a result of the 2014 interceptor inspections that utilized CCTV video, NASSCO PACP data, sonar, and laser profiling, and the subsequent condition assessment, CRW completed the cleaning of 33,534 linear feet of its interceptors. The cleaning operation began in June 2016 and was completed in early March 2017. Approximately 1,500 tons of debris were removed from the interceptors.

A May 3, 2017 memorandum prepared by CDM Smith provided CRW with an update of the interceptor cleaning and rehabilitation improvements.⁷ As the interceptor cleaning was completed, additional inspections of the interceptors were conducted providing better detail and evaluation of the existing conditions than the initial inspections. In some cases, this resulted in expanding the scope of proposed improvements for sewer and manhole rehabilitation. Additional areas were recommended for rehabilitation within the Paxton Creek Interceptor and the Front Street Interceptor. The opinion of probable construction cost for the Paxton Creek Interceptor was estimated to be \$7.3 million, \$1.6 million for the Asylum Run Interceptor, \$9.4 million for the Front Street Interceptor, and \$2.5 million for the Spring Creek Interceptor. The Asylum Run Interceptor improvements project is scheduled for completion in 2018.

The design of the first phase of interceptor rehabilitation, which was scheduled for the Paxton Creek Interceptor commenced in 2016 and was completed and bid in 2017. The Paxton Creek Interceptor rehabilitation project is underway using spin-cast applied geopolymer due to the irregular sewer shape. During construction, the cost of the rehabilitation project has escalated because the pipe was in worse condition than anticipated and the efforts to prepare the pipe (including stopping active infiltration) for geopolymer application are beyond what was anticipated in the contract documents. CRW intends to terminate the current contract and is currently investigating alternative methods for pipe rehabilitation prior to bidding out rehabilitation of the remaining portion of the interceptor.

4.2.3.2 CSO Outfalls and Regulators

CRW operates and maintains 59 CSO regulator structures located along Front Street, Paxton Creek, and Hemlock Street Interceptors, which ultimately direct combined flows of wastewater and stormwater to the AWTF. During dry weather, the CSO regulators divert all of the combined flows from the trunk sewer lines to the interceptor sewers. During wet weather, the CSO regulator structures divert a controlled volume of flow to the interceptors, while untreated excess combined flow is discharged to receiving waters. In addition to the 59 CSO regulator structures and outfalls, there are two additional CSO outfalls at the Front Street pumping station and the Spring Creek pumping station that activate only during mechanical failure of the pump stations or if the pump station capacities are exceeded.

The regulators and diversion chambers are inspected by CRW on a daily basis to ensure proper operation. Furthermore, each of the 59 regulator structures are inspected once per day by CRW.

During the manhole inspections in the fall of 2015, zoom cameras were used to inspect each of the flood chambers, gates, and the outfall pipes. This information was analysed by CRW for structural integrity and operation and maintenance issues. CRW continues to develop recommendations for early action projects to address critical structural deterioration and river intrusion. Five CSO outfalls have been scheduled to be addressed in 2019 for critical structural deterioration.

⁷ Memorandum from CDM Smith to CRW entitled "Capital Region Water Interceptor Cleaning and Rehab Improvements Update", dated May 3, 2017.

5 CAPITAL IMPROVEMENT PLAN

5.1 Overview

CRW prepares a capital improvement plan (CIP) that identifies the major planned projects and initiatives for the Wastewater System. The CIP includes projects that are required to replace aging infrastructure, enhance or expand services to customers, provide resiliency and redundancy, and increase cost effectiveness and efficiency. Portions of the CIP are related to repair and replacement of assets that are beyond their useful life and other portions address requirements under the Consent Decree, the LTCP, and other regulatory driven projects.

CRW's CIP as of the date of this report is summarized in Table 5-1. Below is a brief discussion of the capital projects and a summary of the review findings.

5.2 AWTF Upgrades

In March 2016, CRW completed an upgrade to its AWTF, adding biological nutrient removal in order to comply with the Chesapeake Bay Tributary Strategy and meet new NPDES permit discharge requirements.

