City of
Alexandria

Sanitary Sewer Master Plan

Final Report

October 2021

CDM Smith

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ADF	average dry weather flow
AlexRenew	Alexandria Renew Enterprises
BFP	Backflow preventer
BSF	Base sanitary flow
the Bay	Chesapeake Bay
CCTV	Closed-circuit television
CDD	Coordinated Development District
cfu	colony forming unit
CIP	Capital Improvement Program
CIPP	cured-in-place pipe
CMOM	Capacity, Operations, Management, and Maintenance
CSS	combined sewer system
CSO	combined sewer overflow
CWA	Clean Water Act
EAP	Environmental Action Plan
E. Coli	Escherichia coli
EPA	Environmental Protection Agency
ERU	Equivalent residential units
FCWA	Fairfax County Water Authority
FEMA	Federal Emergency Management Agency
FOG	fats, oils, and grease
FSE	food service establishment
FY	fiscal year
gpd	gallons per day
GIS	geographic information system

GWI	groundwater infiltration
HGL	hydraulic grade line
HRS	Holmes Run Sewer
I/I	infiltration and inflow
LTCPU	Long-Term Control Plan Update
mgd	million gallons per day
MS4	municipal separate storm sewer system
MSA	metropolitan statistical area
MWCOG	Metropolitan Washington Council of Governments
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
P&Z	Planning and Zoning
PWS	Public Works Services
PYTS	Potomac Yard Trunk Sewer
RDII	rainfall induced inflow and infiltration
SANUP	State-of-the-Art Nitrogen Upgrade Program
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SSO	Sanitary Sewer Overflow
T&ES	Transportation and Environmental Services
TMDL	Total maximum daily load
TO	task order
VAWC	Virginia American Water Company
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollutant Discharge Elimination System

WIP	Watershed Implementation Plan
WLA	Wasteload allocations
WPCP	Water Pollution Control Plant
WQS	water quality standard
WRRF	Water Resource Recovery Facility
WSP	Water Supply Plan
WWTP	wastewater treatment plant

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Executive Summary

The purpose of this Sanitary Sewer Master Plan is to provide the City of Alexandria (City) and its decision-makers with a plan to address future projected wastewater flows, identify when and where infrastructure upgrades or improvements will be needed to accommodate growth, and continue to serve the wastewater needs of residents and businesses by effectively operating and maintaining the sewer system. This Sanitary Sewer Master Plan also addresses regulatory drivers related to sanitary sewers, such as the 2017 combined sewer overflow (CSO) legislation (2017 CSO Law). Finally, this Sanitary Sewer Master Plan includes a review of sanitary sewer fees, including sewer user fees (on monthly sewer bills) and connection fees as part of redevelopment, and provides fee change recommendations.

Sanitary Sewer Capacity Needs

This Sanitary Sewer Master Plan uses the growth forecasts through 2045 and post-2045 (build-out conditions) to analyze the following:

- Hydraulic capacity of the City's collector (local) sanitary sewers
- Hydraulic capacity of the Alexandria Renew Enterprises (AlexRenew) interceptor sewers
- Treatment plant capacity at both the AlexRenew Water Resource Recovery Facility (WRRF) and the Arlington County Water Pollution Control Plant (Arlington WPCP)

The results of these analyses indicate additional needs related to sanitary sewer collection system capacity, treatment plant capacity, and wet weather capacity:

- A total of 12,000 feet of sanitary sewer have been identified with capacity deficiencies in the City's collection system based on current system flows and another 4,000 feet of sanitary sewer will have capacity exceedances based on future growth. The City is identifying projects to alleviate sewer capacity deficiencies, which will be incorporated into the City's Capital Improvement Program (CIP) as part of a future CIP. Capacity projects required for growth needs will be a requirement of future development in accordance with the City's current policies and requirements. See Chapter 6 of this Sanitary Sewer Master Plan for more information.
- Capacity improvements are required in both the AlexRenew Holmes Run Trunk Sewer and Potomac Yard Trunk Sewer to serve future growth. The City continues to work with AlexRenew to determine timing of future capacity improvements in these sewers. Because the Holmes Run Trunk Sewer is a joint-use sewer between the City and Fairfax County, the cost of capacity improvements will be shared. Cost-sharing discussions are currently underway between the City, Fairfax County, and AlexRenew. The current CIP identifies the need to upgrade the Holmes Run Trunk Sewer, but the amount of funding to be programmed is not yet provided since cost share discussions are ongoing. The timing for capacity improvements for the Potomac Yard Trunk Sewer is not anticipated in the next 10 years; hence, it is not currently in the CIP. See Chapter 8 of this Sanitary Sewer Master Plan for more information.
- The City will have sufficient capacity at the Arlington WPCP based on current growth forecasts and its existing allocation of 3.0 million gallons per day

(mgd). See Chapter 7 of this Sanitary Sewer Master Plan for more information.

- The City will exceed its annual average allocation of 21.6 mgd at the AlexRenew WRRF between 2040 and 2045. Based on growth projections, an additional 4 mgd will be needed to meet the wastewater demand for build-out conditions. Alternatives to meet this need include modifications and upgrades at the AlexRenew WRRF, purchase of capacity from Fairfax County, or a combination of the two alternatives, along with various other smaller-scale measures to reduce wastewater flows (e.g., infiltration and inflow reduction). Following the completion of the RiverRenew Program and once the RiverRenew infrastructure is operational, AlexRenew will conduct a feasibility study of expanding their WRRF by 4 mgd. The feasibility study will be programmed as part of the upcoming fiscal year (FY) 2023 CIP. See Chapter 7 of this Sanitary Sewer Master Plan for more information.

Sanitary Sewer Asset Management and Maintenance

In addition to the impacts of growth on the sewer system, effectively operating and maintaining existing sewer assets is crucial. Additionally, effective operations and maintenance can help to minimize addressing sanitary sewer backups that occur because of extreme wet weather events is an important priority, especially in the face of climate change. Several projects and initiatives have been funded in the CIP, and are discussed in more detail in Chapter 4 of this Sanitary Sewer Master Plan, to reduce the potential for sanitary sewer backups:

- The City's backflow preventer (BFP) assistance program reimburses residents 50 percent of the cost of installing a BFP device, up to a maximum of $2,000.
- $36 million has been programmed in the FY 2022 to 2031 CIP for sanitary sewer system assessment and rehabilitation, which will help reduce the amount of infiltration and inflow (I/I) in the separate sanitary sewer system.
- Several hundred manhole inserts that were installed in the mid-2000s will be replaced to prevent stormwater runoff from entering the sanitary sewer in the Four Mile Run and Commonwealth sewersheds (areas more prone to sewer backups).
- The City has begun identifying sanitary sewers that can be upsized to reduce the number of and severity of sanitary sewer backups. Initial sewer upsizing projects will move to detailed design in 2022 and funding for construction will be proposed in the FY 2023 CIP.
- Sewer backups will be identified in the combined sewer area that could be mitigated by separating small sections of sanitary sewer (where backups occurred) from the combined system and connecting to a separate sanitary sewer. Sewer separation projects will be funded as part of a future CIP.
- The framework for a private I/I reduction program for disconnecting private stormwater sources (e.g., downspouts, sump pumps, basement area drains) into the sanitary sewer will be developed.
- A fats, oils and grease (FOG) program will continue to be implemented to minimize the amount of FOG entering sanitary sewers, which can take up valuable capacity.

- Two engineering positions were added in the FY 2022 budget to assist with the implementation of the above-mentioned programs.

Sanitary Sewer Fees

Chapter 10 of the Sanitary Sewer Master Plan update provides a review of the existing CIP, presents a summary of which programs are funded, and identifies areas where additional funding may be required in future years. It also presents an overview of the existing sewer user fees and connection fees and provides specific recommendations for updating these fees. The following fee changes are recommended:

- Change the sewer user fee billing basis from monthly water usage to the winter quarter consumption to more accurately reflect water that reaches the sewer system and to be on the same basis as the AlexRenew wastewater treatment billing.
- Increase the connection fee teardown credit for redevelopment from 50 to 100 percent.
- Establish senior living facilities as their own use and set the connection fee to 75 percent of the single-family fee.
- Use the equivalent residential unit (ERU) methodology to establish the nonresidential sewer connection fees.

Changes to the above fees can only be done through an update to the City's ordinance. Following approval of the Sanitary Sewer Master Plan, City staff will bring the required ordinance changes to City Council for approval.

Outreach

After the draft of this Sanitary Sewer Master Plan update is released, the City will begin an outreach period to solicit input and feedback before finalizing and submitting the plan to the Planning Commission and City Council. The following types of outreach are planned:

- Public meetings that are open to all City residents
- Presentations to neighborhood civic and citizen associations
- Presentation to the development community
- Presentation to the City's Environmental Policy Commission
- Presentation to the City's Ad Hoc Stormwater Utility and Flood Mitigation Advisory Group

The draft of the plan will be announced through the City's eNews and shared on social media. Feedback on the draft plan can also be made in writing and the draft plan will be posted on the City's website.

Schedule

This Sanitary Sewer Master Plan is an update to the first City Sanitary Sewer Master Plan, which was approved in 2013. This plan will be updated periodically as growth forecasts change and to reflect changes in both state and federal regulations related to sewage collection and treatment and water quality. Updates to this Sanitary Sewer Master Plan are anticipated approximately every 5 to 10 years.

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Chapter 1
Introduction

1.1 Background

The City of Alexandria (City) is an independent city in the Commonwealth of Virginia located approximately 6 miles south of Washington, DC, and comprises 15.5 square miles, as shown on Figures 1-1 and 1-2. As an independent city, Alexandria derives its governing authority from the Virginia General Assembly. The City has adopted a council-manager form of government where the city manager is responsible for overseeing the City's administration and departments.

1.2 One Water: Eco-City Alexandria Clean Waterways

Water is essential for human life and has significant impacts on the economy and well-being of a community. This is especially true for the City of Alexandria, which has a deep history as a river town and port on the Potomac River. This connection to the river has made managing water resources wisely and sustainably in our densely urban community both vital and challenging. The City has embraced a "One Water" approach that integrates management of safe drinking water, stormwater, and wastewater resources to benefit the community.

Water from the Potomac River or Occoquan Reservoir is treated by Fairfax County Water Authority (FCWA). Following treatment, Virginia American Water purchases the water from FCWA and then sells and distributes the water to the City's residents and businesses.

Wastewater from residents and businesses is collected through a City-owned and maintained sanitary collection system, which comprises approximately 240 miles of both sanitary and combined sewers. Most of the sewers are less than 12 inches in diameter with the smallest sewer being 6-inch diameter. The largest sewer serving the City is a 7-foot by 6-foot box culvert. The age of the sewer system varies, with the oldest sewers dating back to the 1800s and sewers being built to serve new development.

Flow from the City's collector sewers are primarily conveyed to the Alexandria Renew Enterprises (AlexRenew) Water Resource Recovery Facility (WRRF). A smaller portion of the City's flow is conveyed to the Arlington County Water Pollution Control Plant (WPCP) for treatment to a very high standard before discharging it to local waterways or beneficially reused. Flow from the City's collection system is conveyed to the AlexRenew WRRF through one of four AlexRenew interceptor sewers. AlexRenew was established in 1952 by the Alexandria City Council for the purpose of constructing, operating, and maintaining a sewage disposal system to serve Alexandria and portions of Fairfax County. The City currently is allocated 40 percent of AlexRenew's treatment capacity, or 21.6 million gallons per day (mgd). The City's allocated treatment capacity at the Arlington WPCP is 3.0 mgd.

Most of the City's stormwater inlets drain into local waterways that eventually flow into the Potomac River and Chesapeake Bay, except for those in the oldest part of the City that drain into the combined sewer system (CSS) and are treated at AlexRenew. The City owns and maintains a separate stormwater system, which is comprised of over 185 miles of storm sewers. More information about the separate storm sewer system and stormwater management in the City can be found at https://www.alexandriava.gov/Stormwater.

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Figure 1-1: Regional Map

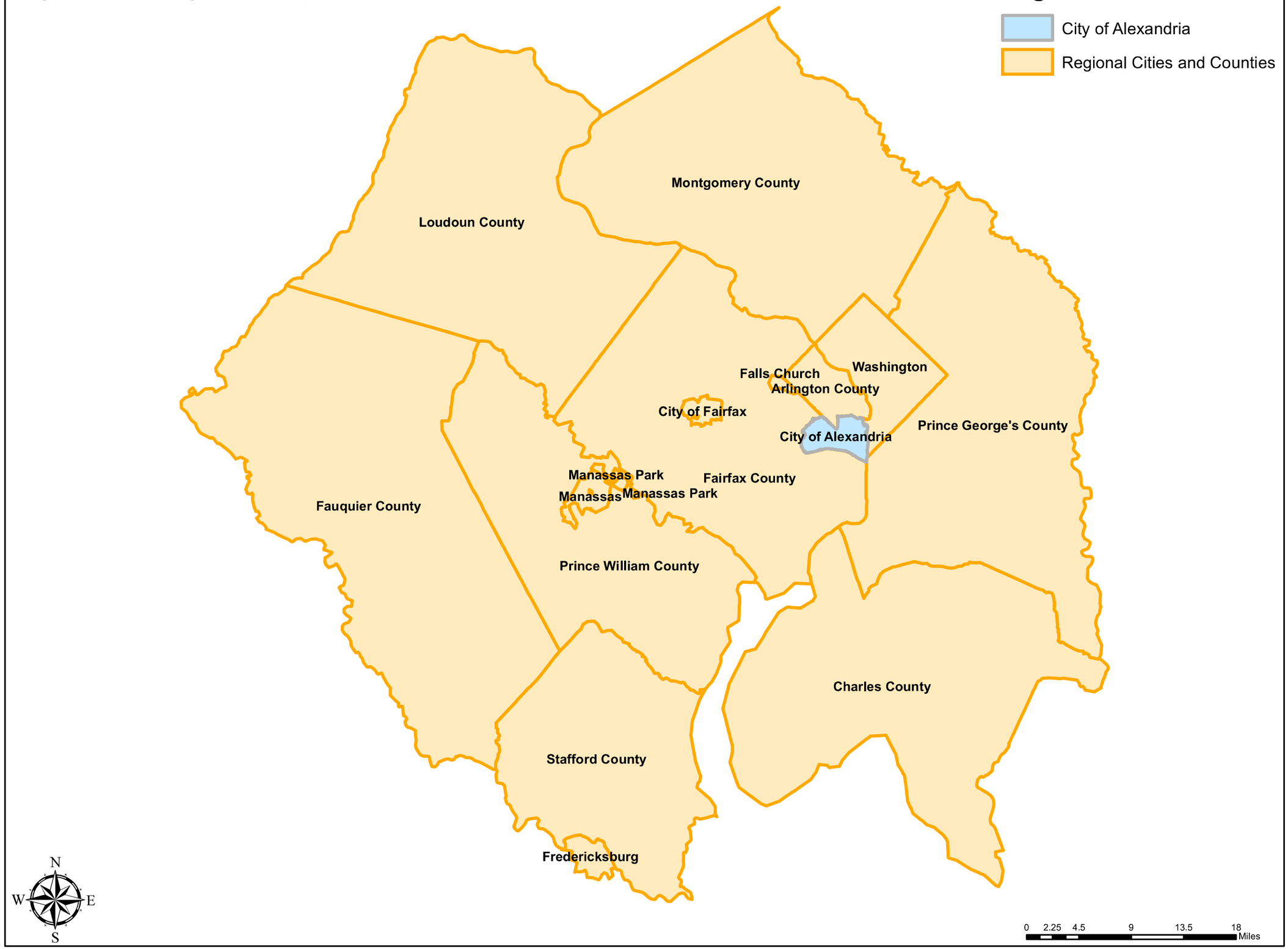

Figure 1-2: City of Alexandria Boundary Map

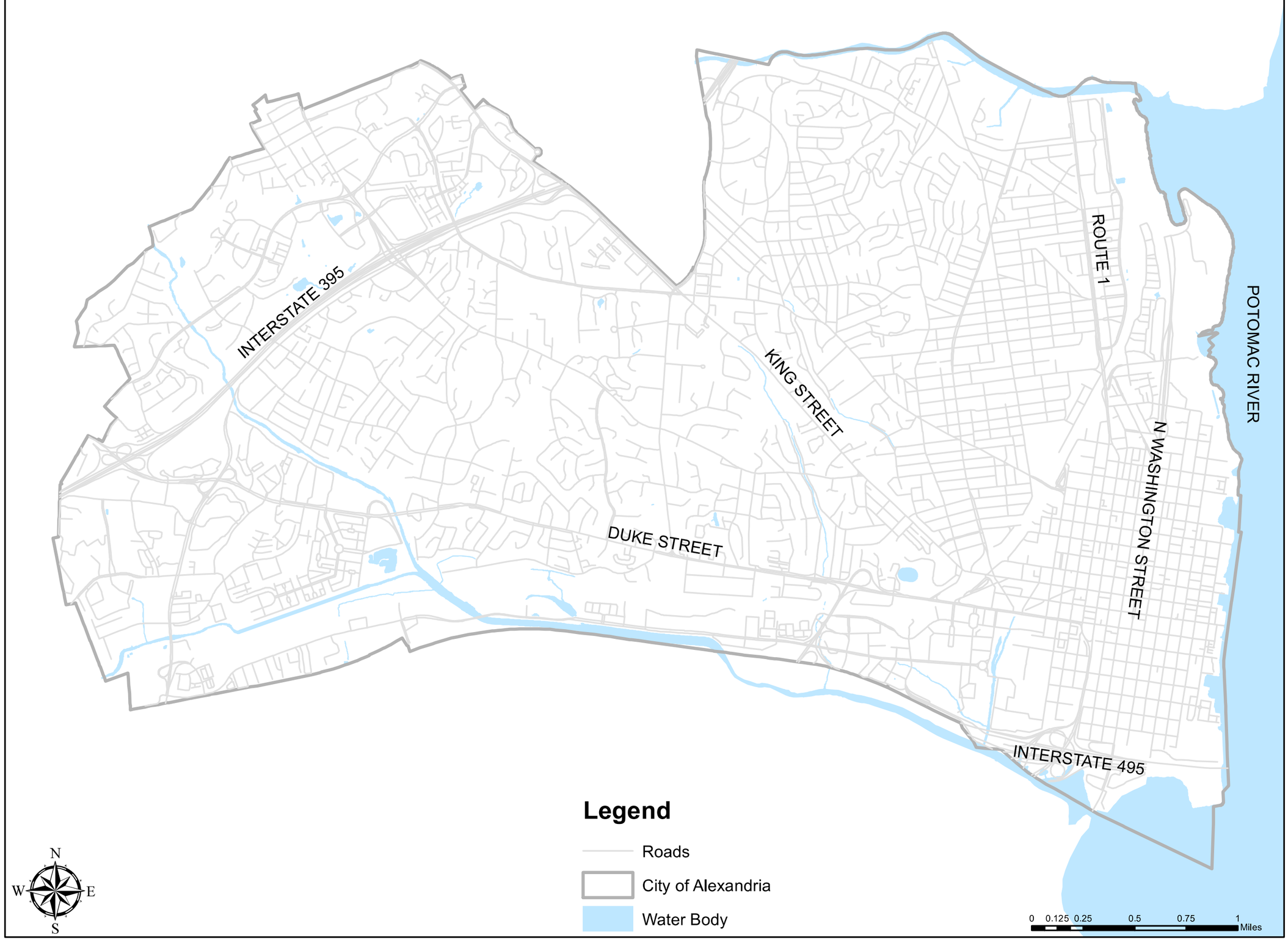

Figure 1-3 shows the relationship between the three "One Water" parties in Alexandria with respect to drinking water, sewage collection, and wastewater treatment.

Protection of the City's water resources is heavily governed by local ordinance as well as state and federal regulations. The City has prioritized the protection of its water resources, recognizing them as a fundamental element of the quality of life in the community and an integral part of the City's thriving economy.

As the City grows and becomes increasingly more densely populated, well thought-out planning for development activities and infrastructure improvements has become critically important. Through forward thinking and planning, the City protects and enhances its existing water resources, reduces water use, beneficially reuses wastewater, and mitigates flooding instances to protect property. Through outreach, education, and the enhancement of opportunities for water-related recreation and water use reduction actions, the City connects people to its waterways and the importance of their protection. Ultimately, the City strives to see its waters once again become fishable and swimmable.

The "One Water" partnership between the City, AlexRenew, and Virginia American Water was established to educate the community and lessen confusion among shared customers. The partnership is comprised of eight individuals between the three entities and meets regularly. The partnership's campaign efforts feature educational videos, a joint presence at school events and Earth Day, cosponsoring the annual Water Discovery Day, a creative logo and collateral materials, social media collaboration, water lesson development for third and sixth graders in Alexandria public schools, and more.

More information about the three One Water entities and regulations can be found in the City's One Water Supplement located in this Sanitary Sewer Master Plan.

Figure 1-3: One Water – Drinking Water, Sanitary Sewer Collection, and Treatment

1.3 Purpose

The City's Transportation and Environmental Services (T&ES) Department is responsible for providing and maintaining various forms of infrastructure for residents, businesses, and visitors, including the operation, maintenance, and capital planning of its sanitary sewer system, which is comprised of over 240 miles of sanitary and combined sewers.

Alexandria has experienced considerable growth in terms of the increased number of residents, employees, businesses, and government and nonprofit organizations in the City. The City is expected to continue to grow well into the future, which will impact the City's existing infrastructure. One aspect of growth is increased wastewater generation, which results in increased wastewater flow

into the sanitary sewer system and at wastewater treatment facilities.

The City developed its first Sanitary Sewer Master Plan, which was adopted as a chapter to the City's Master Plan, in February 2013. This Sanitary Sewer Master Plan serves as an update to that plan. The purpose of this Sanitary Sewer Master Plan is to provide the City and its decision-makers with a plan to address future projected wastewater flows, identify when and where infrastructure upgrades or improvements will be needed to accommodate growth, and continue to serve the wastewater needs of residents and businesses.

1.4 Sanitary Sewer Master Plan Objective

This Sanitary Sewer Master Plan serves multiple objectives, including:

Sanitary Sewer Master Plan Objectives
Provide a detailed description of the existing sanitary sewer system, including identifying sewersheds, how wastewater in the collection system is conveyed, and how much wastewater flow is being sent to wastewater treatment plants.
Summarize the regulatory drivers that impact wastewater collection, conveyance, and treatment.
Summarize existing programs and milestones related to the operation and maintenance of the sanitary sewer system, along with providing a roadmap for how the City is addressing sanitary sewer impacts from climate change and flooding;
Summarize anticipated growth through 2045 and post-2045 (build-out) using demand generators provided by the City's Department of Planning and Zoning.
Perform capacity assessment of sanitary sewers in the City-owned sanitary sewer collection system and the AlexRenew interceptor sewers. Identify the need for and timing of capacity upgrades required to serve future growth.
Perform an analysis of wastewater treatment capacity at both the AlexRenew WRRF and the Arlington WPCP and determine additional treatment needs and timing of needs in terms of both wastewater flows and loads.
Discuss the City's combined sewer system and RiverRenew Program for mitigating combined sewer overflows, including anticipated schedule and costs.
Review and evaluate the City's sanitary sewer revenue sources and develop a financial model and funding plan available to implement systemwide recommended improvements.