In addition, the following maintenance projects were completed at the AWTF in 2017⁸:

- Began construction of AWTF Headworks Screening Facility.
- Replacement of a 4-inch Primary Sludge Pump in the Control Building basement.
- Replacement of a 6-inch Waste Activated Sludge Pump in the Final Clarifier pipe gallery.
- Replacement of a 4-inch sludge pump at the Gravity Thickeners.
- Replacement of the Intercooler Bundles for Joy Compressor Number 2 at the Cryogenic Oxygen Distillation Facility.
- Replaced 2 Hot Water Recirculation Pumps at the Boiler Building.
- Replaced the Turbine for the Cryogenic Oxygen Distillation Facility.
- Installed four wash down hydrants for Final Clarifier maintenance.
- Rebuilt a Hoffman Blower for final aeration at the Settled Sewage Pump Station.

CRW planned in 2018 to move forward with other AWTF capital projects including:

- Complete construction of the AWTF Headworks Screening Facility to provide ¼" screening.
- Commence construction to fully rehabilitate the two (2) primary anaerobic digesters and associated equipment at the AWTF and construct a new electrical building. Construction is estimated to last two years.
- CHP evaluation and rehabilitate the existing engines.
- Replace the Dorr-Oliver Hydrogritter Unit.

The capital projects identified in the CIP for FY2019 related to the AWTF include the following:

- Anaerobic digester roof repair and primary digester facilities

⁸ Chapter 94 Municipal Wasteload Management Report and Semi-Annual Report on Consent Decree Implementation, March 2017.

- Cogeneration (CHP) improvements
- Primary clarifier improvements and repairs

5.3 Pump Station Capital Improvements

In FY 2019, CRW plans to begin to rehabilitate and upgrade its sewerage pump stations. The Front Street and Spring Creek Pump Stations are nearing the end of their useful lives. CRW proceeded with the design for upgrades to the Front Street Pump Station in 2016 and the construction contracts were approved for award in September 2018. CRW is evaluating options for the upgrade or replacement / relocation of the Spring Creek Pump Station in association with the Separate Sanitary Sewer Capacity Plan, and the CSO Long-Term Control Plan. In general, these pump station improvement projects are related to the replacement of screens at the Front Street and Spring Creek Pump Stations, as well as the replacement of pumps, controls, and various improvements to electrical HVAC, and building equipment at the Front Street Pump Station. The replacement of platforms and electrical gear at the City Island Pump Station is included in FY 2020.

5.4 Conveyance Capital Improvements

CRW has included several conveyance capital improvements in its CIP for FY 2019 shown in Table 5-1. These include the Paxton Creek, Front Street, Spring Creek Interceptor, Asylum Run Interceptor improvements, and the Arsenal Boulevard sewer improvements. In addition, collection system cleaning, rehabilitation, and replacement work is expected to be an ongoing annual capital need. In addition to the conveyance capital improvements, CRW plans to implement a number of Long-Term Control Plan related capital projects, including several green stormwater infrastructure projects, as shown in Table 5-1.

The Paxton Creek Interceptor rehabilitation is currently underway but experiencing unexcepted high costs due to difficult site conditions. The project may be reassessed and rebid. The budget for this project may need to be re-evaluated once the approach to rehabilitating the remaining portion of the pipe is determined.

A 2017 Sewer Replacement project study report prepared by HRG provided recommendations and a cost estimate for repairing sewer pipe sections on Cameron Street & Market Street, 12th Street & Magnolia Street, 13th Street & Howard Street, Derry Street & 13th Street, and Fulton Street & Hamilton Street. The engineer's opinion of probable construction cost for the recommended improvements was \$618,000.

5.5 Discussion

The information used to prepare the five-year capital plan was compiled from various engineering reports and studies that were completed for CRW, discussions with CRW and its various engineering consultants, and based on the limited visual inspections of the facilities that were completed as part of the CEAR effort. The timing of completion of the capital projects were scheduled based on the recommendations provided in the above-referenced information. Limited adjustments were made to the scheduling of the capital projects for funding and financing constraints, or the capacity of CRW to execute and implement the projects as currently projected. These factors may impact CRW's actual implementation of the projects that are identified herein. For example, CRW may proceed to reschedule and reprioritize various projects to balance the capital needs over the next several years. Furthermore, the estimates of probable

Consulting Engineer's Annual Report – Wastewater System

costs included in the CIP are preliminary and were developed based on prior reports completed by others for CRW, 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. It is recommended that CRW update its cost estimates and capital funding plans for these projects as additional information becomes available.

Consulting Engineer's Annual Report – Wastewater System

Table 5-1: Capital Improvement Plan

Location	Description	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
AWTF	Anerobic Digester Roof Repair, and Primary Digester Facilities	6,600,000.00	2,200,000.00	-	-	-
AWTF	WAS Thickening & Hauled Waste Improvements	-	-	-	-	-
AWTF	Cogeneration (CHP) Improvements	750,000.00	12,650,000.00	-	-	-
AWTF	Gravity Thickeners	-	-	-	-	-
AWTF	Acid Phase Digester & Secondary Digester Conversion	-	-	-	-	-
AWTF	Primary Clarifier Improvements and Repairs	500,000.00	4,000,000.00	3,500,000.00	-	-
AWTF	Dewatering Improvements - Design Phase	-	-	-	-	-
AWTF	Trucked-In Waste Receiving Station	-	-	-	-	-
Pump	Front Street Pump Station Improvements	10,000,000.00	4,000,000.00	-	-	-
Convey	Paxton Creek Interceptor Repairs	10,000,000.00	5,000,000.00	-	-	-
Convey	Front Street Interceptor Repairs	1,150,000.00	10,000,000.00	-	-	-
Convey	Spring Creek Interceptor Improvements	-	-	-	500,000.00	2,000,000.00
Convey	Arsenal Boulevard Sewer Improvements - Ph 1	-	2,341,855.00	-	-	-
Convey	Collection System Rehabilitation	3,000,000.00	3,000,000.00	4,000,000.00	4,000,000.00	5,000,000.00
Convey	Contracted Pipe Cleaning & CCTV	250,000.00	250,000.00	-	-	-
LTCP	Nine Minimum Controls Plan and Long-Term Control Plan	850,000.00	850,000.00	333,600.00	333,600.00	333,600.00
LTCP	Round 1 CSO Outfall Remediation	400,000.00	-	-	-	-
Misc	3rd St Multi-Modal GSI	777,758.00	-	-	-	-
Misc	Parks GSI	200,000.00	-	-	-	-
Misc	Camp Curtin Big Green Block GSI	2,258,237.50	-	-	-	-
Misc	MulDer Square GSI	500,000.00	500,000.00	-	-	-
Misc	South Allison Hill GSI	711,387.50	-	-	-	-
Misc	2nd St/7th St Multi-Modal GSI	500,000.00	1,000,000.00	-	-	-
Misc	Joint Pollutant Reduction Plan (MS4) Stream Restoration	377,200.00	377,200.00	377,200.00	377,200.00	377,200.00
Total		38,824,583.00	46,169,055.00	8,210,800.00	5,210,800.00	7,710,800.00

¹Project costs are presented in current year dollars.

²Cost estimate for the Spring Creek Interceptor includes rehabilitation costs only. If improvements are necessary to address capacity issues, the cost estimate may be understated.

³Collection System Rehab estimates subject to change based on ongoing asset management efforts, and do not include separate stormwater system rehab needs, which have not yet been quantified.

6 OPERATIONS AND MAINTENANCE EXPENSES REVIEW

6.1 Overview

The Trust Indenture (Section 7.12) requires CRW to adopt a Wastewater System budget each 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 amount of funds that should be expended to meet incremental O&M expenses. CRW must then establish a realistic funding and financing plan that serves to meet these goals, which may necessitate reprioritization of projects and programs.

6.2 Historical Wastewater System Expenses

A summary of CRW's historical actual O&M expenses for FY 2016 and FY 2017 and the budgeted O&M expenses for FY 2018 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 Wastewater System.