1.5 Sanitary Sewer Master Plan Organization

The remainder of this plan is organized into the following chapters that meet the identified objectives:

Chapter 2 – Sanitary Sewer System Overview

Chapter 3 – Regulatory Drivers

Chapter 4 – System Maintenance, Capital Planning, and Asset Management

Chapter 5 – Growth Forecasts

Chapter 6 – Collection System Capacity Assessment

Chapter 7 – Treatment Plant Capacity Assessment

Chapter 8 – Interceptor Sewer Capacity Assessment

Chapter 9 – RiverRenew

Chapter 10 – Sanitary Sewer Funding Evaluation

Chapter 11 – One Water Infrastructure

Chapter 2
Sanitary Sewer System Overview

2.1 Introduction

Alexandria's sewer collection system dates to the 1800s, when the City constructed a system of combined sewers in the Old Town historic district to convey stormwater and wastewater to the Potomac River. This was typical of municipalities during this time throughout the country. Since then, the City's sewer collection system has expanded to over 240 miles of sewers serving the entirety of the City. Flows in the City's sewer system are conveyed to one of two wastewater treatment facilities, as discussed in this section. This chapter presents an overview of the City's sewer collection system, wastewater treatment facilities that serve the City, and other sewer infrastructure in the City.

2.2 Wastewater Treatment Service Areas

In 1952, the Alexandria City Council created the City of Alexandria, Virginia Sanitation Authority, now known as Alexandria Renew Enterprises (AlexRenew), to construct, operate, and maintain a sewage disposal system to serve Alexandria and portions of Fairfax County. AlexRenew is a public body independent of the City government (both administratively and financially) and AlexRenew's operations are overseen by a Board of Directors (AlexRenew Board). The AlexRenew Board consists of five citizen members who are appointed to 4-year staggered terms by the City Council. The AlexRenew Board hires its own staff, establishes its own operating policies, and adopts the schedule of rate fees and charges paid by the users of the system.

The first AlexRenew wastewater treatment plant (WWTP) went into service in 1956 and was an 18-million-gallons-per-day (mgd) trickling filter plant. During that time, three trunk sewers and two pumping stations were constructed to convey wastewater from City collector sewers to the WWTP. Since the initial construction of the WWTP, several upgrades have been performed, including expansion to a 54-mgd annual average design capacity and peak capacity of 108 mgd. A fourth trunk sewer and associated third pump station were constructed in 2002 to serve the Potomac Yard neighborhood.

In 2015, AlexRenew completed the State-of-the-Art Nitrogen Upgrade Program (SANUP) to meet some of the most stringent nutrient permit limits in the Country. Additional upgrades during this time included the installation of water reclamation capabilities. Reclaimed water from treated effluent at AlexRenew is used as part of the plant operations and has the potential to be conveyed to additional sites for irrigation or other non-potable uses.

Most of the City's wastewater flows are treated at the AlexRenew Water Resources Recovery Facility (WRRF). A small portion of the City's wastewater flows are conveyed by gravity into Arlington County and are treated at the Arlington County Water Pollution Control Plant (WPCP), as shown on Figure 2-1. Currently, the City has wastewater flow allocation agreements with AlexRenew and Arlington County based on an annual average flow of 21.6 and 3.0 mgd, respectively, as established via existing sewer agreements. These agreements are discussed further in Section 2.6.

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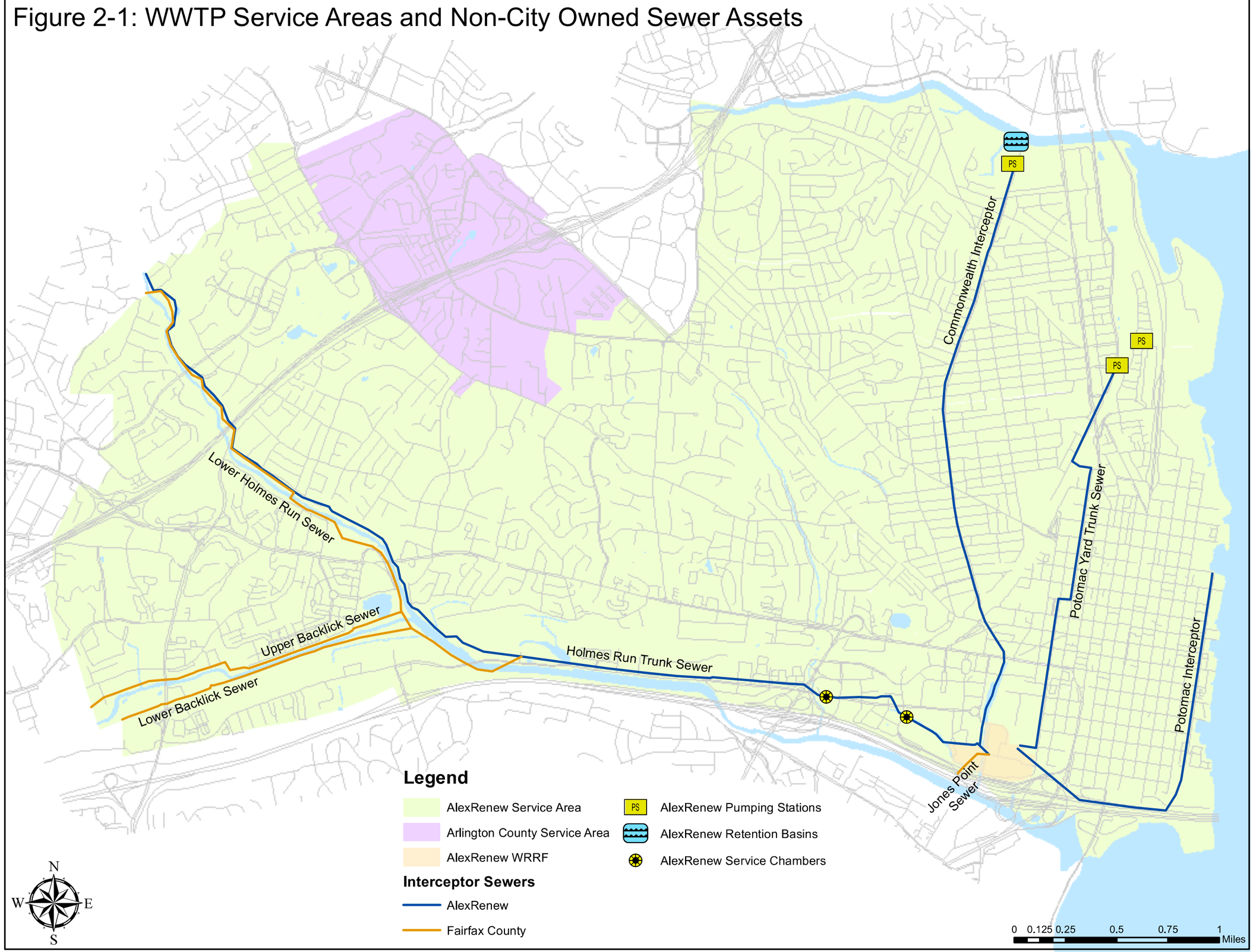
Figure 2-1: WWTP Service Areas and Non-City Owned Sewer Assets



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2.3 Trunk Sewers and Pumping Stations

As discussed in the previous section, AlexRenew owns and operates four large interceptor sewers, several pumping stations, and service chambers within the City. The interceptor sewers collect flows from the smaller City-owned sanitary collector sewers and convey them to the AlexRenew WRRF. Where gravity flow is not possible, these pumping stations and service chambers help convey flow to the City-owned sewers, the AlexRenew interceptor sewers, and the WRRF.

In addition, Fairfax County owns three interceptor sewers in the southwest portion of the City. This area of the City was annexed from Fairfax County in 1951. These three Fairfax interceptor sewers include both City and Fairfax County flows. The Fairfax County interceptor sewers all discharge into the AlexRenew Holmes Run Trunk Sewer, which is a joint-use sewer between Fairfax County and the City.

Figure 2-1 shows the locations of the interceptor sewers, pumping stations, and other non-City-owned sewer facilities. Tables 2-1 and 2-2 list the interceptor sewers for AlexRenew and Fairfax County, respectively. Table 2-3 documents the pumping stations and service chambers located in the City.

As part of the City's Sewer Service Agreement with AlexRenew, the City has allocated peak flow rates (in mgd) in each of the interceptor sewers. The City does not have a current service agreement with Fairfax County with respect to discharging into County maintained interceptor sewers. The City and Fairfax County are planning to initiate discussions to develop a formalized agreement that addresses City's flows into County-maintained interceptor sewers.

Table 2-1: AlexRenew Interceptor Sewers

Interceptor Name	Length (linear feet)	Sewer Diameter (inches)[1]	City Peak Flow Limit (mgd)[2]
Commonwealth Interceptor	15,700	36–42	30.4
Holmes Run Trunk Sewer[3]	28,100	60	28.4
Potomac Interceptor	10,600	42	17.7
Potomac Yard Trunk Sewer	14,200	30	17.3

[1]Sewer diameter varies throughout the length of pipe; reported diameter is basis for capacity
[2]Peak flow limit as reported in *Amended and Restated Service Agreement* between City and AlexRenew dated June 2018
[3]Joint-use sewer with Fairfax County

Table 2-2: Fairfax County Interceptor Sewers

Interceptor Name	Length (linear feet)	Sewer Diameter (inches)
Lower Holmes Run Sewer	15,600	30-60
Upper Backlick Sewer	8,600	36-48
Lower Backlick Sewer	7,900	16-33

Table 2-3: AlexRenew Pump Stations (PS) and Service Chambers (SC)

Pump Station Name	Firm Capacity* (mgd)	On-site Storage Size (million gallons)
Four Mile Run PS	9.4	1.05
Potomac Yard PS	10.5	N/A
Slaters Lane PS	0.75	N/A
Bush Hill SC	0.43	N/A
Mill Road SC	0.53	N/A

*Firm capacity = Rate that can reliably be pumped if the largest installed pump is not available because of failure or maintenance

2.4 Types of Sanitary Sewer Systems

There are two types of sanitary sewer systems in the City—a separate sewer system and a combined sewer system (CSS). Separate sewer systems consist of two pipes. One pipe conveys stormwater runoff from storm drains

to local waterways. The other pipe conveys sanitary sewage to the wastewater treatment facility. A CSS conveys both sanitary sewage and stormwater within a single pipe. Approximately 540 acres in the Old Town area of the City are served by a combined sewer system. During dry weather, all sanitary sewage flows to the AlexRenew WRRF. When it rains (wet weather), stormwater runoff and sanitary sewage are mixed together and conveyed to the AlexRenew WRRF. Once the capacity of the CSS is exceeded because of the amount of stormwater entering it, this mixture (which is typically 90 percent stormwater runoff) overflows into local waterways through one of four permitted combined sewer outfalls. CSSs are common in older cities, with over 800 CSSs nationwide.

Figure 2-2 illustrates the differences in how flows are conveyed between sanitary and CSSs. The City's CSS and combined sewer overflow (CSO) locations are shown on Figure 2-3. As shown in the figure, the City's CSS is divided into three service areas. Table 2-4 provides information about each of the four CSS outfalls in the CSS.

Table 2-4: Summary of CSS Outfalls

CSO Outfall No.	CSS Subshed Name	CSS Subshed Area (acres)	Receiving Waterbody
CSO 001 (Pendleton)	Pendleton	225	Oronoco Bay
CSO 002 (Royal)	Royal	195	Hunting Creek Embayment
CSO 003 (Duke)	King & West	120	Hooffs Run
CSO 004 (Hooffs)	King & West	120	Hooffs Run

CSO discharges are permitted by the Virginia Department of Environmental Quality (VDEQ) under the Virginia Pollutant Discharge Elimination System (VPDES) program. Prior to July 1, 2018, the City owned and operated the combined sewer outfalls under VPDES permit no. VA0087068 issued by VDEQ. On July 1, 2018, ownership of the four CSO outfalls located in the City was transferred to AlexRenew. These outfall structures remain permitted under VPDES permit no. VA0087068. The City still owns and operates the collector sewers located in the CSS. More information about the CSS, applicable regulatory requirements, and future CSO infrastructure planning are provided in Chapters 3 and 9 of this Sanitary Sewer Master Plan.

2.5 City-Owned Sanitary Sewer Collection System

The existing City-owned sanitary sewer collection system covers approximately 15.5 square miles and can be divided based on which AlexRenew interceptor sewer the wastewater flows are conveyed to, with the exception of flows that are conveyed to the Arlington County WPCP. Each of these sewersheds is shown on Figure 2-4. Information pertaining to each sewershed is presented on Table 2-5.

Table 2-5: City Sewershed Summary

Sewershed(s)	Area (square miles)	Miles of Sewer	Interceptor/ Trunk Sewer	Pump Station(s)
Holmes Run	7.39	96	Holmes Run Trunk Sewer	N/A
Commonwealth Four Mile Run King/West CSO	4.41	90	Commonwealth Interceptor	Four Mile Run
Potomac Pendleton CSO Royal CSO	1.94	40	Potomac Interceptor	N/A
Potomac Yard	0.41	4	Potomac Yard Trunk Sewer	Slater's Lane Potomac Yard
Arlington County WPCP	1.18	16	N/A	N/A

Figure 2-2: Sanitary and Combined Sewer Systems

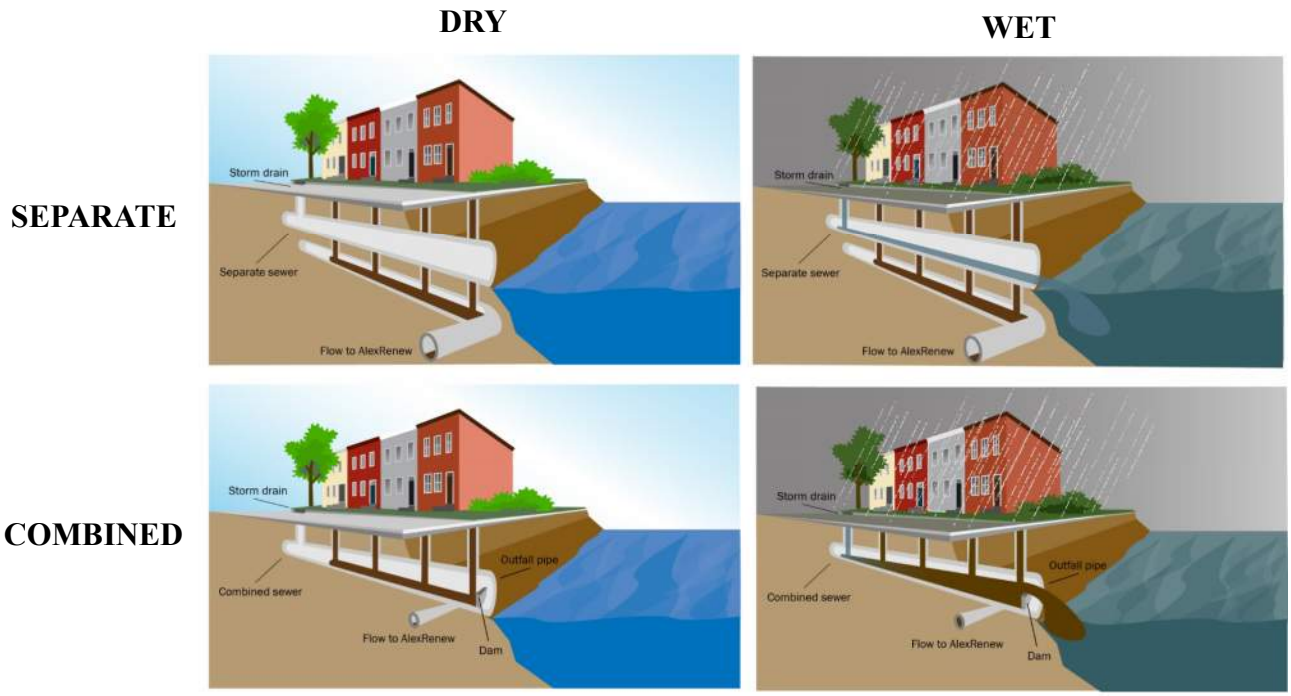

Figure 2-3: Combined Sewer System And Outfalls

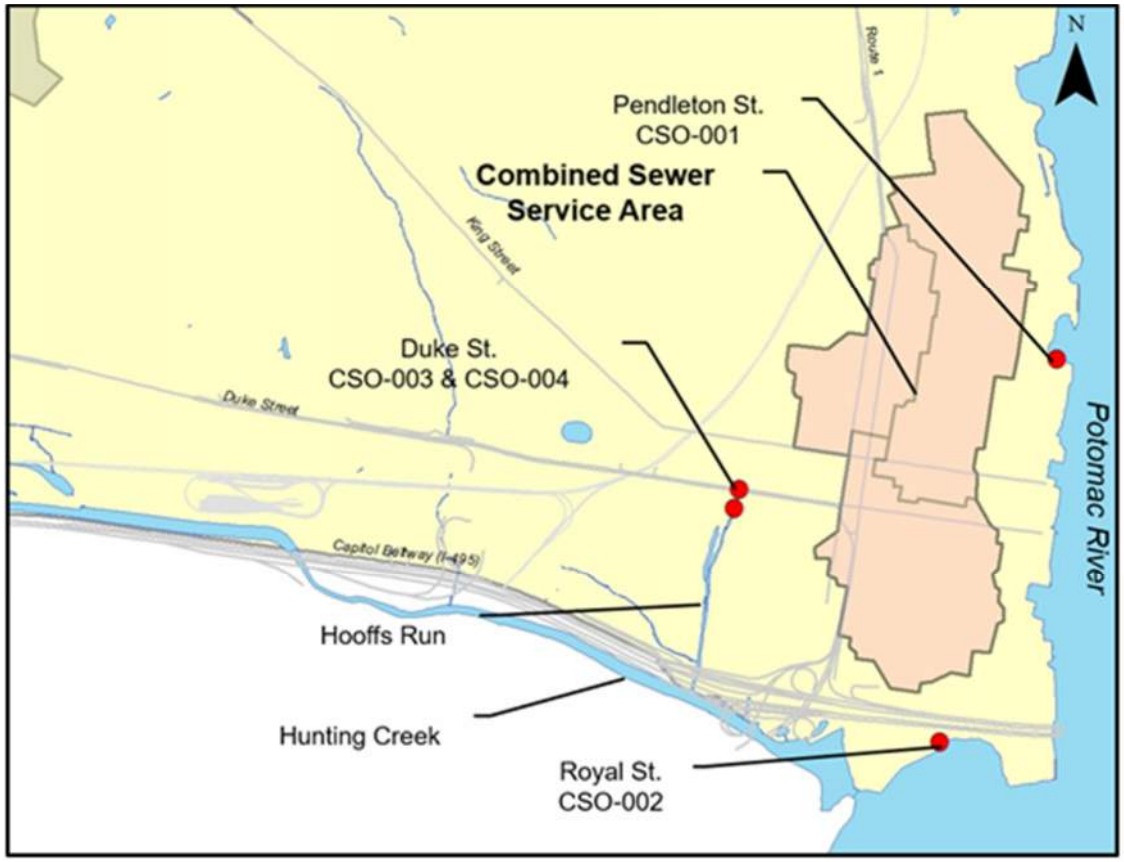

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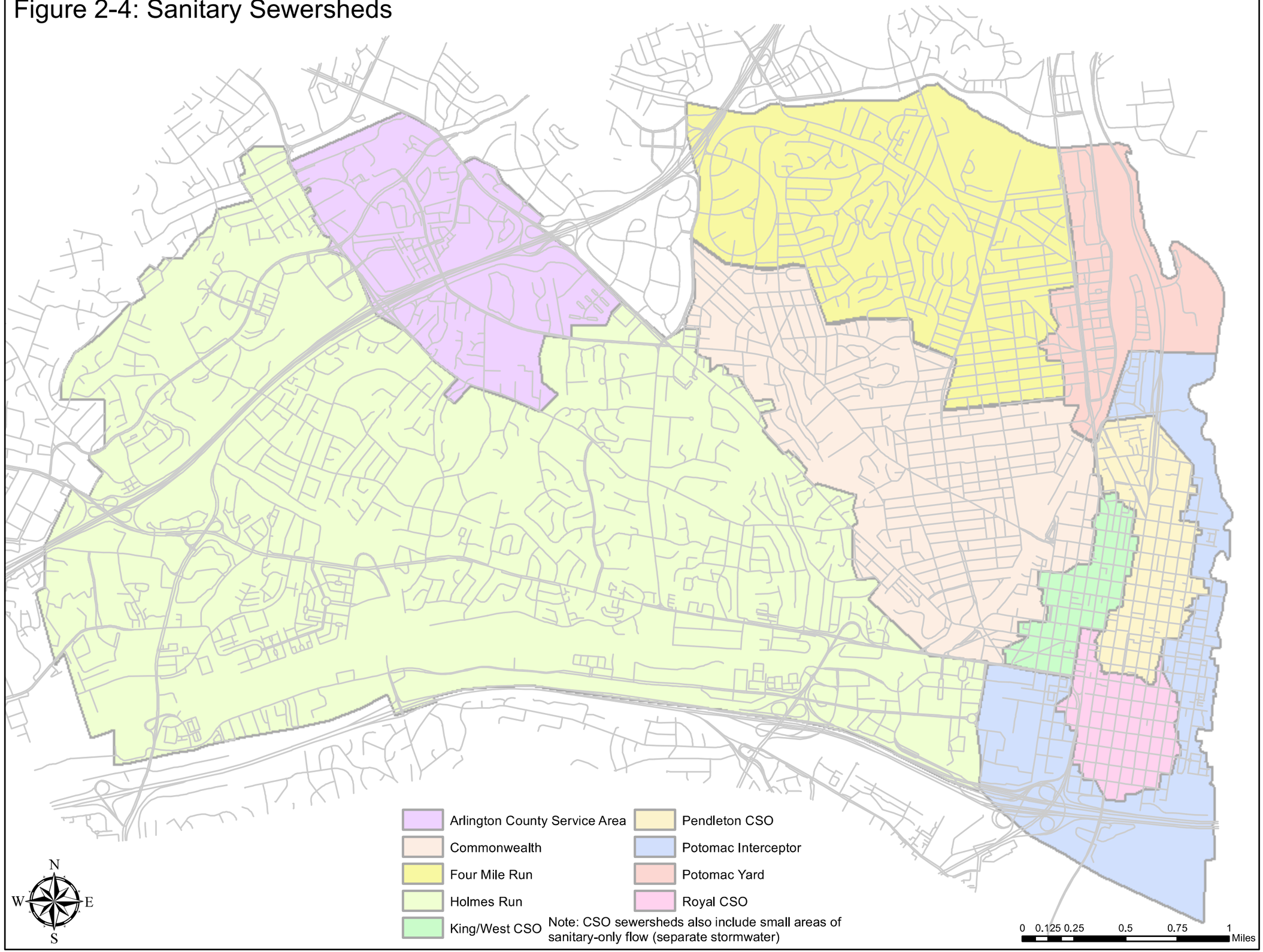
Figure 2-4: Sanitary Sewersheds



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The sanitary and combined collector sewers are operated and maintained by the City's Department of Transportation and Environmental Services (T&ES). The sanitary collector sewers are highlighted on Figure 2-5 and consist of approximately 240 miles of pipeline, ranging in size from 6 inches in diameter to a 6-foot by 7-foot box culvert, and 7,800 manholes. Most of the collection sewers are less than 12 inches in diameter.

Tables 2-6 and 2-7 summarize the sanitary collector sewer length based on pipe diameter and pipe material, respectively. These tables use sanitary sewer system data from the City's geographic information system (GIS), which is updated continuously to reflect new development or redevelopment data collected through field investigations or from as-built plans from City projects. The gravity collector sewers are mostly constructed of reinforced concrete pipe (RCP), ductile iron pipe (DIP), vitrified clay pipe (VCP), or polyvinyl chloride pipe (PVC). Approximately one quarter of the sanitary sewer collection system has been rehabilitated using cured-in-place pipe (CIPP) as part of the City's infiltration and inflow (I/I) program.