Table 6-1: Historical Wastewater System Expenses

Description	Historical		Budget
	FY 2016	FY 2017	FY 2018
O&M Expenses:			
Salaries and Wages	2,107,877	2,398,387	2,830,425
Benefits and Taxes	1,223,069	1,418,083	1,591,778
Contracted and Professional Services	1,569,952	754,402	849,875
Repairs, Maintenance, and Supplies	471,713	453,257	590,100
Electricity	870,284	998,942	755,945
Chemicals	518,070	433,307	446,992
Water	126,044	168,929	156,200
Refuse	437,322	560,626	608,763
Nutrient Credits	447,965	-	-
Insurance	471,068	418,096	443,778
Administrative Fee	2,564,486	2,756,757	3,127,864
Street Sweeping Services	287,248	488,247	692,083
Other Operating Expenses	222,027	243,303	167,449
Total Annual O&M Expenses	11,317,123	11,092,336	12,261,252

6.3 Additional Operations, Maintenance, and Repair Costs

Based on visual inspection and review of the existing CIP for the Wastewater System, several additional O&M expenses were identified for the proper maintenance, repair, and operation of the Wastewater System. These items are summarized in Table 6-2. In addition, until CRW gains several years of operating history associated with its new biological nutrient removal processes at the AWTF, operating costs associated with these facilities could differ from those included in CRW's budget.

Consulting Engineer's Annual Report – Wastewater System

Table 6-2: Additional O&M and Repair Costs

Category	Location	Description	Cost
Pump Station	Spring Creek	Replace drive chain on bar screen	\$ 4,000
Pump Station	Spring Creek	Replace missing railing section between screening enclosure and pump station	\$ 5,000
AWTF	n/a	Repair/Replace Non-Functioning First Floor Lighting in Settled Sewage Pump Station	\$ 1,000
AWTF	n/a	Replace Damaged Exterior Man Doors on Settled Sewage Pump Station	\$ 2,000
AWTF	n/a	Replace Bent Shaft on Chlorine Contact Tank Effluent Sluice Gate	\$ 5,000
AWTF	n/a	Repair Damaged Section of Handrail on Chlorine Contact Tank	\$ 2,000
Estimated Total Additional O&M Expenditure			\$ 19,000

7 CONCLUSIONS

Set forth below are the principal conclusions that have been reached regarding our review of the Wastewater System and associated information provided by CRW:

1. In 2017, the AWTF has operated within its hydraulic capacity with no hydraulic or BOD overloads recorded.
2. There were 28 secondary bypass events during 2017, where there was excess wastewater flow received at the secondary treatment train of the AWTF causing wastewater flow to bypass secondary treatment. These were due to wet weather and one power outage.
3. Based on Arcadis' field inspection, the AWTF was given a risk rating of 3.1, indicating that it is aged but generally in good operating condition and requiring capital investment within 5 years. However, in order to keep the AWTF in compliance with effluent limits and to reduce operating costs, rehabilitation work related to onsite CHP facilities, anaerobic digesters, and primary clarifiers should be completed.
4. With the exception of the Front Street and Spring Creek Pump Stations, all the other pump stations and the CSO regulators were also given a risk rating ranging from 2.0 to 2.3. The Front Street and Spring Creek Pump Stations were given risk ratings of 3.3 and 3.0, respectively, indicating that these facilities were aged or worn. The Front Street Pump Station is scheduled for reconstruction. CRW will continue to assess the Spring Creek Pump Station.
5. Overall the Wastewater System is in fair condition with a risk rating of 3.0. However, some components of the system are aged and will require capital investment to preserve the asset and maintain appropriate system performance.
6. CRW's capital plan is in general alignment with Arcadis' observed requirements for the Wastewater System. CRW generally has a good understanding of capital project needs and should prioritize projects based on urgency and affordability.
7. CRW should perform an evaluation of the adequacy of collection system rehabilitation (budgeted in the Rapid Assessment Report) as it advances its asset management program to assure that the level of service goals for the collection system are achieved.
8. An arc flash study is recommended for the wastewater system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. CRW intends to evaluate the need, scope, and budget for arc flash studies after completion of the improvement projects currently in the CIP.

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

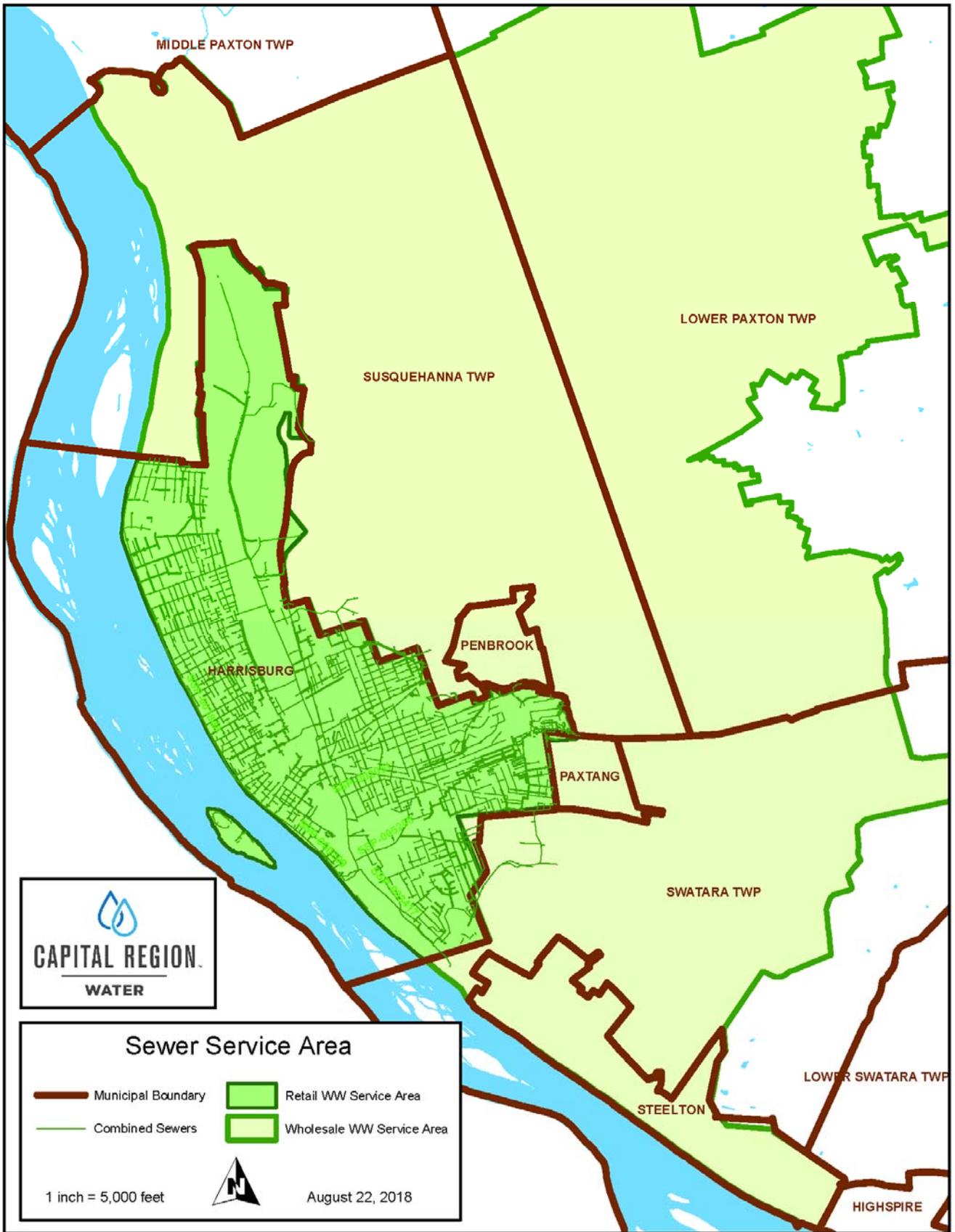
CEAR. To the best of our knowledge, information and belief, the information does not omit material facts necessary to make the statements herein. However, Arcadis has not independently verified the accuracy of the information provided by CRW and others. To the extent that the information is not accurate, 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

Wastewater System Service Area





Arcadis U.S., Inc.

1128 Walnut St.

Suite 400

Philadelphia, Pennsylvania 19107

Tel 215 625 0850

Fax 215 625 0172

www.arcadis.com

A decorative graphic consisting of three thin orange lines. One line is horizontal, extending across the width of the page. Two other lines are diagonal, starting from the bottom left and extending towards the top right, crossing the horizontal line.