Table 2-6: Summary of Sanitary Collector Sewers Based on Pipe Diameter

Pipe Diameter (inches)	Total Length (linear feet)	Percent of Total System (%)
6	4,460	0.3
8	163,235	12.5
10	836,075	63.9
12	121,215	9.3
15–24	138,535	10.6
27–48	10,345	0.8
>48	2,840	0.2
Box/Elliptical/Arch (width/height vary)	11,530	0.9
Unknown or Not Specified	19,190	1.5

Note: Does not include AlexRenew or Fairfax County interceptor/trunk sewers

Table 2-7: Summary of Sanitary Collector Sewers Based on Pipe Material

Pipe Material	Total Length (linear feet)	Percent of Total System (%)
Concrete (RCP or Other)	819,970	62.7
PVC	209,635	16.0
VCP	133,360	10.2
DIP	57,390	4.4
Other/Not Specified/Unknown	87,345	6.7

Note: Does not include AlexRenew or Fairfax County interceptor/trunk sewers

Information about existing City programs related to the operation and maintenance of the City-owned collector sewers is provided in Chapter 4 of this Sanitary Sewer Master Plan.

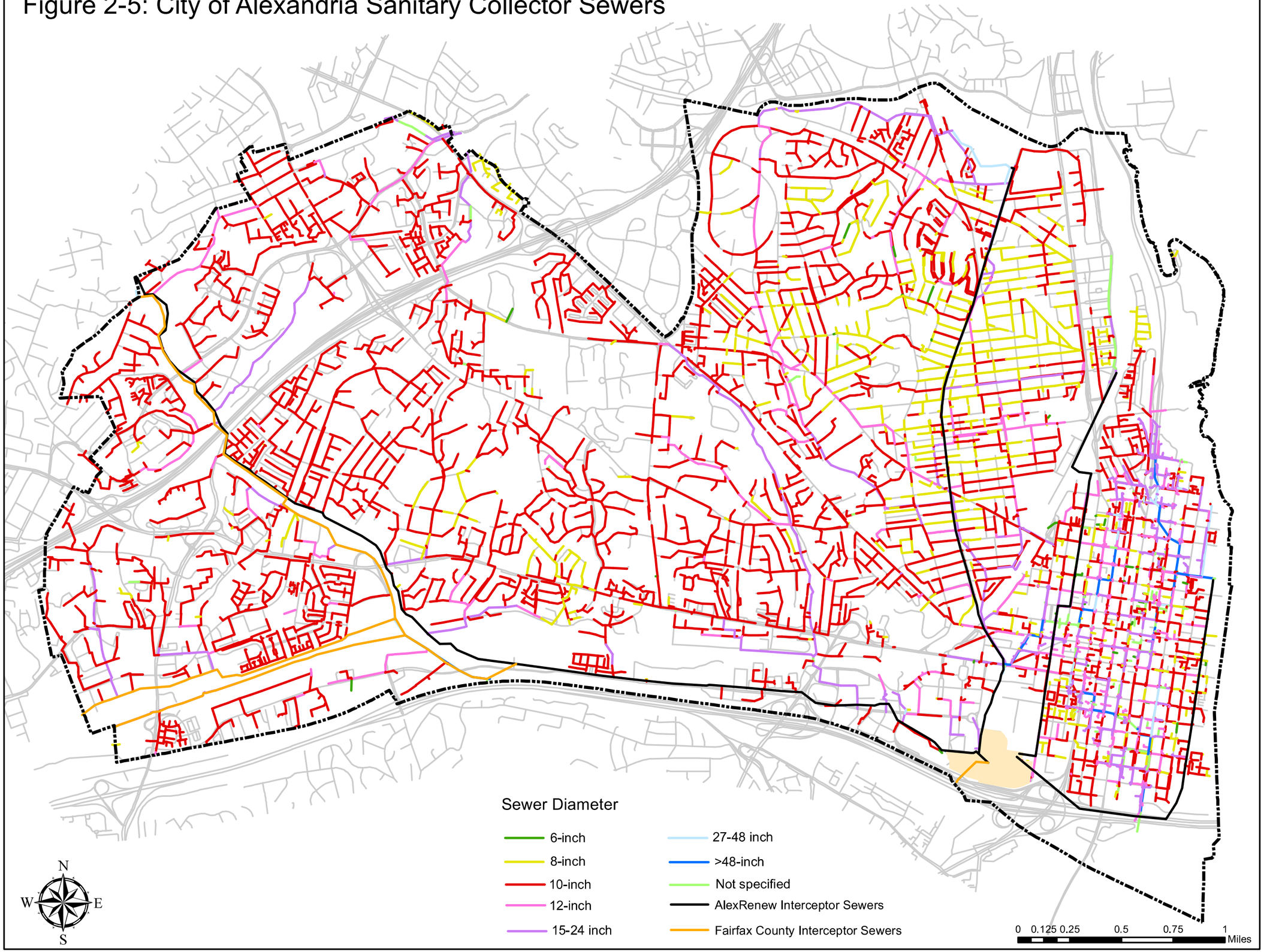
2.6 Sewer Service Agreements

The City has wastewater treatment capacity reserved at the AlexRenew WRRF and Arlington County WPCP through two separate sewer service agreements. Both the City and AlexRenew are signatories to the agreement with Arlington County. As part of this agreement, AlexRenew bills residents and businesses in the Arlington WPCP sewershed directly and then pays Arlington County for a portion of the capital and operations and maintenance costs associated with the WPCP.

The City and AlexRenew's first service agreement dates to 1954 following the construction of the wastewater treatment facility. A supplemental agreement was signed in 1974. Since then, significant development and redevelopment has occurred in the City along with changes to the City's collection system. Further, significant changes have taken place with respect to the regulatory environment governing wastewater collection and treatment, including ownership of the combined sewer outfalls. This necessitated the current update to the sewer service agreement, which was

adopted in June 2018. Along with reserved wastewater treatment capacity, this service agreement also provides for an allocation of flow in each of the interceptor sewers and a provision for acquiring pollution credits generated by future combined sewer projects and the WRRF to assist in meeting the City's Chesapeake Bay pollutant reduction requirements. Finally, it provides a process for the City and AlexRenew to coordinate and plan for future infrastructure improvement projects.

Figure 2-5: City of Alexandria Sanitary Collector Sewers



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Chapter 3
Regulatory Drivers

3.1 Introduction

Wastewater collection and treatment are highly regulated at the state and federal levels. Capital and operating costs are driven by regulatory requirements and these costs are passed to City residents through their rates. This chapter summarizes and discusses the existing regulations that govern the City's sanitary collection system and wastewater treatment. The City must comply with both state and federal regulations as it works to preserve the quality of its streams, rivers, and the Chesapeake Bay.

3.2 Clean Water Act

The main federal regulation governing wastewater collection and treatment is the Clean Water Act (CWA), which was enacted in 1972 by the U.S. Environmental Protection Agency (EPA) with several amendments adopted thereafter.

The overall goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water." The CWA regulates pollution from point source discharges from industrial facilities, municipal wastewater treatment plants, and stormwater runoff. Additionally, through the planning and regulatory process used to develop total maximum daily loads (TMDLs) for water bodies that are not in compliance with designated uses, nonpoint sources have been engaged to take actions to prevent runoff from streets, farms, and construction sites, which also can substantially contribute to water quality degradation. Over the last few years, EPA has begun to recognize the importance of managing water resources from a watershed scale and has supported communities as they move toward One Water management.

Under the CWA, the National Pollutant Discharge Elimination System (NPDES) program was established to issue and manage discharge permits for point sources. The following point source discharges hold permits under the NPDES program:

- Alexandria Renew Enterprises (AlexRenew) Water Resource Recovery Facility (WRRF)
- City of Alexandria Combined Sewer System (CSS)

The Virginia Department of Environmental Quality (VDEQ) is the state-level NPDES issuing authority and issues the discharge permits for the AlexRenew WRRF and the CSS through its Virginia Pollutant Discharge Elimination System (VPDES) program. Permits are issued on a 5-year basis. Each permit is discussed in detail in the following sections.

3.2.1 AlexRenew WRRF Virginia Pollution Discharge Elimination System Permit

The AlexRenew WRRF has a VPDES Individual Permit (VA0025160) for its two wastewater treatment outfalls that discharge highly treated effluent into the Hunting Creek Embayment. The permit establishes discharge limits for several water quality constituents to ensure that treated wastewater effluent does not cause or contribute to exceedance of water quality standards. AlexRenew submits a discharge monitoring report to VDEQ monthly to show compliance with its discharge limits established by this permit.

As part of the Chesapeake Bay Program (discussed in Section 3.4), AlexRenew also has

a separate permit (Watershed General Permit VAN010059) outlining the wasteload allocations (WLAs) for both nitrogen and phosphorous that the treatment plant can discharge. AlexRenew implemented upgrades at the WRRF as part of the State-of-the-Art Nitrogen Upgrade Program (SANUP) to meet the WLA for total nitrogen. The facility was already meeting its WLAs for total phosphorous and sediment when the WLAs were issued.

3.2.2 Combined Sewer System Virginia Pollution Discharge Elimination System Permit

VDEQ issued the first VPDES permit to the City of Alexandria in 1995, following the issuance of EPA's combined sewer overflow (CSO) policy in 1994. The City owned and maintained the CSO outfalls until July 1, 2018, when ownership of the outfalls was transferred to AlexRenew with VDEQ approval. AlexRenew is authorized to discharge CSOs pursuant to VPDES permit no. VA0087068. This permit requires AlexRenew to comply with state legislation passed in 2017 (2017 State CSO Law), which requires significant reductions in combined sewer discharges to be achieved by July 1, 2025. More information about the 2017 CSO Law is provided in subsequent sections of this chapter.

Figure 2-3 shows the City's CSS boundaries, location of CSS outfalls, and receiving waters. Table 2-4 summarizes each of the four permitted CSS outfalls, corresponding CSS subshed name and area, and receiving water body associated with each outfall structure. On average, approximately 60 to 70 rain events per year result in permitted CSO discharges from the CSS outfalls.

In addition, the permit requires that AlexRenew, in coordination with the City, provide best management practices related to the operation of the CSS, termed the Nine Minimum Controls, established by EPA:

- Conduct proper operations and regular maintenance programs
- Maximize use of collection system for storage
- Control of non-domestic discharges
- Maximize flow to the AlexRenew WRRF
- Prohibit CSOs during dry weather
- Control solid and floatable materials in CSOs
- Develop and implement pollution prevention programs
- Notify the public of CSOs
- Long-Term Control Plan review
- Submit an annual report to VDEQ by March 31 each year

3.3 Hunting Creek Total Maximum Daily Load and 2017 State Combined Sewer Overflow Law

A number of waterbodies in the Commonwealth of Virginia have been placed on EPA's impaired waters list per Section 303(d) of the CWA. Once a water body is listed as impaired for a designated use, a TMDL must be developed for that impaired stream or stream segment to address the impairment. This has led to several TMDLs to be issued in the Commonwealth and the City. Most of these TMDLs focus on stormwater runoff as one of the primary pollutant sources. Reductions are aimed at reducing pollutants found in runoff. Hunting Creek, which receives discharges from the AlexRenew WRRF and the City's CSS in addition to other sources, was placed on the 303(d) list because of exceedance of water quality standards for *E. coli* bacteria. The

TMDL for Holmes Run, Cameron Run, and Hunting Creek was finalized in November 2010. The AlexRenew WRRF has a permitted discharge limit for *E. coli* and has proven to meet their discharge limits, so no reductions are required at the WRRF. The TMDL requires wasteload reductions for *E. coli* at CSO outfalls 002, 003, and 004 of 80, 99, and 99 percent, respectively, for a total wasteload reduction (from CSOs) of 86 percent from these three CSS outfalls.

As required by the City's VPDES permit issued in 2013, the City needed to submit a Long-Term Control Plan Update (LTCPU) to VDEQ by August 2016 and specify how it would comply with the Hunting Creek TMDL. While VDEQ was reviewing the LTCPU for approval, new legislation pertaining to CSOs was introduced in the 2017 Virginia General Assembly and signed into law by the governor in April 2017. The 2017 CSO Law requires:

> Any owner of a CSO outfall…shall, by July 1, 2023, initiate construction activities necessary to bring the CSO outfall into compliance and shall, by July 1, 2025, bring the CSO outfall into compliance with Virginia law, the federal Clean Water Act, and the Presumption Approach described in the EPA CSO Control Policy, unless a higher level of control is necessary to comply with a TMDL.

This legislation required the City to revise its LTCPU and develop a plan to bring outfalls 002, 003, and 004 in compliance with the Hunting Creek TMDL and outfall 001 with EPA's CSO Presumption Approach. The revised LTCPU was submitted to VDEQ in May 2018 and was approved by VDEQ in June 2018. More information about the LTCPU, now known as RiverRenew, is provided in Chapter 9.

3.4 Chesapeake Bay Program

The City of Alexandria is part of the Chesapeake Bay Estuary (Bay). This unique estuary is the largest in the nation and third largest in the world. Its 64,000-square mile watershed includes the states of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia (Bay states), and the District of Columbia. In the watershed, there are more than 100,000 streams and rivers that eventually flow into the Bay. All residents in the surrounding communities live within a few minutes of one of these streams and rivers, which are like pipelines from our communities to the Bay. The Bay and its watershed have remarkable ecological, economic, recreational, historic, and cultural value to the region. Because of the pollution and subsequent degradation of the Bay, it is subject to several state and federal regulations, the most notable of which is the Chesapeake Bay TMDL.

On December 29, 2010, EPA approved the Chesapeake Bay TMDL after many years of hard work by individuals and organizations in the Bay watershed. The Chesapeake Bay TMDL is a historic and comprehensive "pollution diet" to restore clean water in the Chesapeake Bay and the region's streams, creeks and rivers. The Chesapeake Bay TMDL, the largest ever developed by the EPA, identifies the necessary pollution reductions of nitrogen, phosphorous, and sediment across Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia (District) and sets pollution limits necessary to meet applicable water quality standards in the Bay and its tidal rivers and embayments. Each state and the District were required to develop and submit Watershed Implementation Plans (WIPs),

which detail how they will meet the pollution reductions outlined in the TMDL. More information about the Chesapeake Bay TMDL is provided in Chapter 11.

3.5 Possible Future Regulations

There are potential future regulations that could impact the collection and treatment of the City's wastewater, including the following that are discussed in this section:

- Sanitary sewer overflows
- Water quality standards

3.5.1 Sanitary Sewer Overflows

EPA has acknowledged, and confirmed, that sanitary sewer overflows (SSOs) cannot be eliminated. Sanitary sewer systems that are designed to accommodate a given design storm (frequency and duration) may experience wet weather induced overflows as a result of rainfall conditions that exceed the design storm. These are referred to as "unavoidable" overflow events. However, EPA also believes that inadequate management, operation, and maintenance of wastewater collections systems are the greatest cause of SSOs across the nation. These are referred to as "avoidable" SSOs.

In general, the regulatory requirements for wastewater collection systems are becoming more stringent at the state and federal levels. EPA estimates that there are at least 23,000 to 75,000 SSOs per year, not including sewage backups into buildings. SSOs can contaminate waters, causing serious water quality problems. EPA has not set a threshold or defined what constitutes an unavoidable SSO with relation to wet weather.

Currently, the City has a maintenance program related to its collection system but does not own or operate any constructed SSO outfalls. When SSOs occur, it is typically due to a blockage in the sewer line that results in sewage building up and overflowing out of a nearby manhole. All occurrences of SSOs are required to be reported to VDEQ within 24 hours of the event. Changes to the City's maintenance program are also enacted in response to SSOs. The City and AlexRenew have a very low occurrence of SSOs. More information about the City's program to reduce the occurrence of SSOs is provided in Chapter 4.

The City's collection system is not included as part of AlexRenew's existing VPDES permit, but it is possible that EPA could require individual jurisdictions that own and operate collection systems to be included as part of the NPDES permit program in the future.

3.5.2 Water Quality Standards

Water quality standards are the foundation of the water quality-based control programs mandated under the CWA, which can affect both wastewater treatment and sewer collection system requirements. Water quality standards for a water body are set to protect the designated uses and establish provisions to protect water quality from pollutants. A water quality standard consists of four basic elements:

- Designated uses of the water body (e.g., recreation, water supply, aquatic life, agriculture)
- Water quality criteria to protect designated uses (numeric pollutant concentrations and narrative requirements)
- An antidegradation policy to maintain and protect existing uses and high-quality waters
- General policies addressing implementation issues (e.g., low flows, variances, mixing zones)

Standards help to identify water quality problems that can be caused by improperly treated wastewater discharges, runoff or discharges from active or abandoned mining sites, sediment, fertilizers, chemicals from agricultural areas, and erosion of stream banks caused by improper grazing practices. Standards also support efforts to achieve and maintain protective water quality conditions, including:

- TMDLs, which incorporate WLAs for point sources of pollution and load allocations for non-point sources of pollution
- Water quality management plans that prescribe the regulatory, construction, and management activities necessary to meet the water body goals
- NPDES water quality based effluent limitations for point source discharges
- Water quality certifications under CWA Section 401 for activities that may affect water quality and require a federal license or permit
- Reports, such as the reports required under CWA Section 305(b), that document current water quality conditions
- CWA Section 319 management plans for the control of non-point sources of pollution

The CWA requires states and authorized Indian tribes to periodically review their standards at least once every three years (called the triennial review of water quality standards) and revise them, if appropriate. Updates to water quality standards may also be precipitated, for example, because of changing water quality conditions, water body uses, or new scientific information on the effects of pollutants in the environment.

Each state and authorized tribe has its own legal and administrative procedures for adopting water quality standards. In general, standards are adopted following a process in which draft revisions are developed (this may include a work group process or informal public meetings) and formally proposed for public comment. A public hearing is then held to receive input from the public regarding the proposal. The proposed water quality standards and supporting information are made available to the public prior to the hearing. States and tribes are required to prepare a summary of the public comments received and how each comment was addressed. Upon EPA approval, new or revised water quality standards become effective.

EPA may develop water quality standards that supersede state water quality standards in cases where new or revised state or tribal standards are not consistent with applicable requirements of the CWA or in situations where the EPA administrator determines that federal criteria or standards are necessary to meet the requirements of the CWA.

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Chapter 4
System Maintenance, Capital Planning, and Asset Management

4.1 Introduction

As discussed in Chapter 2, the City of Alexandria's Department of Transportation and Environmental Services (T&ES) owns and operates over 240 miles of sanitary and combined sewers across the City. The City has a rolling 10-year Sanitary Sewer Capital Improvement Program (CIP) that includes all capital projects, maintenance-related sewer expenditures, personnel expenditures, and debt service. The CIP is funded through sewer revenues, which include two sources:

- Connection fees from development/redevelopment
- Sanitary sewer user fees (wastewater/sewer bill)

More information about these sources of revenue is provided in Chapter 10.

This chapter summarizes sanitary sewer programs that have been implemented, current system maintenance efforts and milestones, and goals and initiatives moving forward, especially with respect to climate change and flooding. A copy of the fiscal year (FY) 2022 10-year CIP is provided in Appendix A.

4.2 Routine System Maintenance Program

The sanitary sewer system maintenance needs of the collection system are typically related to roots, grease, and sags—these may not cause structural failure of a sewer; however, the City must pay for the maintenance required to support conveyance capacity and prevent sewer backups. This program is administered by the Public Works Services (PWS) Division of T&ES. The current budget related to system maintenance, including sewer cleaning and closed-circuit television (CCTV), is approximately $1 million annually.

PWS has developed a schedule for sewer maintenance activities that generally include cleaning and, in some cases, CCTV. Frequency of maintenance activities for any given sewer depends on a variety of factors. "Hot spot" areas may be cleaned weekly and other areas/sewers may not need maintenance for a year or longer.

The most common hot spot areas are sewer siphons, also called depressed sewers or sags. These sewers allow wastewater to flow through a pipe under low-lying areas such as streams or other obstructions, where flow by gravity is not possible. As a result, these sewers require frequent maintenance to remove solids and other material that settles in the depressed sewer. Given the frequent maintenance needs of siphons, the City is planning to assess these sewers to determine if design modifications are required or if there is a way to eliminate any of the siphon structures. This assessment will be programmed in a future CIP and will be conducted by the Sanitary Infrastructure Division of T&ES, working closely with PWS.

In addition to preventative maintenance, PWS is responsible for citizen services requests related to sewer issues, along with emergency repairs. Emergency repairs typically arise from a structural failure, such as a collapsed pipe. In addition to City forces, the Operations Division has an approved list of contractors

who can respond to these occurrences on short notice. These requests are typically related to a maintenance issue, such as a sewer blockage or a structure issue on City-owned sewers. In some cases, these requests are issues on privately owned sewer laterals before connection into the City system; therefore, the City is not responsible for these requests.

Over the past year, PWS received and responded to over 300 requests for service of sanitary sewer-related issues. Over the past year, PWS reached the following milestones:

- Repaired nine sewer main breaks
- Inspected and cleaned 880 catch basin/inlet structures in the combined sewer area
- Inspected and cleaned over 90 miles of sanitary sewer
- Issued a "wet utilities" contract to more quickly address sanitary sewer infrastructure needs, including repairing broken sections of sewer pipe

PWS will continue these investments in sewer infrastructure and City staffing to more quickly address customers' needs regarding sewer issues.

4.3 Capital Projects

The City's Sanitary Infrastructure Division of T&ES is responsible for implementing the City's Sanitary Sewer CIP. This section focuses on a few of the notable capital improvement projects that have been implemented or are currently being implemented:

- Citywide Sewershed Infiltration and Inflow Program
- Sanitary Sewer Asset Renewal Program
- Combined Sewer Assessment and Rehabilitation
- Reconstruction and Extension of Sanitary Sewers

4.3.1 Citywide Sewershed Infiltration and Inflow Program

Since the 1990s, T&ES has been implementing a program to address infiltration and inflow (I/I) into its separate sanitary sewer system. Infiltration is groundwater that enters the sanitary sewer system through leaks in pipes and manholes. Inflow is stormwater that is directed into sanitary sewers through connections such as roof downspouts, driveway drains, sump pumps, and runoff into manhole covers. During periods of significant wet weather, I/I can increase to the point where the capacity of the sewers is reached. When this happens, the excess water can result in sewage backups into homes and businesses or overflow out of manholes and then into City waterways.

The City's I/I program consists of the following elements:

- Pre-construction flow monitoring to determine the amount of I/I in individual sewersheds
- Field assessment phase including the inspection of all sewers and manholes in sewersheds with I/I
- Rehabilitation of sewers and manholes to reduce I/I
- Post-construction flow monitoring to determine how much I/I has been reduced

The City's I/I program started in sewersheds with the highest rates of I/I and then progressively moved toward areas with lower I/I. Only sewersheds with the highest rates of I/I were included in the program.

Figure 4-1 shows the sewersheds that were part of the I/I program. Some of the subareas within the Holmes Run Sewershed had only pre-construction flow monitoring performed, whereas the other subareas included the field assessment, rehabilitation, and post-construction flow monitoring. This was because there were several areas within the Holmes Run Sewershed that did not have measurable I/I; thus, no additional work was done in these areas. To date, 60 miles of sewer and approximately 3,200 manholes have been rehabilitated, as shown in Table 4-1. A total of $30 million has been spent on the program since the 1990s.

The City is transitioning its I/I program into an asset renewal program, which will cover all areas of the City, not just those areas with measurable I/I. The focus of the asset renewal program will be to address those areas that have experienced sanitary sewer backups first before moving into other areas of the City.

In response to continued I/I in the sanitary sewer system resulting in sanitary sewer backups, the City provides residents an opportunity to participate in its backflow preventer (BFP) assistance program, which reimburses homeowners up to 50 percent of the cost of installing a BFP device, up to a maximum of $2,000. BFPs are installed on private sewer laterals and work to block off a property from the sewer system to help protect against a sewer backup. More information about the program can be found at https://www.alexandriava.gov/tes/info/default.aspx?id=105378.

Table 4-1: Summary of City I/I Program

Program Element	Four Mile Run	Commonwealth	Taylor Run	Holmes Run
Sewers inspected (feet)	158,400	204,900	128,400	180,500
Sewers rehabilitated (feet)	58,900	71,400	76,700	114,200
Sewer point repairs	111	237	170	0
Manholes inspected	944	1,091	696	1,061
Manholes repaired	648	855	619	1,061
Rehabilitation completed	March 2006	March 2008	November 2010	March 2020
Assessment phase cost	$0.95M	$0.94M	$1.95M	$2.99M
Construction cost	$4.46M	$4.56M	$5.68M	$7.74M

Note: M = million

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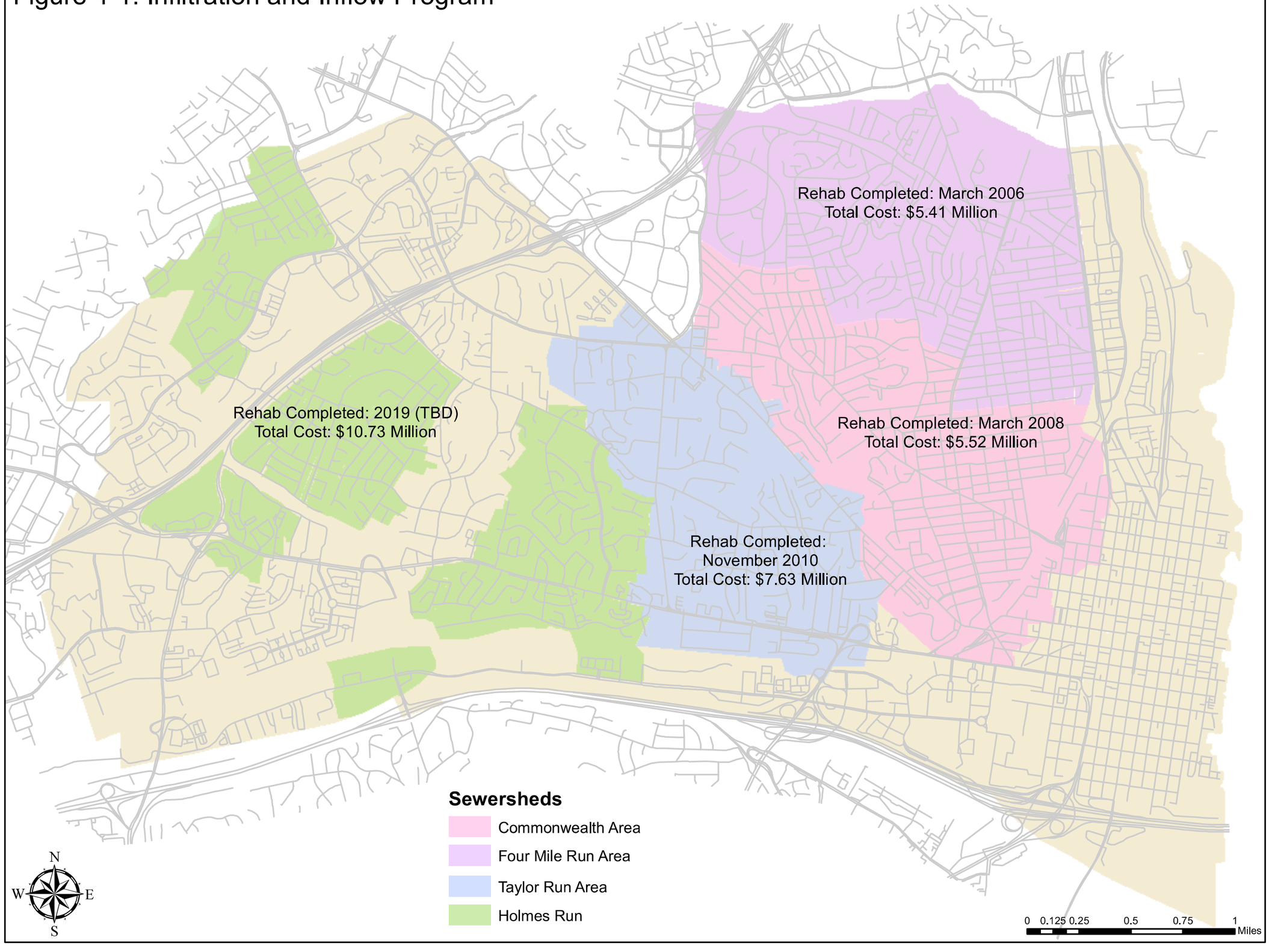
Figure 4-1: Infiltration and Inflow Program



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4.3.2 Sanitary Sewer Asset Renewal Program

The City initiated a Sanitary Sewer Asset Renewal Program in FY 2021. This program is funded to inspect approximately 10 percent of the sanitary system and rehabilitate approximately 2 percent of the system annually (to begin within a year after initial inspections are completed). The program has been initiated in areas subject to sanitary sewer backups as a result of extreme wet weather. These areas are generally located in the Four Mile Run and Commonwealth sewersheds. Between July 2018 and September 2020, the City experienced many extreme wet weather events that resulted in sanitary sewer backups within these areas of the City. Additional sewer rehabilitation, and possibly other measures, will likely be required to continue to address I/I.

The Sanitary Sewer Asset Renewal Program will include condition assessment of City mainline sewers and manholes, similar to work done as part of the I/I program. In addition, it will include inspection and rehabilitation of portions of sewer laterals that the City owns and maintains. These include all laterals running between the City sewer mains and the curb lines that were installed prior to July 1, 1955. Rehabilitation activities will commence in 2022. The City is currently preparing specifications and contract documents for an on-call rehabilitation contract. A total of $36 million is programmed in the FY 2022 CIP for this project.

4.3.3 Combined Sewer Assessment and Rehabilitation

Similar to the Sanitary Sewer Asset Renewal Program, this project provides for the inspection of all City-owned mainline sewers, lateral sewers, and manholes in the Old Town and combined sewer area, followed by rehabilitation. The purpose of this project is unrelated to I/I, but it is being conducted to locate and repair structural deficiencies, which renews the life of the infrastructure and reduces the number of costly emergency repairs.

Funding for this project started in FY 2019 and the first field assessment phase of this project began in February 2019. This first phase included physical inspection of approximately 1,800 manholes and 900 stormwater structures (inlets and catch basins). This first phase is complete and the second field assessment phase is underway, which includes CCTV inspection of all the sewers, amounting to approximately 53 miles of sewers. A map displaying all the structures and sewers to be inspected is shown on Figure 4-2. Rehabilitation activities will commence in 2022. Rehabilitation will be performed as part of the on-call rehabilitation project. A total of $8.9 million has been programmed for the construction phase of this project. Depending on the results of the field assessment phase, additional funding and an update to the 10-year CIP may be needed.

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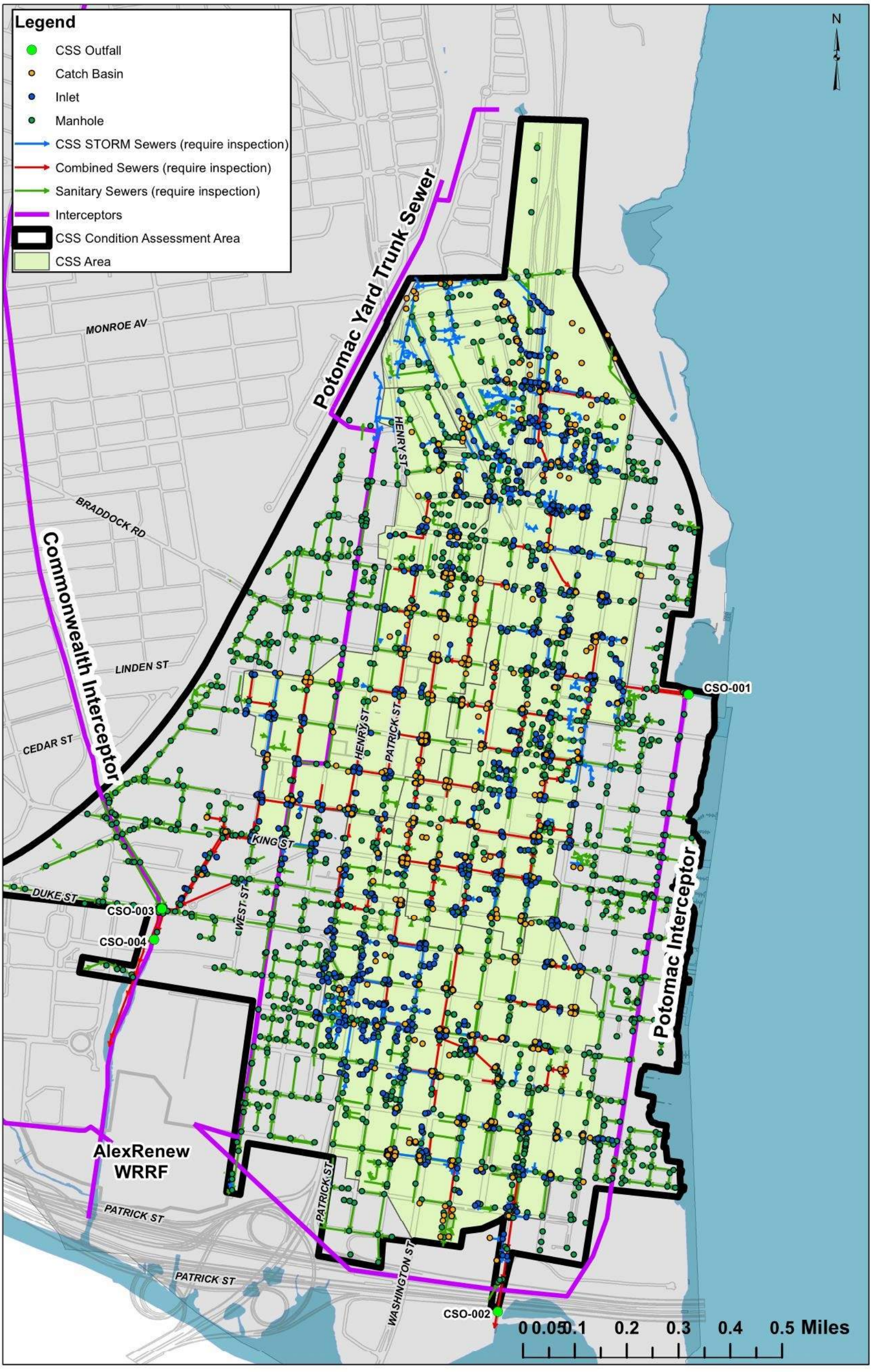
Figure 4-2: Combined Sewer Assessment and Rehabilitation



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4.3.4 Reconstruction and Extension of Sanitary Sewers

This program addresses the replacement of existing sanitary sewers for instances where sewer rehabilitation is not applicable because of the condition of the pipe. Funding needs are assessed yearly as part of the 10-year CIP process and can range from no funding (if sufficient funds exist) to up to $900,000 in any given year, depending on existing available funds and project needs. Each year, there are typically 3 to 5 projects in various phases, from concept design to active construction. Project needs are usually identified through the City's PWS, based on calls they receive from the public related to local sewer issues. This program is one of the oldest in the CIP and dates to 1987. Completion of projects under this program improves the City's sanitary sewer infrastructure while reducing the frequency of unplanned repairs due to deferred maintenance. Existing projects either upcoming (in design) or active (under construction) can be found on the City's website at https://www.alexandriava.gov/DPI.

4.4 Collection System Modeling

In 2009, the City began developing a hydraulic model of City-owned collector sewers to identify any future capacity improvements needed to serve future growth. A total of 31 basins, as shown in Figure 4-3, were developed and incorporated into the model. These areas represent where most of the development is forecasted.

The hydraulic model was developed by collecting data regarding the primary sewers within the model basins (pipe diameter, pipe lengths, pipe slopes, pipe material). The City's geographic information system (GIS) building layer was used to determine the number of residential units or total square footage of nonresidential floor area that contributed sewer flows in each pipe. This was done by multiplying the use (residential, nonresidential, or hotel) by various sewer flow factors. These flow factors were developed from flow monitoring studies conducted throughout the City over the years. Flows were computed for average dry weather conditions and for peak flow conditions using the flow factors for both existing conditions and future conditions based on forecasted growth at build-out conditions, also known as post-2040 conditions.

The hydraulic modeling shows, using these flow factors, which sewers would operate over capacity in the future and would require pipe replacement, flow rerouting, or parallel sewers to serve future development. With respect to development, this model is used to provide the existing condition flows. For each development project, the developer is required to analyze the impacts of the development project on the sanitary sewer system. If the project results in sewers operating over capacity, then the developer is required to make capacity-related infrastructure improvements.

Model flow factors were developed using flow monitoring conducted previously over various parts of the City. Because previous data was limited, it was determined that additional flow monitoring should be collected for each of the 31 model basins as part of the Sanitary Sewer Master Plan so that the model could be further refined and calibrated based on actual measured flows. This work began in 2015 and was completed in 2020. The results of this model update are discussed in detail in Chapter 6. The results of the modeling, which include system improvements to increase capacity, will be incorporated into a future CIP.

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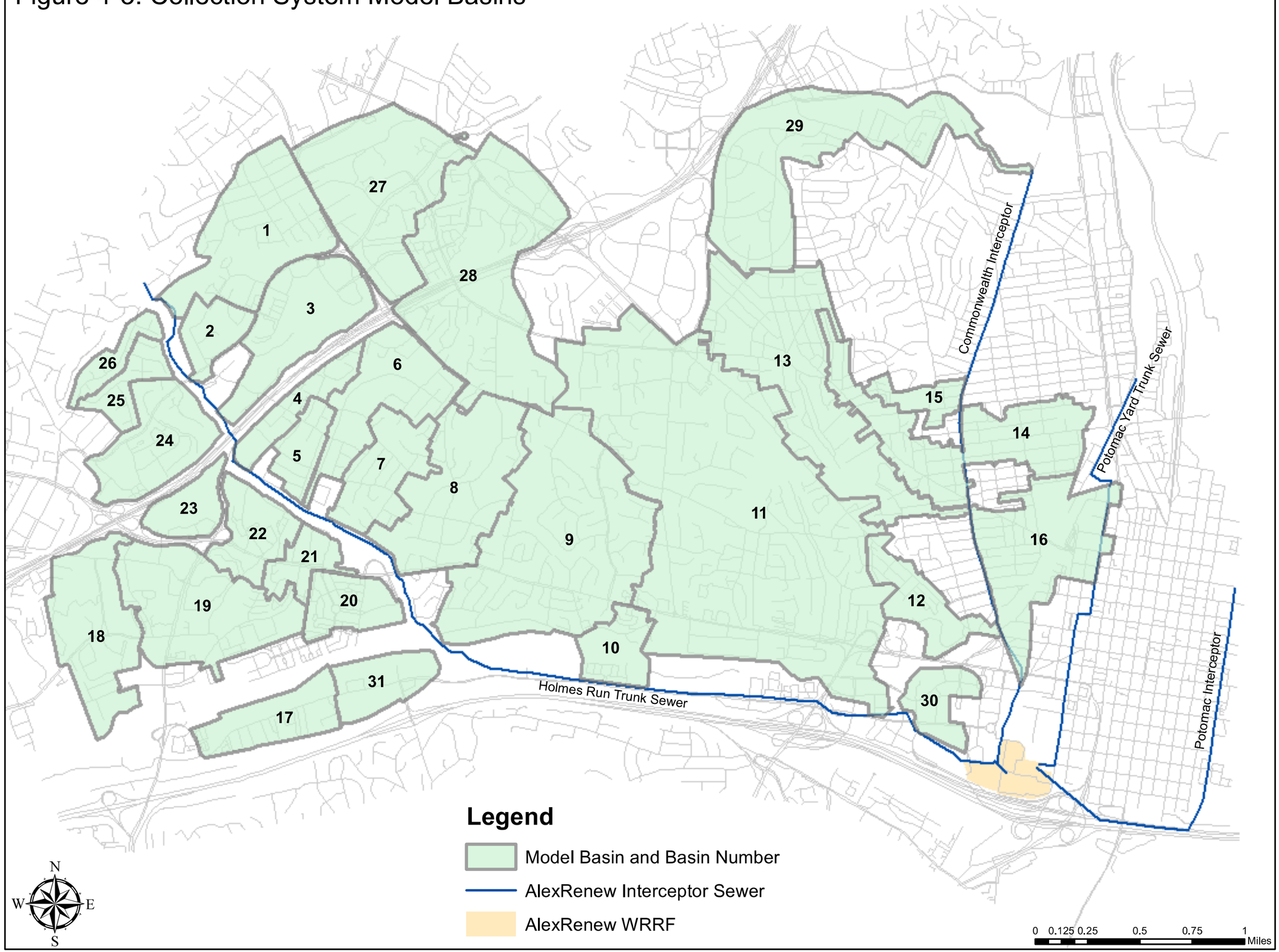
Figure 4-3: Collection System Model Basins



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4.5 Capacity, Operations, Management, and Maintenance Program

As part of the 2013 Sanitary Sewer Master Plan, it was recommended that the City develop a Capacity, Operations, Management, and Maintenance (CMOM) program to help manage sewer infrastructure assets to minimize the cost of owning and operating them, while delivering desired customer service levels. A CMOM program allows the owner of a sewer system to operate in a continuous planning mode versus a reactive mode, which decreases the number of emergency repairs. Other benefits of CMOM program implementation include:

- Prolong asset (i.e., sewer) life and improve decisions about asset rehabilitation, repair, and replacement
- Improve responses to emergencies
- Meet customer needs, such as addressing sewer backups as a result of extreme wet weather events
- Meet regulatory requirements
- Reduce overall costs for both operations and capital expenditures

The City began to develop its CMOM program in 2016. The CMOM program includes developing:

- A fats, oils, and grease (FOG) program
- An operations and maintenance plan manual and staff training
- A CMOM program strategy that presents recommended actions to be implemented in the near-, mid-, and long-term ranges

4.5.1 Fats, Oils, and Grease Program

FOGs are the byproducts generated from cooking and food preparation, including cooking oil, meat fats, food scraps, shortening, sauces, and dairy products. Discharge of FOG into the sewer system can cause the FOG wastes to solidify and stick to the interior of sewer pipes. This layer of FOG can build up over time, restricting the flow in the sewer and leading to sewer backups and sanitary sewer overflows (SSOs). Restaurants and other food service establishments (FSEs) are major sources of FOG.

In FY 2020, the City implemented an inspection program of approximately 100 FSEs in areas of increased sewer maintenance activities because of FOG in the sanitary sewer system. The purpose of these inspections was to educate FSEs about FOG, review each FSE's best management practice related to FOG wastes, and provide recommendations to reduce the amount of FOG in the sewer system.

T&ES provided informational FOG-related brochures to all FSEs located in the City. The City also provides information to residents related to sewer FOG prevention through events such as Earth Day and through its website.

In October 2020, the City updated its ordinance related to FSEs that generate FOG. Updates to the ordinance included the following:

- Clarify FOG management requirements for both new and existing FSEs
- Clarify City's authority to inspect FSEs with respect to FOG
- Provide minimum maintenance and record keeping requirements related to FOG management
- Provide a compliance schedule for FSEs related to FOG management requirements

- Clarify civil penalties for non-compliance with FOG management requirements

FOG inspections were temporarily put on hold because of COVID-19 in 2020 but are anticipated to start again in fall 2021. The benefits of a FOG program include fewer blockages into the sanitary sewer system, less potential for sanitary sewer backups and SSOs, and fewer impacts to wastewater treatment operations.

4.5.2 Operations and Maintenance Plan

The City has been updating its operations and maintenance plan, which includes updating its standard operating procedures (SOPs) related to sewer maintenance activities, along with developing or updating different types of emergency response plans. To do this, the City's CMOM consultant spent months accompanying City operation crews and observing work practices, including sewer cleaning, sewer CCTV, catch basin cleaning, vactor truck operations, sewer overflow responses, and sewer repairs. The operations and maintenance plan will serve as a training tool for existing and new City staff. The CMOM's consultant also identifies gaps in City staffing needs and recommends best ways to fill these gaps.

4.5.3 CMOM Program Strategy and Asset Management Plan

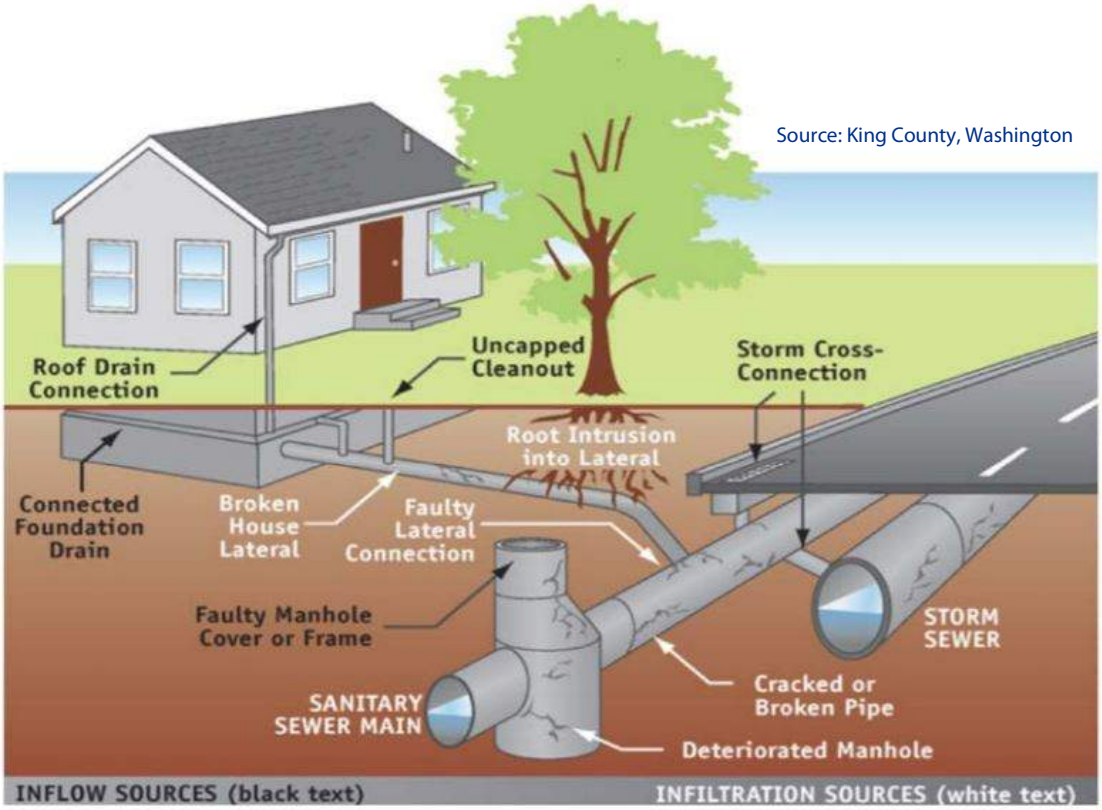
The City has developed a CMOM program strategy that provides recommendations for actions, in addition to its current program, to be implemented in the near-, mid-, and long-term. The CMOM program strategy is used to develop a formalized asset management plan, which is underway. The asset management plan will include the development of a risk matrix to assess the probability and consequence of failure for all City-owned sewers. This will be linked visually with the City's GIS of its sanitary sewers. This plan will be completed in 2022 and will be incorporated into the next update to the Sanitary Sewer Master Plan.

4.6 Wet Weather-Related Sanitary Sewer Backups

Wet weather-related sanitary sewer backups occur when too much I/I enters the sanitary sewer system. These backups typically occur in basements where sanitary sewage backs up through floor drains, toilets, or shower drains. Figure 4-4 shows various sources of I/I into sanitary sewer systems.

Sanitary sewer backups may also occur in the combined sewer area where both the sanitary sewage and stormwater are contained in the same pipe and the amount of stormwater overloads the sewer system. Many sewer backups have occurred because of severe storm events, most recently in July 2018, July 2019, July 2020, and September 2020. Most of these backups are located in the combined sewer area and in the Four Mile Run and Commonwealth sewersheds east and west of Commonwealth Avenue, including the Arlandria, Del Ray, and Rosemont neighborhoods. Some of these areas also experience stormwater flooding during flash flood events, leading to homes and businesses being flooded separate from the sanitary sewer backups.

Figure 4-4: Sources of Infiltration and Inflow Into Sanitary Sewers



In response to these flooding events, the City has implemented or will soon implement various strategies to reduce the amount of I/I in the sanitary sewer system and reduce the potential for sanitary sewer backups, some of which have been discussed in this chapter. These strategies include:

- BFP Assistance Program: The City's BFP assistance program reimburses residents 50 percent of the cost of installing a BFP device, up to a maximum of $2,000. This assistance program, which originally dates back to 2004, was reimplemented in response to the July 2018 flood event that caused numerous sewer backups in certain areas of the City. The City is continuing to fund this program into 2021 and beyond. Additionally, the City is reviewing other types of BFP programs and may update the program in FY 2022. More information about the BFP is provided in Section 4.6.1.
- $36 million has been programmed in the FY 2022–2031 CIP for sanitary sewer system assessment and rehabilitation, which will help reduce the amount of I/I in the separate sanitary sewer system (outside the combined sewer area). Inspections began in March 2021 and will take approximately 1 year to complete. Rehabilitation will begin following these first round of inspections. In addition, there is another $8.9 million programmed for assessment and rehabilitation of sewers in the combined sewer system.

- The City will replace over 800 manhole inserts in the Four Mile Run and Commonwealth sewersheds (areas more prone to sewer backups) that were installed in the mid-2000s. Inspections of existing manhole inserts with installations dating back to the mid-2000s were completed in April 2021 and replacement of inserts is planned for FY 2022. Inserts prevent stormwater runoff (inflow) from entering sanitary manholes.
- The City has begun identifying sanitary sewers that can be upsized to reduce the number of and severity of sanitary sewer backups. Initial sewer upsizing projects will move to detailed design in 2022 and funding for construction will be proposed in the FY 2023 CIP.
- The City will identify sewer backups in the combined sewer area that could be mitigated by separating small sections of sanitary sewer (where backups occurred) from the combined system and connecting them to a separate sanitary sewer. A study of 12 possible separation areas was completed in December 2020. Design of initial separation projects began in January 2021 with construction planned for FY 2022.
- The City will develop a framework for a private I/I reduction program of private stormwater sources (e.g., downspouts, sump pumps, basement area drains) into the sanitary sewer. This framework will consider the results of a 2021 survey of other jurisdiction programs. The City will use this information to develop the program framework and implementation options. This framework will be completed in FY 2022.
- The FY 2022 budget includes two additional engineering positions to assist in the implementation of the above-mentioned initiatives and programs.

4.7 City Backflow Preventer Assistance Program

The City first implemented a BFP assistance program in 2004 in response to an event where over 18 inches of snow fell, followed by a temperature warming and a rain event with over 2.5 inches of rainfall. The combined snowmelt and rainfall resulted in a significant number of sanitary sewer backups. The 2004 BFP assistance program provided a rebate of $500 for homeowners who installed a BFP device. The program continued intermittently, including after the June 2006 100-year storm event. The program was reintroduced in fall 2018 following the July 2018 wet weather event.

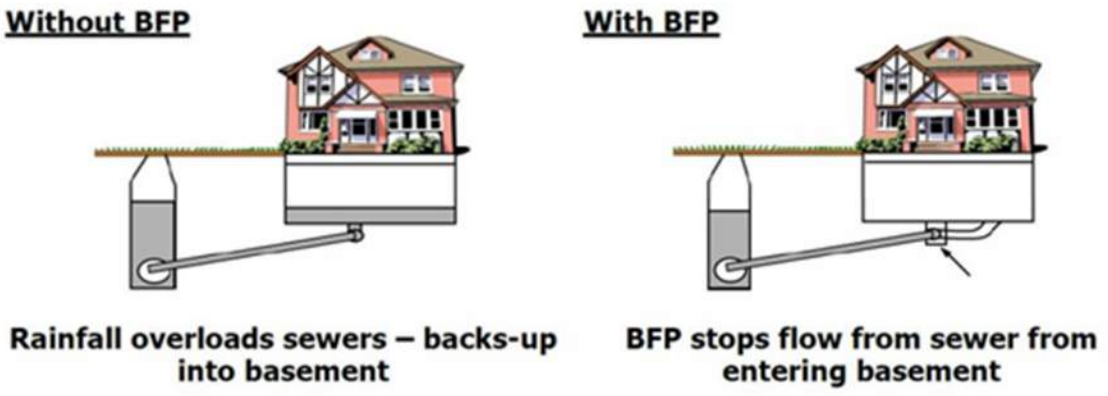
Figure 4-5 shows how a BFP protects against sewer backups. A BFP can function automatically or be operated manually by the resident. An automatic BFP can be equipped with a battery-operated light (much like a smoke alarm) to notify the resident when it is open or closed. When the BFP is engaged (closed), a property owner cannot use their plumbing system; otherwise, a sewage backup could occur. This period when owners cannot use indoor plumbing varies depending on the size and duration of the storm. In addition, the property owner cannot have any stormwater connections to the sanitary sewer (such as a sump pump or outdoor basement area drain) upstream of the BFP device. BFP devices can operate effectively for 10 or more years but should be inspected and serviced annually by a plumber.

The City will reimburse an eligible property owner 50 percent of the total BFP installation cost, up to a maximum of $2,000. Qualifications for reimbursement include:

- Property must have a basement (finished or unfinished).
- Plumber licensed by the State and City must install the BFP device.
- City must be granted access to verify installation.
- Owner/plumber must have obtained an installation permit and an approved final inspection.
- Owner and installer must certify to pay in full.
- Owner must accept responsibility for the warranty of the product with the plumber and release City from liability.

More information about the BFP assistance program can be found at https://www.alexandriava.gov/tes/info/default-105378.html.

Figure 4-5: How a Backflow Preventer Protects Against Backups



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Chapter 5
Growth Forecasts

Demand for wastewater collection, treatment, and disposal is created by the population and economic activity in a community. At a local level, the built environment drives population and economic activity dynamics. This chapter identifies the nature and geographic distribution of land uses in Alexandria today, and provides forecasts of future development consistent with regional projections. These forecasts are used to project future sanitary sewer infrastructure needs.

Table 5-1 summarizes key components of existing conditions and projected future development used to develop forecasts of wastewater generation for the City of Alexandria. This chapter discusses how these estimates were developed and the assumptions on which they were based. The COVID-19 pandemic and disruption to economic activities will have an unknown impact on these projections. The forecasts and their implications for future facilities' demand will be regularly reviewed in response to changing information, especially when this information indicates a significant change to past assumptions is in order.

5.1 Demographic Projections

5.1.1 Baseline Population and Employment

Alexandria is a medium-sized city of approximately 150,000 people. In 2010, the Washington, DC metropolitan statistical area (MSA) had a population of over 5.5 million people and was the seventh most populous MSA in the country. Because it includes a relatively small portion (about 2.5 percent) of the total population in the region, the City is subject to the economic fortunes of the region as a whole, but its small size also means it has some ability to set policy for what specific residential, commercial, and public use markets it will serve within the wide range of possible activities in the region.

Alexandria is home to many national and international associations that have their headquarters in the Washington, DC region to be close to the seat of national government. It provides work locations for government agencies and for contractors and consultants who support the U.S. Department of Defense and other federal agencies. Alexandria is a tourist center with a long and colorful history and provides hospitality services to the larger visitor population attracted by Washington, DC, Mount Vernon, and other sites in the region, and those passing through on major transportation corridors.

Table 5-1: Housing, Population, and Employment Forecasts

	2020	2025	2030	2035	2040	2045	Post-2045[1]
Housing Units	80,885	87,463	95,415	102,240	110,109	117,183	140,680
Hotel rooms	4,946	4,946	5,116	5,566	5,946	6,580	7,030
Non-residential square footage (excluding hotel)	48.7 msf	49.8 msf	49.7 msf	50.2 msf	50.6 msf	51.8 msf	51.8 msf

Notes:

[1] Post-2040 estimates for Sanitary Sewer Master Plan only, see text for explanation of assumptions and method.

[2] msf = mean square footage

While the Port of Alexandria once hosted significant shipping and shipbuilding, the waterfront's economy is now based on serving residents, visitors, and office-based businesses. Heavy industry today plays a smaller role as part of the City's economic activity. Economic activity in Alexandria includes providing day-to-day retail and service support for its resident population, as well as providing a wide range of services to the metropolitan region.

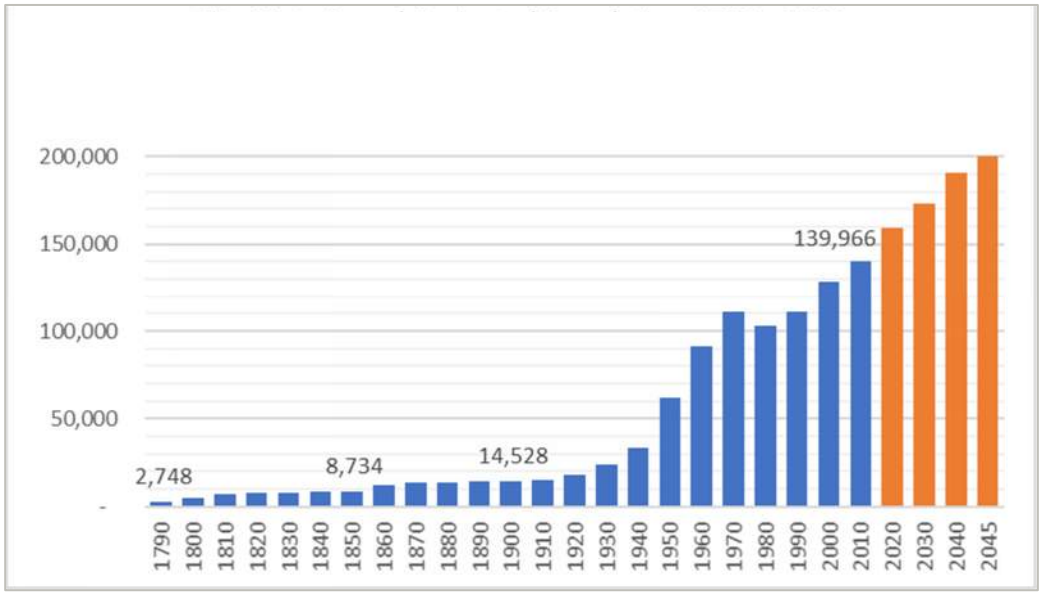
The City's economy has a healthy employment balance with roughly the same number of jobs and workers. The number of jobs is estimated to be 104,409 in 2018 by the U.S. Bureau of Labor Statistics and the number of workers (members of the civilian/non-military labor force) is estimated at 102,459 by the Virginia Employment Commission. Alexandria's economy is supported by its connection to the region along the Metrorail system and its close access to the national capital.

The City's area of jurisdiction has grown greatly since its founding in 1749 — it reached its current and expected permanent boundary in 1950 with the incorporation of areas of Fairfax County in the West End, with a few adjustments along the Capital Beltway in the 1970s. Figure 5-1 provides historical and projected population data for the City.

5.1.2 Future Projected Population and Employment

Nearly all land in the City is currently developed in productive uses. As the development pattern shifts to redevelopment of existing active uses, the threshold of density and economic activity necessary to make development profitable increases. Because the City is near the core of the metropolitan region, the convenience of the City as a location for housing and employment means that this threshold is expected to continue to be met, and reinvestment is expected to keep the City growing with a healthy rate of internal renewal for the foreseeable future.

Figure 5-1: City Historical and Projected Population 1790–2040



Source: US Decennial Census, 1790 – 2010; Metropolitan Washington Council of Governments (MWCOG) Round 9.1 Population Forecast.

Although most of the City has seen its first round of development, there is active demand and development opportunity for significant infill within the existing fabric. Development demand continues even after a City has become fully developed for several reasons.

These include national demographic changes such as changes in the distribution of population by age and family structure, movements of people internationally and within the country in search of jobs and other opportunities, changes in availability of resources and technology that change patterns of travel and residential choices, and many other factors. There are constantly opportunities to provide housing of varying types and in locations that are more in current demand as desires and conditions change. Some of the key changes that are encouraging new and changing residential demand in Alexandria are:

- Arrival of major employers, such as Amazon and Virginia Tech, in the region
- Development of the Potomac Yard Metro, which will provide residents in the surrounding neighborhood rail access into Washington, DC for work or recreation
- Steady and increasing international migration to gateway communities like the Washington, DC metropolitan region
- Movement of many households, including empty nesters, young professionals, singles, retirees, and families with children, back to the City as a place of convenience, culture, jobs, and other resources
- A desire to ensure the availability of a variety of housing types at all levels of affordability

International, national, and local changes in the nature and distribution of employment affect residential demand and affect the choice of firms and self-employed individuals to locate in Alexandria. Among the trends that are likely to affect future employment growth in the City are:

- Technological changes that are closer to realizing the full potential of telecommuting and increasing the number of employees who telecommute for some or all of their work week
- Desire of firms to locate headquarters or support staff near customers, such as the U.S. Department of Defense, with their headquarters offices in Washington, DC
- New transit systems, such as streetcars and bus rapid transit, are currently being planned for communities inside the Capital Beltway, making commuting by transit between communities within the Capital Beltway more convenient.

5.1.3 Projected Future Development/Land Use

5.1.3.1 Development Growth Zones

The City's single-family areas are stable residential communities that are not currently zoned for change in the near future. Because of the scarcity of single-family homes near the center of the metropolitan area, these units are in high demand and command a high price. However, other areas of the City, particularly auto-dependent commercial and multi-family residential areas with extensive surface parking lots developed from the

1940s boom years through the 1970s could be redeveloped. The City's plans for these areas anticipate their gradual redevelopment as new urban centers with more efficient pedestrian-oriented and transit-oriented mixed-use development that minimizes vehicle trips and results in a more economically and environmentally sustainable pattern of development for the long-term future.

5.1.3.2 Forecasting Future Development

The forecasts of the future build on information about existing conditions. Estimates of future development are added to information about what exists in the City today to give totals for the future.

5.1.3.3 Existing Baseline

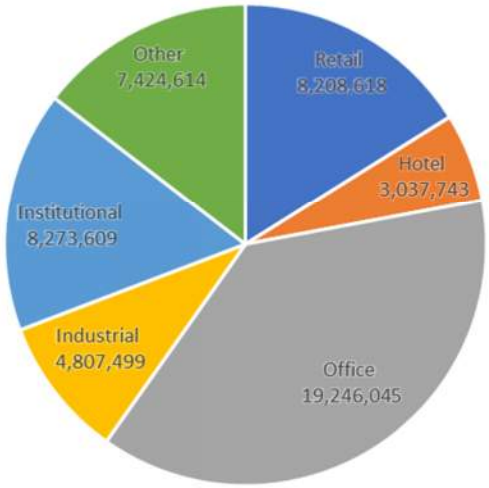
The City of Alexandria uses a geographic information system (GIS) to maintain a regularly updated database on each property and structure in the City. Data available includes existing land use, floor area, parcel area, and number of dwelling units. This database provides a detailed picture of where people in the City live and work, and where the existing demand for wastewater collection is generated. When combined with measurements of existing flows, this data can be used to calibrate models and estimate generation rates for each type of development in the City. A summary of these data sources is provided in Table 5-2.

Figure 5-2 summarizes information on existing nonresidential development including floor area by major category of occupancy (retail, hotel, office, industrial, and other). Industrial uses include flex space, warehousing, and miscellaneous service and industrial uses, and "other" uses include public facilities and institutional uses other than offices.

Table 5-2: Data Sources for Existing Conditions

Existing Conditions	Data Source
Existing land use (assessor's land use code), parcel area, and floor area by parcel	City GIS parcel database, based on information collected for real estate assessment
Structure use (assessor's land use code) and floor area by structure	City GIS, combining real estate data with analysis of structures from aerial photography and site plans.
Housing – number of units	City of Alexandria, Office of Housing annual survey of multifamily buildings over 10 units, recorded in City GIS; single-family and duplex units by parcel from GIS by assessor's land use code.

Figure 5-2: Citywide Total Floor Area for Nonresidential Land Uses



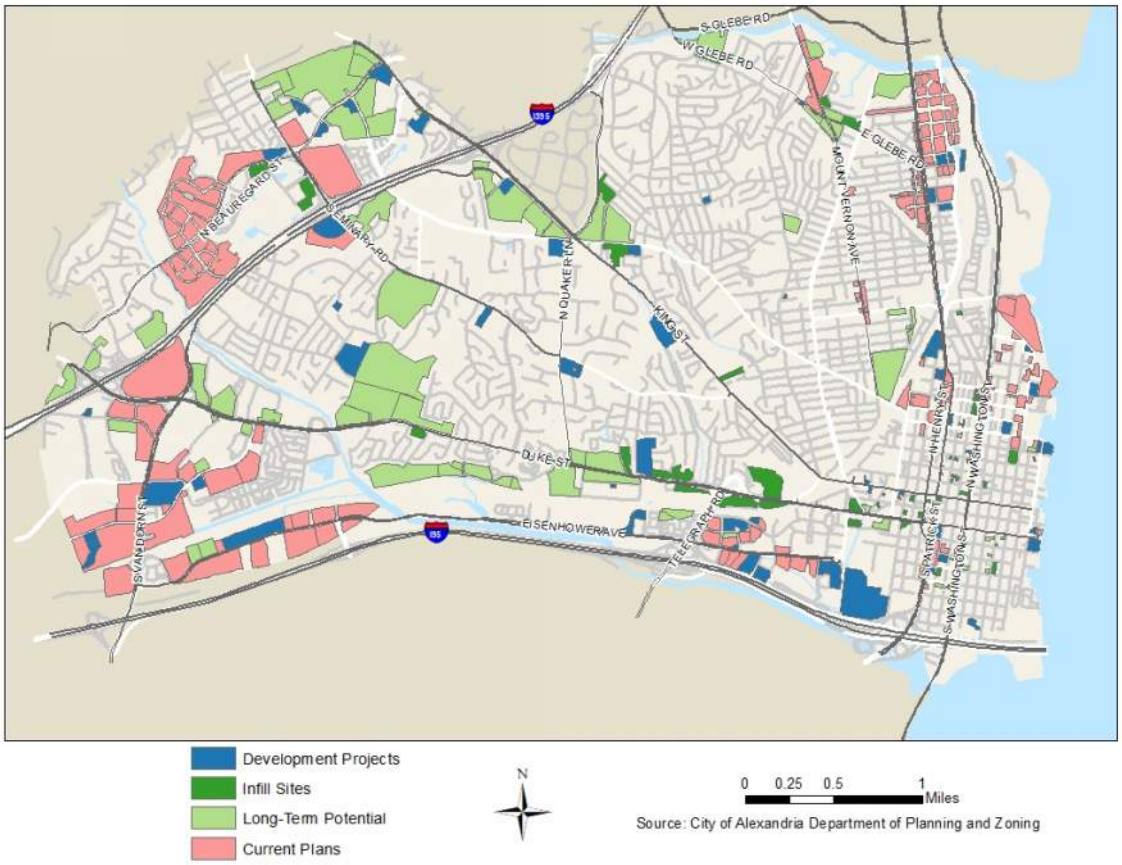
Source: City of Alexandria Information Technology Services

5.1.3.4 Local Development Forecast

Figure 5-3 shows locations of potential future development used in preparing the City's forecasts. Future potential developments include the following by approval status:

1. Development projects, both approved and in the approval process. These are typically projects permitted by current zoning for which there is an active or approved application for development.
2. Infill potential. These are relatively small sites that are underdeveloped by current zoning but are sufficiently large and well-located and therefore present current development opportunities.
3. Current plans. This category includes major development sites and blocks within approved plans or plans currently being developed. Development policies of these sites and blocks are established in an adopted plan or are assumed to be similar to a development policy in recently approved plans. Projects may require rezoning and development approvals.
4. Long-term development potential. These sites are larger areas with long-term development potential because of their current use and location. Master plan amendments and rezoning would typically be required for redevelopment of these sites at the assumed intensity.

Figure 5-3: Potential Future Development Areas



5.1.3.5 Near-Term Development: Approved Projects and Projects in the Approval Process

For near-term development in the next 5 to 10 years, estimates are based primarily on approved projects or projects currently in the approval process. Most development approvals, except for long-term conceptual plans, are assumed to be completed within 10 years after approval. Approximately 100 projects were used to estimate development in this short-term period. Projects approved or in the approval process and not already occupied by 2019 include approximately 7,700 new dwelling units and a net increase of 1.2 million square feet of nonresidential development, most of which is either retail or office development. Nearly all of this development is expected to be in place by 2030.

5.1.3.6 Near- and Intermediate-Term Development: Infill Sites

Infill sites are small sites scattered throughout the City, typically in commercial areas along arterial streets, that are underutilized compared to their neighbors and represent a development opportunity under current zoning and patterns of development. Infill sites are typically assumed to redevelop over the next 10 to 20 years. Identified infill sites are a small part of potential future development, with a potential for up to approximately 3,500 dwelling units between now and 2045, replacing existing parking lots, small retail and service facilities, and about 700,000 square feet of office use.

5.1.3.7 Intermediate-Term Development: Approved Plans and Plans under Development

For intermediate-term development in the next 10 to 25 years, the City considers development sites or blocks that have been identified in recent corridor and area plans for areas in transition. Each of the City's major recent plans, beginning with the Arlandria and Upper Potomac West plans adopted in 2002, has identified sites for redevelopment with policies for the type and intensity of development. Potential development identified in these plans on 179 sites or blocks was used to estimate development for the intermediate term. Not all of these sites or blocks were assumed to fully built out within the intermediate term. Potential development in these planning areas includes over 21,000 dwelling units and a net increase of 5.0 million square feet of nonresidential development by 2045, with a loss of about 1.9 million square feet of industrial development and increases in office development. The intermediate-term development plans include the:

- 2003 Arlandria Neighborhood Area Plan
- 2012 Beauregard Corridor Plan
- 2008 Braddock Road Metro Neighborhood Plan
- 2019 Eisenhower East Small Area Plan
- 2016 Eisenhower West Small Area Plan
- 2019 Landmark/Van Dorn Corridor Plan
- 2005 Mount Vernon Avenue Business Area Plan
- 2017 North Potomac Yard Plan
- 2015 Oakville Triangle & Route 1 West Corridor Plan
- 2017 Old Town North Small Area Plan
- 2018 South Patrick Street Affordable Housing Strategy
- 2012 Waterfront Plan

5.1.3.8 Long-Term Potential Development

To estimate long-term development potential to give a reasonable guide to estimate

ultimate need for wastewater collection and treatment, the City went beyond the 2045 period for which Metropolitan Washington Council of Governments' forecasts are prepared. To develop this long-term estimate, planning staff evaluated the potential for redevelopment of most areas where current development and ownership patterns do not preclude redevelopment. In identifying these areas, existing single-family residential areas and areas in condominium ownership were generally excluded because of the City's general policy of protecting existing residential areas and because of the difficulty of assembling and redeveloping areas with many individual ownerships. Shopping centers, office areas, and rental apartments with substantial surface parking not included in the near- and intermediate-term forecasts were assumed to redevelop to a floor area ratio that is typical of redevelopment sites in all but the densest areas of the City near metro stations, ranging from 1.25 to 2.5 depending on access to transit and the use assumed.

Long-term development outside adopted planning areas was estimated at up to 14,000 additional dwelling units between 2046 and 2080. A loss of approximately 1.7 million square feet of nonresidential uses would provide some of the sites for this development to take place.

5.1.3.9 Location, Density, and Phasing of Forecast Development

To support the City's Department of Transportation and Environmental Services in preparing estimates of wastewater generation for the sewer collection and interceptor systems and wastewater treatment, the City's Department of Planning and Zoning prepared tables detailing these forecasts by project starting in 2018. These estimates are not predictions of what will happen in future years but are a best estimate of the general distribution and amount of development distributed over future years with totals controlled by regional forecasts. They are based on professional judgment on which projects and areas are likely to develop first. Local and regional conditions and decisions by owners and developers will ultimately determine when and if these potential projects develop as anticipated.

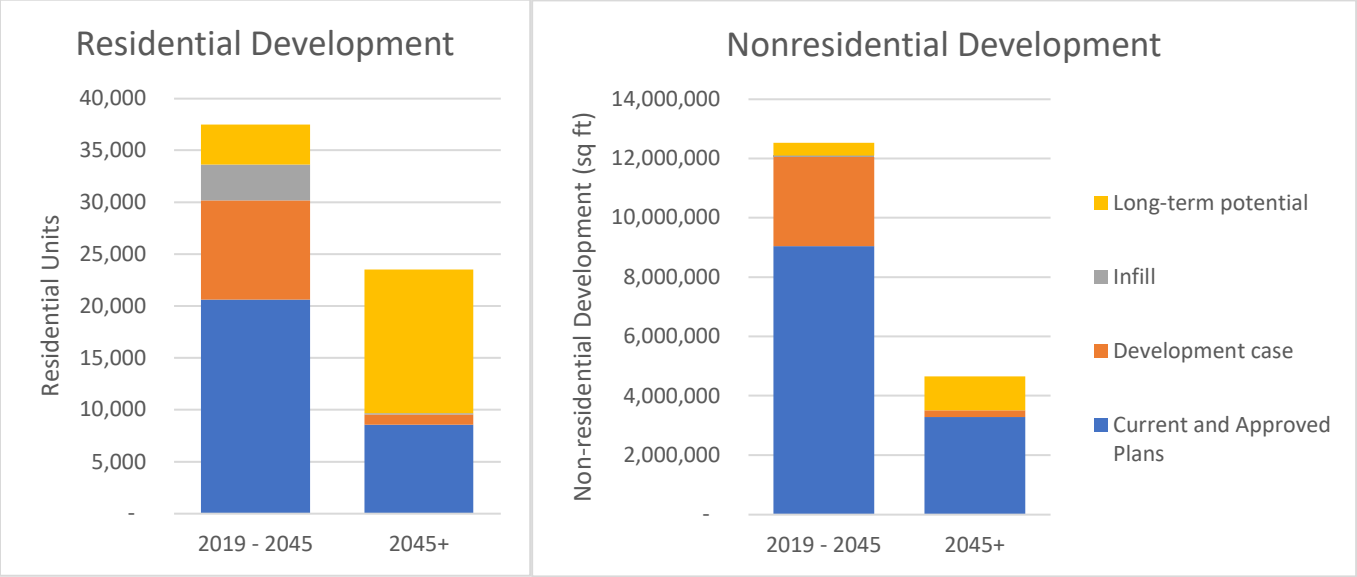
5.1.3.10 Summary of Potential Development by Approval Status

To develop the forecasts for this Sanitary Sewer Master Plan, the City used information on approximately 110 development projects either approved or currently under review, 190 potential infill or long-term redevelopment opportunity sites throughout the City, and 260 potential development sites or blocks within areas identified in recently approved plans.

As shown on Figure 5-4, development approved or in review represents about 25 percent of potential residential and nonresidential development through 2045. Infill projects are a small portion of both residential and nonresidential development. Development in planning areas represents more than half of potential residential and more than 70 percent of nonresidential development through 2045.

For potential development past 2045, long-term potential development sites account for just over half of expected residential development. Development in planning areas represents nearly 40 percent of residential development, and about 70 percent of nonresidential development. Most long-term potential development sites would require plan amendments and rezoning before they could be developed for the assumed land use and intensity of development.

Figure 5-4: Forecasted Future Development by Use and Category



Source: City of Alexandria Department of Planning and Zoning

Chapter 6
Collection System Capacity Assessment

6.1 Introduction

The sanitary sewer collection system sewers are operated and maintained by the City's Department of Transportation and Environmental Services (T&ES). The City has developed a hydraulic model, made up of 31 individual drainage areas comprising over 60 percent of the City by land area, as shown on Figure 6-1. Portions outside the modeled basins are either served by the combined sewer, are served by a newer sewer system (Potomac Yard sewershed), or have a small potential for growth.

The purpose of this chapter is to present the findings of the sewer capacity assessment in the City's sanitary collection system. Sanitary sewer capacity is assessed in the local sewers using a hydraulic model of the collection system. Capacity has been analyzed for future wastewater flows using the forecasts developed by the City's Planning and Zoning (P&Z) Department as presented in Chapter 5.

6.2 Local Collection System Model Development

6.2.1 Model Network Development

The City developed a comprehensive hydraulic model of 31 basins representing the areas within the City where the greatest amount of future development or redevelopment is forecasted. The model was developed in the InfoSWMM sanitary sewer modeling software based on invert elevations, pipe slope, and pipe diameters and system connectivity as indicated in the City's sewer GIS database. The model was calibrated to sewer flow and rainfall data collected over various periods of time, ranging from 2010 to 2018. The model then was used to simulate existing and future flow conditions and to identify capacity constraints in the system.

6.2.2 Wastewater Flow Calculations Methodology

The terminology used to describe wastewater flows for this modeling study includes:

- Base Sanitary Flow (BSF) – BSF represents the flows in the sanitary sewer system excluding groundwater infiltration and wet weather rainfall-dependent inflow and infiltration. These are the flows discharged to the sanitary sewer system for treatment.
- Groundwater Infiltration (GWI) – GWI is the more or less constant inflow of groundwater into the sanitary sewer system and is a function of groundwater table depth. GWI flows vary gradually as groundwater levels rise and fall seasonally in response to long-term rainfall and evapotranspiration. GWI is unavoidable where the sewers are below the groundwater table and groundwater enters the sewers through defects, including cracks and joints in the sewer pipe and manholes. Sewers near perennial streams are below the groundwater table year-round. Smaller diameter sewers located in upland areas away from perennial streams may be below the groundwater table only during wet weather periods (e.g., late winter and spring).

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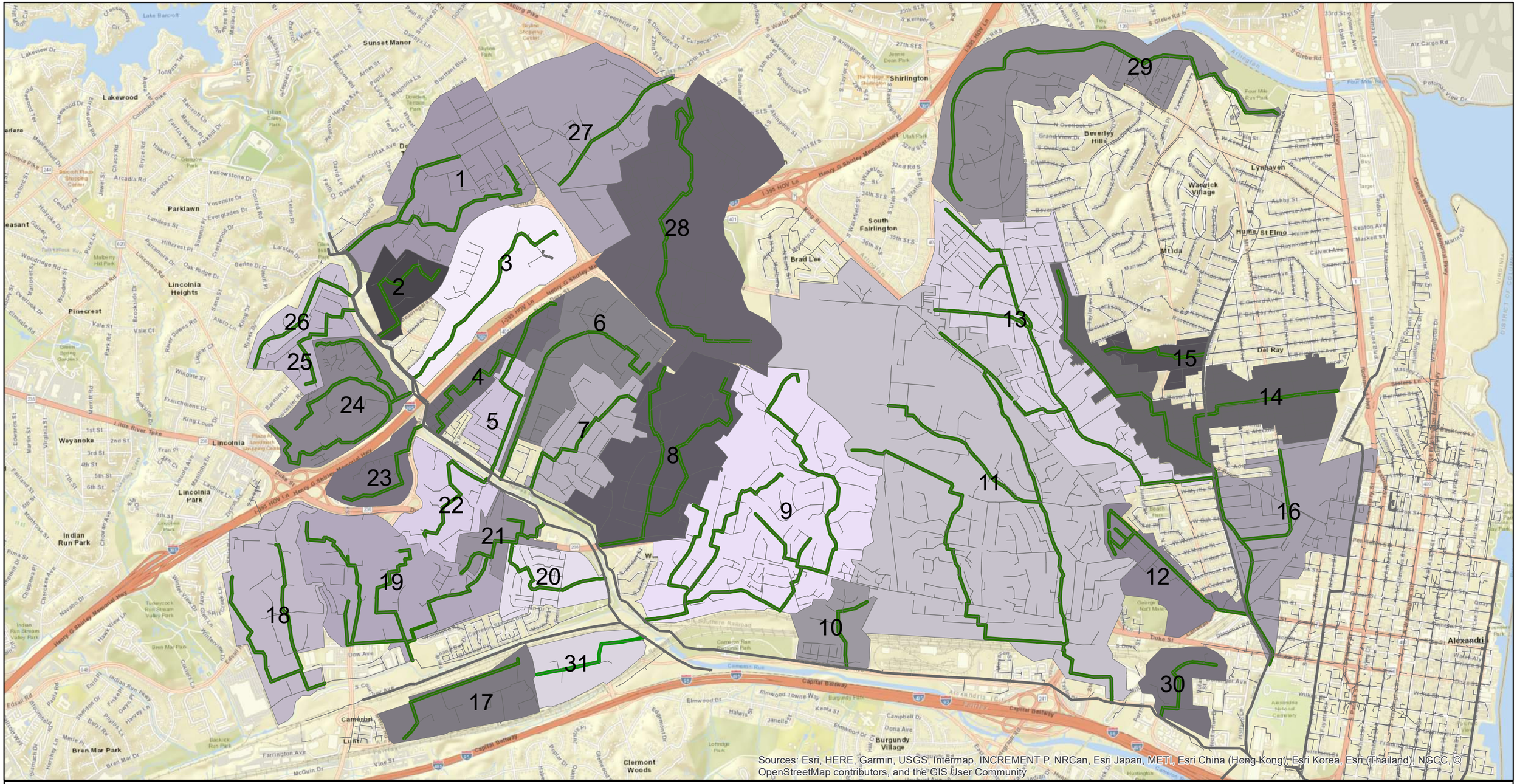

N
W E
S

Legend

- Not Modeled Sewers
- Not Modeled Interceptors
- Modeled Sewers

0 0.25 0.5 1 1.5 2 Miles

Figure 6-1
City of Alexandria Sanitary Sewer System

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- Average Dry Weather Flow (ADF) – ADF equals the sum of BSF and GWI and represents the flow in the sewers during dry weather flow periods not affected by rainfall or snowmelt. ADF varies over the year as GWI flows increase and decrease in response to long-term rainfall and evapotranspiration.
- Rainfall Induced Inflow and Infiltration (RDII) – RDII represents the flows that enter the sewer as a direct result of a rainfall or snowmelt event. RDII is zero before the rainfall event and returns to zero after the rainfall stops. RDII flows can be estimated by subtracting the estimated ADF from the observed wastewater flows.

Flow data collected at various intervals over several years was used to compute the average dry weather flows and the peak flows to estimate existing conditions for each modeled sewer basin.

Dry Weather Flows

Dry weather flows were calculated over the flow monitoring period and days where flows were not affected by the rainfall. Average dry weather flows and diurnal patterns determined from the flow meter data were input to the model to simulate current dry weather flows.

The flows were distributed proportionally to the number of dwelling units for residential use and the gross floor area for nonresidential use and were spatially assigned to the nearest manhole within the same basin. The existing number of residential households and total nonresidential building floor area was based on analysis of the City's GIS building and parcel layers for each sanitary basin.

Wet Weather Flows

Wet weather flows were calculated as a fraction of the rainfall that enters the sanitary sewers during each rainfall event. The wet weather flow parameters defining rainfall volume entering sewers and time distribution/duration were derived from the flow monitoring data.

One set of parameters was developed for each flow meter and the values were constant for all events. The parameters were adjusted to match the peak flows, flow volumes, and the general shape of the wet weather hydrograph. Higher emphasis was placed on matching the peak flows and hydrograph shape for the larger events. However, the accuracy of observed flows during extreme events (e.g., events with recurrence intervals greater than 10 years) and events that may have exceeded the capacity of the facilities were considered carefully when calibrating the parameters to these events.

Future Flows

Future dry weather flows were estimated by adding the existing dry weather flows determined from the flow meters and the increase in the base sanitary flows estimated based on the future development projections provided by the City. This procedure assumes that GWI flows remain constant between existing and future land use conditions.

The City provided estimates of the projected increase in dwelling units and the building gross floor area and the future flows were estimated using flow factors established by City's Sanitary Sewer Master Plan dated November 2012:

Residential = 146 gallons per day (gpd)/unit

Commercial = 110 gpd/1000 square feet

Hotel = 130 gpd/room

These factors represent base sanitary flows for new development assuming the typical number of residents per household and mix of commercial uses, but do not include allowances for GWI or wet weather flows.

A study to review and refine flow factors for residential and nonresidential categories was performed by the City as part of this update to the Sanitary Sewer Master Plan. Flow factors were reviewed by analyzing flow monitoring data that was collected to calibrate the model and water consumption data for the past three years. The results show that the 2012 master plan flow factors, on average, are higher than the average flow factors from the model basins and the water consumption data. Therefore, no changes are being proposed to the master plan flow factors.

The study included consideration of expanding the above master plan flow factors by increasing the number of categories for nonresidential flows to provide basis for more accurate future flow estimates. Although the nonresidential flow factor is a good representation of the average, the study showed a significant amount of variability in the water consumption data based on the type of nonresidential use (e.g., office, retail, restaurant, institutional). Based on these study findings, the City will perform a sensitivity analysis of the existing model using these various categories. This work will be done as part of a future modeling contract to be initiated in FY 2022.

6.3 Sanitary Collection System Capacity Analysis

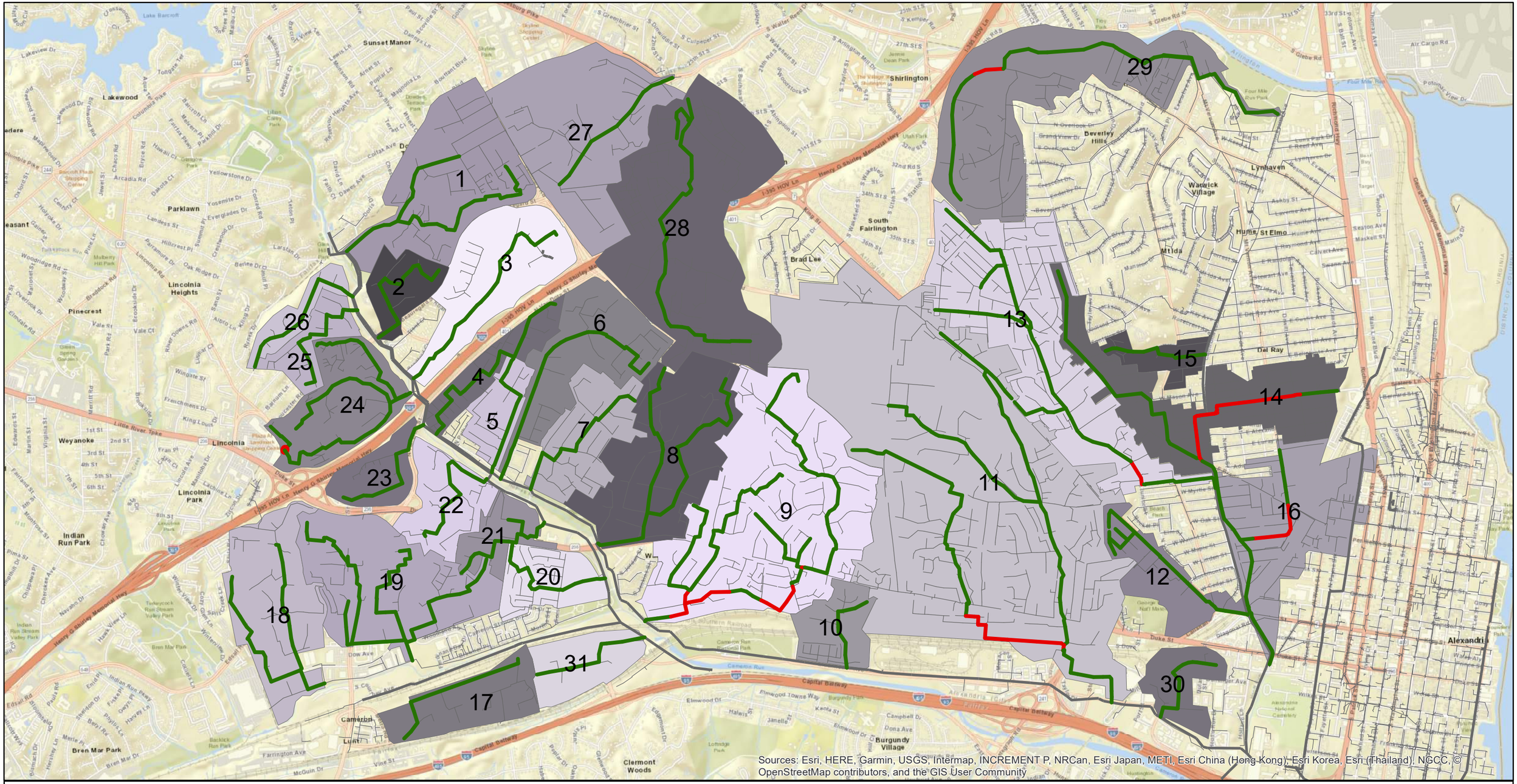
6.3.1. Methodology

The calibrated models were applied to perform the capacity assessment for current and future flow conditions and a design storm. A design rainfall event was developed for evaluating capacity for the 10-year, 24-hour rainfall recurrence frequency (10-year design storm). The 10-year design storm rainfall distribution is based on the rainfall recurrence frequency data from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 report. A 10-year design storm was chosen, as it serves as the minimum design standard for all new storm sewer construction in the City. Although this represents a minimum level of protection, in some areas where flooding and sewer backups have occurred, evaluation of larger storms should be considered. This level of service is different than what is used for the interceptor sewer system, as discussed in Chapter 8.

For capacity analysis, the models were simulated with a constant BSF by eliminating the diurnal curve. This eliminates concerns regarding the timing of the peak relative to the BSF variation. The assumption is that the rainfall likely has an equal probability of occurring at any time of the day. Therefore, combining the peak RDII flow with the average BSF represents a reasonable condition.

6.3.2 Capacity Results and Capacity Improvement Planning

The hydraulic model was run for both existing and future peak flows using the 10-year design storm. The results of the existing conditions model indicate that there are currently a small number of collector sewers where the hydraulic grade line (HGL) is not contained below the crown of the pipe. Figure 6-2 identifies these sewer mains. Approximately 12,000 feet of sanitary sewer (approximately 4 percent of modeled pipes) is currently operating over capacity under peak flow conditions.



N
W E
S

Legend

- Modeled Sewers Below Capacity
- Modeled Sewers Over Capacity
- Not Modeled Sewers
- Not Modeled Interceptors

0 0.25 0.5 1 1.5 2 Miles

Figure 6-2
City of Alexandria Sanitary Sewer System Capacity Analysis
Existing Flow Conditions

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As expected, the build-out conditions model resulted in additional sewer segments exceeding their installed capacity. These sewer segments are identified on Figure 6-3 and the model results indicate that about 16,000 feet of sanitary sewer (approximately 6 percent of the pipes modeled) will have insufficient capacity to accommodate forecasted growth. A list of the sewers shown in Figures 6-2 and 6-3 is provided in Appendix B.

An analysis of capacity needs based on build-out conditions resulted in a recommendation of growth-related improvements. As plans for development/redevelopment that impact these sewers are submitted, further analysis will be performed and improvements, if necessary, will be required as a condition of that development.

To address sewers over capacity, a study is currently ongoing to identify what capacity improvements are required or will be required in the future. When developing a plan to alleviate capacity constraints in the system, the following options for increasing capacity and lowering the HGL will be evaluated:

- Increasing pipe diameter
- Increasing pipe slope
- Adding a new parallel sewer main (splitting flow)
- Redirecting the flow to a different sewer main

Each sewer improvement will be evaluated, and the most efficient and cost-effective means will be identified for implementation. This study will be completed in FY 2022.

6.4 Conclusions and Next Steps

Results from the sanitary sewer collection system hydraulic model indicate that most of the existing sanitary sewers have adequate capacity to meet future wastewater demands based on the estimated flows. A total of approximately 12,000 feet of sewers were identified as having insufficient capacity under current flow conditions, thus requiring capital improvements projects to address the issue. Additional improvements are required to provide adequate capacity to serve development and will be reevaluated when the development occurs and future capacity improvements shall be the requirement of the development in accordance with the City's Memo to Industry 06-14 (Sanitary Sewer Adequate Outfall Analysis).

Based on the existing capacity assessment results, the City is currently reviewing the modeling results and will determine what capacity improvements are needed to address the capacity constraints. These capacity improvements will then be programmed into the City's 10-year Capital Improvement Program (CIP). Using a planning-level cost of $750 per linear foot of sewer pipe, it is estimated that these sewer capacity improvements will cost approximately $9 million.

For areas that have been subject to flooding and repeated sewer backups, the City will determine what capacity improvements will be required to protect against larger storm events to address the impacts of climate change. These capacity improvements will be evaluated and prioritized and will be programmed into a future CIP.

The rainfall frequency is based on historical data and does not consider potential changes in the rainfall frequency that may be caused by climate change. Sea level rise will likely not affect the sewers included in this capacity assessment.

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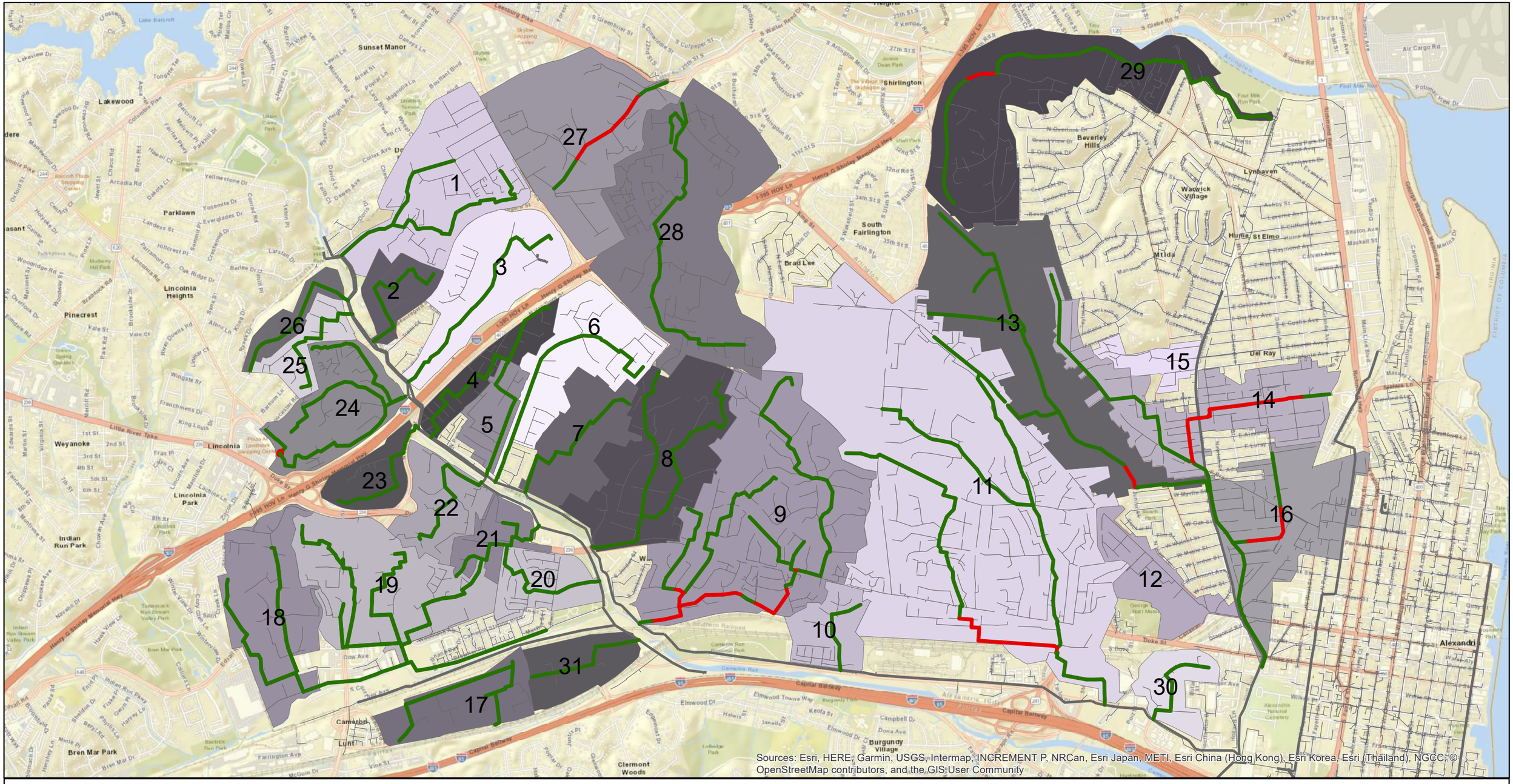

N
W E
S

Legend

- Modeled Sewers Below Capacity
- Modeled Sewers Over Capacity
- Not Modeled Sewers
- No Modeled Interceptors

0 0.25 0.5 1 1.5 2 Miles

Figure 6-3
City of Alexandria Sanitary Sewer System Capacity Analysis
Build-out Flow Conditions

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Chapter 7
Treatment Plant Capacity Assessment

7.1 Introduction

As discussed in Chapter 5, the City of Alexandria's Department of Planning and Zoning (P&Z) developed forecasts of predicted population, employment, and land use for 2020 through build-out (post-2050) conditions. This chapter discusses the evaluation of existing and future annual average wastewater flows, along with potential capacity needs at the Alexandria Renew Enterprises (AlexRenew) Water Resource Recovery Facility (WRRF) and at the Arlington County Water Pollution Control Plant (WPCP). Timing of future capacity needs and options for obtaining additional capacity are discussed.

7.2 Annual Average Flow Assessment

7.2.1 Existing Annual Average Flows

The City has wastewater flow allocation agreements with AlexRenew and Arlington County based on an annual average daily flow of 21.6 mgd and 3.0 mgd, respectively. Annual average daily flow refers to the total volume of wastewater flowing into a wastewater facility during any consecutive 365 days, divided by 365. This differs from dry weather wastewater flows because the annual average daily flow includes flows to the wastewater treatment plant during both dry and wet weather days. The amount of precipitation in any given year impacts the total wastewater flow volume at a wastewater treatment facility.

The City's allocation of 21.6 mgd at the AlexRenew WRRF represents 40 percent of the permitted annual average treatment plant design capacity of 54.0 mgd. The remaining 60 percent is allocated to Fairfax County. The AlexRenew WRRF has a peak (instantaneous) flow capacity of 108 mgd, two times the annual average design capacity. The facility is currently undergoing plant upgrades to increase this peak capacity to 116 mgd, through primary treatment, to accommodate additional wet weather flows. The upgrades are expected to be completed no later than 2025.

To determine existing wastewater flows to AlexRenew and Arlington, quarterly flow reports provided by AlexRenew were analyzed from 2015 through 2018. Table 7-1 summarizes the annual average wastewater flows at these two facilities based on the 2015 through 2018 reports for this period and the annual precipitation total.

Table 7-1: Annual Average City Wastewater Flows

Year	Flow to AlexRenew (mgd)	Flow to Arlington (mgd)	Annual Precipitation (inches)
2015	17.13	1.35	45.02
2016	16.46	1.28	31.70
2017	15.81	1.20	35.60
2018	19.15	1.30	66.28
Average	17.14	1.28	44.65

As shown in Table 7-1, flows at the wastewater treatment facilities varied primarily because of the impact of rainfall that fell during that period, with higher amounts of rainfall resulting in increased flows at the plant from both the separate and combined (only at AlexRenew) sewer systems. The annual average precipitation during this period is equal to approximately 45 inches, which is approximately 4 to 5 inches greater than the average precipitation total for the City based on rainfall records dating back to the late 1800s. 2018 was the wettest calendar

year on record, with more than 20 inches greater than the annual average precipitation.

The results of the analysis indicate annual average daily flow from the City of 17.14 mgd and 1.28 mgd to the AlexRenew and Arlington service areas, respectively. These flows represent the baseline existing flows to which all future flows to the AlexRenew WRRF and the Arlington WPCP are added for the purposes of this Sanitary Sewer Master Plan.

7.2.2 Future Dry Weather Wastewater Flows

As discussed in Chapter 5, the City developed population, employment, and land use forecasts for every 5 years between 2020 and 2050, and then for build-out (post-2050) conditions. This section discusses the estimation of future wastewater flows to the treatment facilities based on the application of unit flow factors. These future flows are added to the baseline existing flows shown in Table 7-1 and compared to the City's allocation at the AlexRenew WRRF and the Arlington WPCP.

The flow factors for residential (146 gallons per day [gpd] per household), nonresidential (110 gpd per 1000 square feet, non-hotel) and hotel (130 gpd per hotel room) uses were multiplied by the total number of projected additional households, square feet of nonresidential building area, and number of estimated hotel rooms, respectively. These results are presented in Table 7-2 for 2025 through build-out conditions. No additional infiltration or inflow (I/I) is incorporated into these flow estimates. This is because most proposed development or redevelopment already has sewer infrastructure in place such that there would be no additional entry points for I/I to enter the sewer system. It is assumed that the City will continue its program to maintain the integrity of these sewers, which will help minimize the amount of I/I in the system. A 20-percent allowance for low flow fixtures is incorporated into the nonresidential flow factor as required for all new development. Even though this requirement also pertains to residential development, this was not incorporated into the residential flow factor as these fixtures tend to be replaced more frequently and may not be as water efficient.

The flows in Table 7-2 were then added to the existing average baseline flows presented in Table 7-1 to determine if the City's existing allocation would be exceeded and, if so, approximately when this allocation would be exceeded. This information is presented in Table 7-3.

Table 7-3 indicates that the City's annual average allocation of 21.6 mgd at the AlexRenew WRRF will be exceeded sometime between 2040 and 2045. The total build-out flow projections exceed the annual average allocation by 3.7 mgd. A future additional need of 4-mgd capacity at the AlexRenew WRRF was previously identified as part of the 2013 Sanitary Sewer Master Plan, which is consistent with this Sanitary Sewer Master Plan update.

Table 7-3 indicates that the City will not require additional capacity at the Arlington WPCP to accommodate future wastewater flows for build-out conditions, which is also consistent with the findings of the 2013 plan.

Table 7-2: Projected Future Wastewater Flows

	Net Incremental Average Daily Wastewater Flow (mgd)							
Location	2018–2025	2026–2030	2031–2035	2036–2040	2041–2045	2046–2050	Build-out (post-2050)	Total
AlexRenew Service Area	1.54	0.95	0.91	0.82	1.03	0.84	2.08	8.17
Arlington Service Area	0.15	0.06	0.07	0.05	0.07	0.00	0.10	0.50
Total City Flow	1.69	1.01	0.98	0.87	1.10	0.84	2.18	8.67

Table 7-3: Projected Total Annual Average Flows

	Total Average Daily Wastewater Flow (mgd)							
Location	2018–2025	2026–2030	2031–2035	2036–2040	2041–2045	2046–2050	Build-out (post-2050)	Additional Need
AlexRenew Service Area	18.68	19.63	20.54	21.36	22.39	23.23	25.31	3.71
Arlington Service Area	1.43	1.49	1.56	1.61	1.68	1.68	1.78	0

7.3 Treatment Plant Capacity Alternatives

A review of the City's existing wastewater flows and growth projections indicates the need for an additional wastewater treatment at AlexRenew is approximately 4 mgd and that the City will reach its existing allocation sometime between 2040 and 2045. This section identifies alternatives to potentially meet this 4-mgd need at the AlexRenew WRRF.

These alternatives can be classified into four broad categories:

- Modifications and upgrades at the AlexRenew WRRF
- Purchase of AlexRenew treatment capacity from Fairfax County
- Combination of above two options
- Other options to decrease City wastewater treatment capacity needs

A discussion of each alternative follows.

7.3.1 Modifications and Upgrades at the AlexRenew WRRF

This alternative involves modifying the existing and future planned wastewater treatment and water reclamation processes to meet treatment and flow requirements for an additional 4 mgd. The AlexRenew WRRF is currently going through major upgrades as part of its RiverRenew program to meet the 2017 Combined Sewer Overflow (CSO) Law. Following the completion of this program and once the RiverRenew infrastructure is operational, a study will be undertaken to determine which plant processes will need to be upgraded, the timing of such upgrades, and the total capital cost to provide this additional 4-mgd capacity allocation to the City.

7.3.2 Purchase Additional Wastewater Treatment Capacity

As part of the 2013 Sanitary Sewer Master Plan, Fairfax County indicated that it might not require all of its allocated capacity at AlexRenew and may be willing to sell 4 mgd of its 32.4-mgd allocation. Further discussion will be needed, along with the completion of the study to expand the plant to treat an

additional 4 mgd, before the City can decide whether to proceed with this option.

7.3.3 Combination of Modifications and Upgrades at the AlexRenew WRRF with Purchase of Additional Wastewater Treatment Capacity

This alternative represents a scenario where hydraulic capacity upgrades are completed for a portion of the 4-mgd need and the remaining capacity is purchased from Fairfax County.

7.3.4 Other Options to Decrease Wastewater Treatment Capacity Needs

As discussed in Chapter 4, the City has a 20-year program aimed at reducing I/I in the separate sanitary sewer system, which has successfully reduced some of the of I/I that gets into the sanitary sewer system. The City's continued sewer replacement and rehabilitation programs will result in continuation of reduced wet weather flows to the AlexRenew WRRF.

The amount of wastewater flow generated from households has also decreased over time as plumbing fixtures have become more water efficient, along with education regarding water conservation. A number of communities across the country have implemented various programs aimed at water conservation. In 2019, the City updated its Environmental Action Plan (EAP 2040). One of the EAP 2040's short-term actions is to educate homeowners and businesses in water conservation practices and consider an incentive program (such as rebates, fee reductions, or tax breaks) aimed at reducing water consumption. The City will participate in a study that will review other community programs, provide recommendations for future program implementation, and provide education and outreach materials starting in FY 2022, to be completed in FY 2023.

Finally, the City continues to support reductions in wastewater flows through greywater reuse and using reclaimed water from AlexRenew. Greywater reuse involves the treatment and on-site reuse of "grey" wastewater (from sinks, showers, and washing machines) for toilet flushing. Reclaimed water from treated effluent at AlexRenew has the potential to be conveyed from their site to additional sites for irrigation or other non-potable uses. AlexRenew currently uses reclaimed water as part of their plant operations.

7.4 Conclusions

The assessment presented in this chapter indicates that the City will exceed its average annual allocation at the AlexRenew WRRF between 2040 and 2045 based on current growth forecasts. As part of the next Sanitary Sewer Master Plan update, anticipated around 2027 to 2028, the City will have completed a study regarding options to obtain additional wastewater treatment capacity. This will include AlexRenew WRRF expansion, purchasing capacity from Fairfax County, a possible combination of both options, and other potential alternatives, including water conservation, and greywater reuse, reclaimed water reuse. The City will also continuously track growth projections and flows at AlexRenew.

Chapter 8
Interceptor Sewer Capacity Assessment

8.1 Introduction

Chapter 6 addressed sewer capacity in the City-owned collection system and Chapter 7 addressed sewer capacity at the AlexRenew and Arlington County wastewater treatment facilities. This chapter presents an analysis of future flows, including during periods of wet weather, for the AlexRenew interceptor sewers. The City has an existing service agreement with AlexRenew, which provides for allocated peak flows in the interceptor sewers. This chapter evaluates whether there is sufficient capacity in these sewers for both existing wet weather flows and future growth, presents the timing of when capacity and infrastructure improvements are needed, and provides a planning level of cost for these improvements. This chapter builds upon existing hydraulic modeling studies conducted jointly between the City, AlexRenew, and Fairfax County.

8.2 Interceptor Sewer Evaluation

8.2.1 Background and Goals

The City has been working with AlexRenew and Fairfax County since the late 1990s on studies related to wet weather hydraulic modeling of the AlexRenew interceptor sewers. That model has been updated and expanded over the past 20 years and now includes the combined sewer system and outfalls, the Fairfax County Lower Holmes Run and Backlick sewers, and the proposed RiverRenew infrastructure. The model has also been recalibrated using additional flow and rainfall modeling data in 2002, 2007, 2009, and 2015.

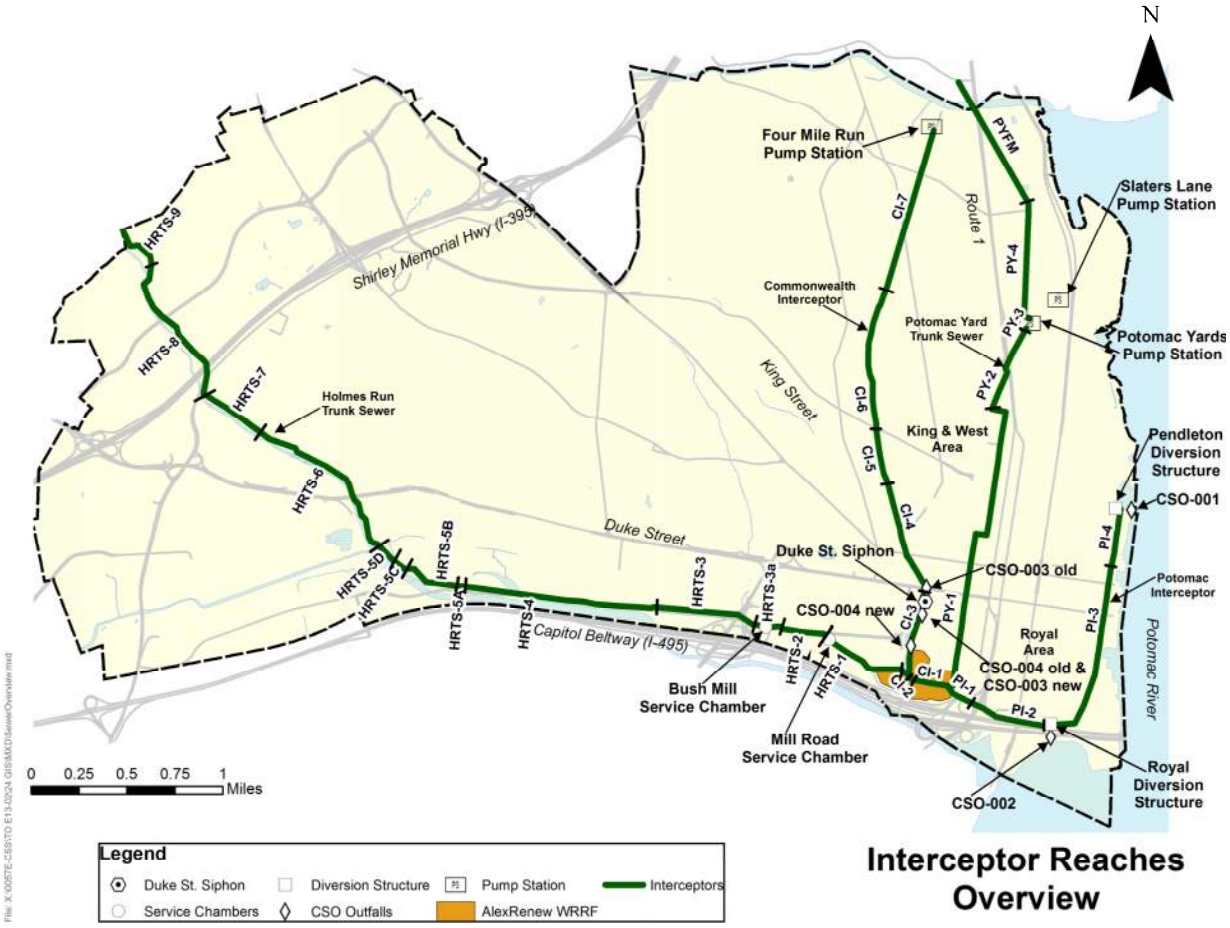
The City, Fairfax County, and AlexRenew jointly developed wet weather goals as part of the modeling effort with the primary goal to mitigate wet weather flows such that no sanitary sewer overflows (SSOs) occur for any rain event less than or equal to the 5-year , 24-hour design storm. As discussed in Chapter 3, SSOs are not permitted by the Virginia Department of Environmental Quality (VDEQ) and must be reported to VDEQ each time they occur. A 5-year design storm was chosen because it represents the typical level of design of larger interceptor sewers, such as those owned by AlexRenew, that serve a wide area. This is separate from what the City uses for its sanitary sewer collection system with respect to sewer capacity.

The City's service agreement with AlexRenew provides the City's share of peak flow limits in various sections of the AlexRenew interceptor sewers, which include the Commonwealth Interceptor, Holmes Run Trunk Sewer (joint-use sewer with Fairfax County), Potomac Interceptor, and Potomac Yard Trunk Sewer. These peak flow limits are based on a 5-year design storm, consider future growth, the RiverRenew program (see Chapter 9), and future capacity improvements on the Fairfax County Lower Holmes Run Sewer (discussed later in this Chapter). A 5-year design storm is a reasonable level of control for interceptor sewers and is consistent with other jurisdictions across the country.

8.2.2 City Peak Flow Limits

Figure 8-1 shows a schematic of the model including the AlexRenew interceptor sewers, the AlexRenew Water Resource Recovery Facility (WRRF), inputs of City flow, and the four combined sewer outfalls. Each of the interceptor sewers is broken out into model reaches based on pipe diameter and flow inputs.

Figure 8-1: AlexRenew Interceptor System Overview



These reaches correspond with the pipe capacities and peak flow limits shown in the service agreement and listed on Tables 8-1 through 8-4. The Commonwealth Interceptor, Potomac Interceptor, and Potomac Yard Trunk Sewer only receive flow from the City. The Holmes Run Trunk Sewer is a joint-use sewer, receiving flows from both the City and Fairfax County's sanitary collection system.

The City also has sewer flows that enter the three Fairfax County trunk sewers located in the City (Lower Holmes Run, North and South Backlick Sewers), as shown on Figure 8-2. The City, as part of its 1951 annexation of a portion of Fairfax County, was required to reimburse the County a portion of the capital cost of the North and South Backlick Sewers. This annexation transferred County lands (generally now known as Eisenhower West) to the City.

Table 8-1: Holmes Run Trunk Sewer Peak Flow Limits

Reach	Upstream	Downstream	City of Alexandria Peak Flow Limit (mgd)
HRTS-1	Mill Road	Hooffs Run Junction Chamber	28.4
HRTS-2	West of Swamp Fox Road	Mill Road	27.8
HRTS-3a	Taylor Drive	West of Swamp Fox Road	20.8
HRTS-3	Washington Metropolitan Area Transit Authority MH-17	Taylor Drive	20.8
HRTS-4	Fairfax Holmes Run Sewer (HRS) Connection	Washington Metropolitan Area Transit Authority Manhole H-17	20.8
HRTS-5a	West of Fairfax HRS Connection	Fairfax HRS Connection	8.3
HRTS-5b	South of Original Cameron Station Connection	West of Fairfax HRS Connection	8.3
HRTS-5c	Original Cameron Station Connection	South of Original Cameron Station Connection	8.3
HRTS-5d	South of South Jenkins Street	Original Cameron Station Connection	8.3
HRTS-6	North Paxton Street	South of South Jenkins Street	8.3
HRTS-7	North Van Dorn Street	North Paxton Street	7.9
HRTS-8	Dora Kelley Park	North Van Dorn Street	5.7
HRTS-9	Dowden Terrace Diversion	Dora Kelley Park	1.7

Table 8-2: Commonwealth Interceptor Peak Flow Limits

Reach	Upstream	Downstream	City of Alexandria Peak Flow Limit (MGD)
CI-1	Junction Chamber A	WRRF Influent	N/A
CI-2	Hooffs Run Junction Chamber	Junction Chamber A	N/A
CI-3	Duke Street Siphon Outfall	Hooffs Run Junction Chamber	30.4
CI-4	Walnut Street	Duke Street	21.6
CI-5	Braddock Road	Walnut Street	11.7
CI-6	Caton Avenue	Braddock Road	10.9
CI-7	Four Mile Run Pump Station	Caton Avenue	9.4

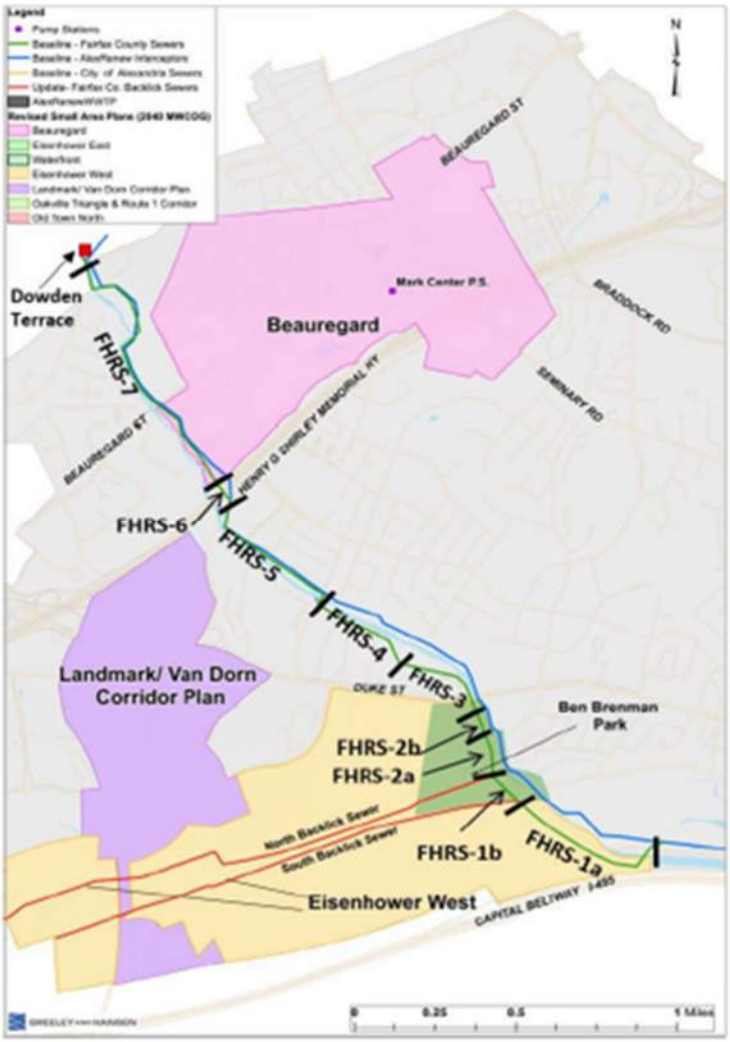
Table 8-3: Potomac Interceptor Peak Flow Limits

Reach	Upstream	Downstream	City of Alexandria Peak Flow Limit (MGD)
PI-1	Route 1	WRRF Influent	17.7
PI-2	Royal Street	Route 1	17.1
PI-3	Cameron Street	Royal Street	14.5
PI-4	Pendleton Street	Cameron Street	13.9

Table 8-4: Potomac Yard Trunk Sewer Peak Flow Limits

Reach	Upstream	Downstream	City of Alexandria Peak Flow Limit (MGD)
PYTS-1	Manhole S24 (North of East Glendale Avenue)	WRRF Influent	17.3
PYTS-2	Manhole S33A	Manhole S24 (North of East Glendale Avenue)	11.7
PYTS-3	Potomac Yard Pump Station	Manhole S33A	10.5
PYTS-4	East Glebe Road	Potomac Yard Pump Station	10.5
PYTS-5	Four Mile Run Pump Station	East Glebe Road	4.0

Figure 8-2: Fairfax County Trunk Sewers in City



8.2.3 AlexRenew Interceptor Modeling Results

Studies and reports have been published that document the interceptor modeling studies since the late 1990s. The most recent report, *Eisenhower Avenue/Holmes Run Trunk Sewer Capacity Evaluation* (HRTS report), prepared by Greeley and Hansen (2019), builds off of the modeling work summarized in *Wet Weather Management Evaluation Update (Task Order 16-2005)* (TO-16 report), prepared by CH2MHill (2015). The purpose of the HRTS report was to determine the impact of the City's future capacity needs associated with new growth in the western portion of the City, including the capacity in Fairfax's Backlick Sewers. The modeling to support the evaluation added the Backlick Sewers to the task order (TO)-16 model and recalibrated the model in the vicinity of the Backlick Sewer. The Backlick Sewer model calibration was downgraded to match the TO-16 peak wet weather flows at the Cameron Run Station meter, which maintained consistency with TO-16 results. The next steps to improve the predictability of the model and to evaluate the capacity needs of the AlexRenew interceptor system are:

1. Recalibrate the TO-16 model to reflect the most recent conditions of Fairfax County and City collection systems in the Backlick Sewer system.
2. Assess the lower Holmes Run Trunk Sewer based on the revised calibration to determine if additional capacity is required to convey the 5-year, 24-hour design storm.
3. Evaluate the impacts on the RiverRenew program and Long-Term Control Plan Update (LTCPU) performance.

Both the HRTS report and the TO-16 report indicate that the AlexRenew interceptor sewers require capacity improvements to accommodate the 5-year design storm and support future growth. The modeling shows surcharging of interceptor sewers, potentially leading to sewer backups and SSOs.

With respect to the Commonwealth Interceptor and Potomac Interceptor, the capacity issues will be significantly mitigated with the construction of the RiverRenew program, which will provide a wet weather pumping station to help reduce sewer backups during extreme wet weather events. More about the RiverRenew program is presented in Chapter 9.

As discussed in Chapter 3, the RiverRenew program must be completed by July 1, 2025 to comply with the 2017 Combined Sewer Overflow (CSO) Law. As part of the construction of this program, the modeling results show that the City will remain within its peak flow limit for future conditions (post-2050 build-out) during the 5-year design storm for these two interceptor sewers. However, the service agreement will need to be amended in the future to account for the Commonwealth Interceptor from Duke Street to AlexRenew that is being upsized as part of the RiverRenew program.

With respect to the Commonwealth Interceptor, for storms larger than the 5-year design storm, certain areas of the City will still be subject to potential sewer backups and overflows. Additional mitigation measures will be required to reduce the potential for backups and overflows for these events. Chapter 4 discusses some of the strategies the City is implementing to reduce the potential for sanitary sewers during extreme wet weather events, such as those that took place in July 2019, July 2020 and September 2020,

which were larger storms that the 5-year design storm.

The Potomac Yard Trunk Sewer was analyzed as part of a sewer study conducted in the 2020 Coordinated Development District (CDD) update for North Potomac Yard. As stated in the conditions of the CDD, the applicant shall be required to provide all sewer capacity improvements upstream of the 30-inch diameter trunk sewer to serve the development, with some sewer tap fee offsets provided to account for improvements that serve other areas outside North Potomac Yard. Capacity issues and improvements for the 30-inch diameter trunk sewer to alleviate capacity issues are discussed in this chapter.

There are two separate capacity issues that need to be addressed for the Holmes Run Trunk Sewer, which are not mitigated by the RiverRenew project. For simplicity, these will be referred to as the Upper Holmes Run Sewer and the Lower Holmes Run Sewer. These capacity issues are discussed in detail below.

8.2.4 Upper Holmes Run Interceptor Capacity Discussion

8.2.4.1 2015 TO-16 Report Recommendations

As mentioned above, the City's current service agreement includes capacity improvements in the western area of the City. These improvements were first proposed as part of the 2015 TO-16 report. The improvements include:

- Pipe lining of the Holmes Run Trunk Sewer upstream of North Van Dorn Street (HRTS-8 and HRTS-9, as shown in Figure 8-1).
- Increasing capacity in the Fairfax Lower Holmes Run Sewer by increasing the pipe diameter from 30 to 36 inches from Dowden Terrace to Ben Brenman Park. This would allow more flow from Fairfax County to be diverted into their Lower Holmes Run Sewer at the Dowden Terrace diversion chamber, thus lowering the flow in the AlexRenew Holmes Run Sewer (FHRS-7, FHRS-5 to FHRS-1a, as shown on Figure 8-2). No capacity increase is required on FHRS-6.

Flow between the Upper Holmes Run Trunk Sewer and the Fairfax Lower Holmes Run Sewer would be further optimized using a gated sewer connection between the two sewers located near Paxton Street.

8.2.4.2 2019 Interceptor Modeling

The interceptor model was updated in 2019 to account for the RiverRenew program and for updated growth forecasts used as part of this Sanitary Sewer Master Plan update. This includes incorporating growth detailed in the Eisenhower West Small Plan. The model results indicate that, with the proposed improvements discussed above, the City will be within its allocated peak flow limits for this portion of the Holmes Run Trunk Sewer.

8.2.4.3 2019 Capacity Improvements Cost and Schedule

Planning-level costs for these interceptor improvements were provided in the TO-16 report and then updated to 2018 dollars in the HRTS report. The total planning-level cost is approximately $24 million. These costs will be shared between the City and Fairfax County because the Holmes Run Trunk Sewer is a joint-use sewer. The total cost share will be based on a future study and will be negotiated between the City and Fairfax County, along with determining the timing for when the improvements will be constructed. Once the timing and cost share are determined, the City will add the

improvements to its capital improvement program. These improvements are anticipated to be constructed following the completion of the RiverRenew program.

8.2.5 Lower Holmes Run Interceptor Capacity Discussion

Although the wet weather pumping station being constructed as part of the RiverRenew program will reduce surcharging in the Lower Holmes Run Trunk Sewer, capacity improvements may be required to accommodate future growth in the East Eisenhower Valley. The recently completed update to the East Eisenhower Small Area Plan provides for an additional 6.8 million square feet of development. The interceptor model was updated to account for this additional growth. It is anticipated that the City will start to exceed its peak flow allocations starting on or around 2035.

Once the RiverRenew program has been completed and is operational (2025), it is recommended that the interceptor model be recalibrated based on the performance of RiverRenew infrastructure and the level of surcharging in the East Eisenhower Valley be reassessed. These results, along with specific infrastructure improvement recommendations on the Lower Holmes Run Trunk Sewer, will be included as part of the next Sewer Plan update (around 2027).

8.2.6 Backlick Sewers Discussion

As part of the 2019 HRTS report, the Fairfax County Backlick Sewers were added to the interceptor model and analyzed. These sewers include flows from both the City and Fairfax County. The model results show that there is sufficient capacity to accommodate future growth, but more information needs to be collected and that recalibration will be required for these sewers.

8.2.7 Potomac Yard Trunk Sewer Capacity Discussion

To serve the development envisioned in the 1999 Potomac Yard/Potomac Greens Small Area Plan, significant new sewer infrastructure was constructed by the developer in the 2000s both on-site (within Potomac Yard boundaries) and off-site, as shown on Figure 8-3 (sewer reaches PY-1 to PY-5).

Figure 8-3: Existing Potomac Yard Sanitary Sewer Infrastructure

This infrastructure included the construction of a very deep 30-inch diameter trunk sewer, known as the Potomac Yard Trunk Sewer (PYTS) or reach PY-1, which begins at Main Line Boulevard and ends at the AlexRenew WRRF. Given the scope and size of the infrastructure constructed, sewer connection fees in Potomac Yard were significantly reduced per City Code section 5-6-25.1(c). The reduction in fees is set to expire in 2026.

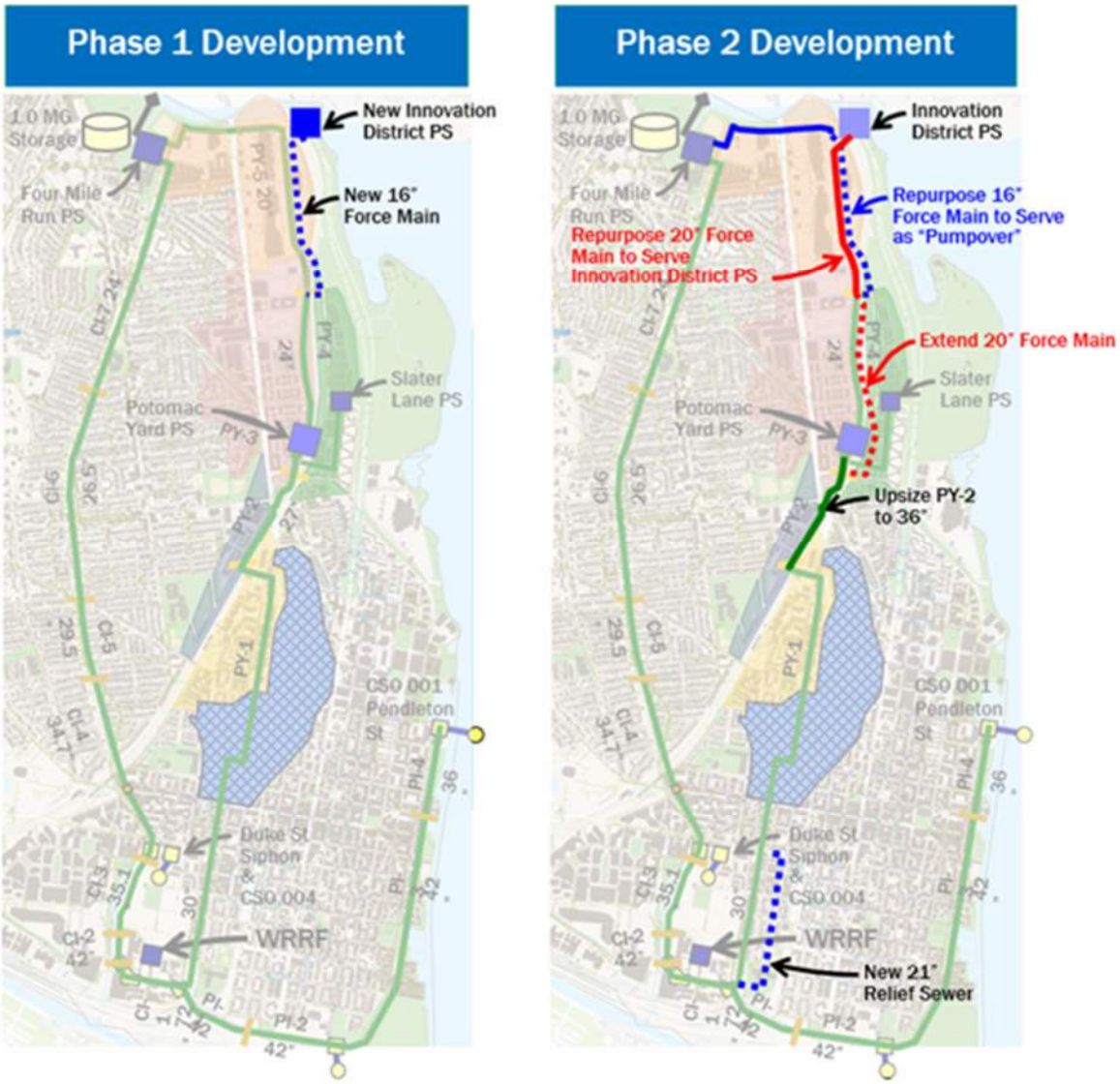
As part of the 2010 CDD and 2020 CDD update for North Potomac Yard, the allowable density was increased from 700,000 to 8.4 million square feet. A sewer study was completed in 2020, which included new sewer infrastructure, along with required capacity upgrades for existing infrastructure. To serve ultimate development, the following is required, as shown on Figure 8-4:

- New 5.6-mgd pumping station (Innovation District Pumping Station) located on the northeast end of North Potomac Yard and associated force main connecting to the existing 24-inch sanitary sewer (reach PY-4) located at Potomac Avenue and East Glebe Road (Phase 1 development).
- Force main extension from Potomac Avenue and East Glebe Road to the 27-inch sanitary sewer (reach PY-2) located just downstream of the existing Potomac Yard Pumping Station (Phase 2 development).
- Repurposing of existing 20-inch diameter force main from Four Mile Run Pumping Station to serve as pumpover for new Innovation District Pumping Station and repurpose 16-inch diameter force main to serve as pumpover for existing Four Mile Run Pumping Station (Phase 2 development). It should be noted that the existing pumpover at the Four Mile Run Pumping Station is one-way in that it pumps flow from the Four Mile Run Sewershed into the Potomac Yard Sewershed. Flows from Potomac Yard cannot be pumped into Four Mile Run.
- Upsizing the existing 27-inch diameter sanitary sewer (reach PY-2) to a 36-inch diameter sanitary sewer (Phase 2 development).
- New 21-inch diameter relief sewer parallel to reach PY-1 (Phase 2 development).
- The new Innovation District Pumping Station will allow for future potential construction of a sanitary wastewater energy exchange system to extract thermal energy for heating/cooling purposes to North Potomac Yard using flows from the pumping station.

Because new sewer infrastructure and infrastructure upgrades also serve areas outside of Potomac Yard, credits shall be provided against the sewer tap fee to extend beyond 2026.

Per its service agreement with AlexRenew, the City must provide any required upgrades in the 30-inch diameter PYTS (reach PY-1). The timing of these improvements is dependent upon both timing of development in North Potomac Yard and areas outside of the Potomac Yard boundaries. Capacity upgrades will likely consist of a parallel sewer. These improvements are not anticipated to be needed in the near-term (next 10 years). The City and AlexRenew together will continue to monitor flows in this trunk sewer and determine required capacity improvements. These future improvements must be funded using connection fees revenues, including those from development projects that connect into this trunk sewer.

Figure 8-4: Future Potomac Yard Sewer Improvements



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Chapter 9
RiverRenew

9.1 Background

As discussed in Chapters 2 and 3, a portion of Alexandria is served by a combined sewer system that dates back to the 1800s where combined sewer discharges can occur from four combined sewer outfalls during periods of wet weather. The 2017 Virginia Combined Sewer Overflow (CSO) Law states that all four of Alexandria's combined sewer outfalls must be remediated by July 1, 2025 by meeting either the 1994 U.S. Environmental Protection Agency (EPA) CSO Control Policy or the Hunting Creek Total Maximum Daily Load (TMDL)—whichever is more stringent.

In response to the 2017 CSO Law, a Long-Term Control Plan Update (LTCPU) was submitted to Virginia Department of Environmental Quality (VDEQ) on May 4, 2018. This plan was developed jointly between the City and Alexandria Renew Enterprises (AlexRenew). The LTCPU set forth a publicly vetted, preferred alternative, referred to as Option B+, consisting of a tunnel system coupled with upgrades at the AlexRenew Water Resource Recovery Facility (WRRF). On June 29, 2018, VDEQ sent a letter to the City and AlexRenew stating VDEQ's concurrence that Option B+ would meet the requirements of the 2017 CSO Law.

On July 1, 2018, ownership of the four combined sewer outfalls was transferred from the City to AlexRenew. Subsequent to the LTCPU and transfer of outfalls, Option B+ of the LTCPU became known as Alexandria's Wet Weather Program. This "wet weather" moniker was a temporary placeholder until an overall brand for the remediation program was established. The recommended plan, Option B+, and the Wet Weather Program are now referred to as RiverRenew.

9.2 RiverRenew Facilities

9.2.1 Overview of Facilities

RiverRenew consists of four major projects:

- Tunnel System Project: a storage and conveyance tunnel system, pumping stations, and wet weather treatment
- WRRF Site Security and Access Project: upgrades to AlexRenew's existing access points (gate) and site security system
- 108 to 116 mgd Expansion Project: upgrades to AlexRenew's primary treatment pumping capacity at the WRRF
- Building J Facilities Relocation and Decommissioning Project: relocation of facilities and decommissioning of AlexRenew's former administrative building

The tunnel system project comprises the most substantial construction related to the RiverRenew program and represents most of the program cost. More information about the tunnel system is discussed in Section 9.2.2. The remaining three projects are already under construction and slated to be completed in time for tunnel system project construction to begin at the WRRF.

9.2.2 Tunnel System Description

The Tunnel System Project is the largest of the proposed RiverRenew projects. Upon its completion, the project will reduce the average volume of overflows to Alexandria's receiving waters from 140 million gallons to less than 17 million gallons and reduce the frequency of overflows from 70 events to less than 4 on an annual average basis. Additionally, the project will provide a

systemwide capture of 98 percent and significantly mitigate the frequency, magnitude, and duration of sewer flooding and basement backups along the Commonwealth Interceptor and Holmes Run Trunk Sewer. The project includes three main components: Waterfront Tunnel, Hooffs Run Interceptor, and Tunnel Dewatering and Wet Weather Pumping Station. Figure 9-1 illustrates the components of the Tunnel System Project.

9.2.2.1 Waterfront Tunnel

The Waterfront Tunnel is a soft ground tunnel designed to control overflows from Outfalls 001 and 002. The Waterfront Tunnel will commence at AlexRenew's WRRF and terminate at Oronoco Bay, as illustrated on Figure 9-1. The tunnel includes an east-west alignment largely under Old Town Alexandria that bends to the north under Jones Point Park, and then is mainly aligned under the Potomac River until it reaches Oronoco Bay. The proposed tunnel will have a minimum inside diameter of 12 feet and maximum outside diameter of 19 feet. The 11,500-linear foot tunnel will be located between 115 and 160 feet below the ground surface.

9.2.2.2 Hooffs Run Interceptor

The proposed Hooffs Run Interceptor is designed to control overflows from Outfalls 003 and 004 and convey flows to AlexRenew's WRRF for treatment. The Hooffs Run Interceptor will also mitigate sewer flooding and basement backups along the Commonwealth Interceptor and Holmes Run Trunk Sewer. Components associated with the Hooffs Run Interceptor include:

- Diversion chamber and tie-in to existing Outfalls 003 and 004 near Duke Street
- 6-foot-diameter, 2,500-foot-long interceptor between Duke Street and AlexRenew's WRRF. 1,400 linear feet include the replacement of the existing 3-foot-diameter Commonwealth Interceptor
- Hydraulic grade line control structure

9.2.2.3 Tunnel Dewatering/Wet Weather Pumping Station and Superstructure

The Tunnel Dewatering and Wet Weather Pumping Station is proposed to be housed within the approximately 65-foot-diameter, 130-foot-deep Waterfront Tunnel mining shaft located at AlexRenew's WRRF. An additional 35-foot-diameter, 130-foot-deep screening shaft is proposed to be located adjacent to the mining shaft. The screening shaft will be used to connect the Hooffs Run Interceptor to the Waterfront Tunnel and manage residuals due to wet weather events. The components at the surface will be housed in superstructure that ranges from one to four stories with dedicated spaces for mechanical, electrical, and instrumentation facilities to support the pumping station.

The tunnel dewatering pumps are proposed to be installed in a manifold configuration at the bottom of the Waterfront Tunnel mining shaft to deliver tunnel system flows to the AlexRenew WRRF for treatment prior to discharge to Hunting Creek. The wet weather pumps are proposed to operate in conjunction with the hydraulic grade line control structure to reduce combined sewer discharges from Outfalls 003 and 004 and minimize backwater that contributes to basement backups and sewer flooding along the Commonwealth Interceptor and Holmes Run Trunk Sewer. The wet weather pumps are proposed to be installed within an intermediate floor in the Waterfront Tunnel mining shaft (above the tunnel dewatering pumps).

Figure 9-1: RiverRenew Tunnel System

Depending on storm event intensity, flows from the wet weather pumps will be directed to Outfall 001 (via the Waterfront Tunnel), wet weather treatment, or Outfall 004 via a gravity control structure (headbox).

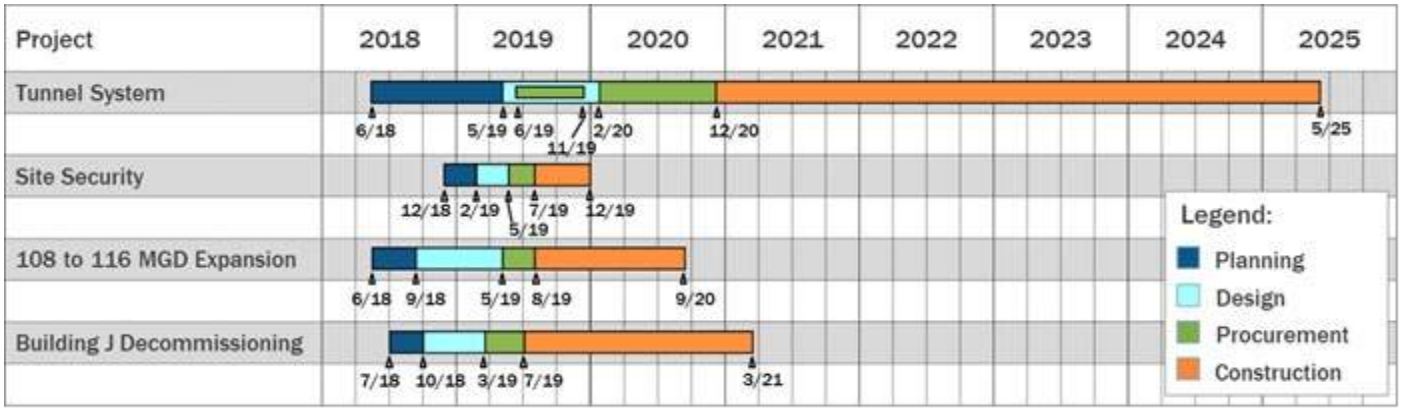
A significant portion of the project is located within residential and commercial areas containing significant community and natural resources. Considerable planning and careful execution are essential to prevent or mitigate impacts to neighborhoods, public activities, historic structures, archaeological resources, and the environment. Special consideration will be given to employing active outreach and communication with stakeholders to maintain AlexRenew's reputation for commitment to the community.

9.3 RiverRenew Implementation Schedule, Cost, and Financing

The schedule stipulated by the 2017 CSO Law requires the combined sewer controls be in place by July 1, 2025. An implementation schedule for each project that comprises RiverRenew is shown on Figure 9-2. To meet the required schedule, AlexRenew began construction at the WRRF starting in 2019.

RiverRenew is estimated to cost $615 million. The project will be financed through increases in sewer-related fees that AlexRenew charges its residential and commercial customers. To help mitigate this significant financial burden on the community, AlexRenew and the City are soliciting funding from the governor and the General Assembly for the program, similar to what has been provided for other Virginia communities with combined sewer systems. The State has committed an additional $65 million in grant funding for the program, to be provided prior to the program completion.

Figure 9-2: RiverRenew Implementation Schedule



9.4 Performance of the RiverRenew Facilities

The 2017 CSO Law requires AlexRenew to "bring the CSO outfall into compliance with Virginia law, the federal Clean Water Act, and the Presumption Approach described in the EPA CSO Control Policy, unless a higher level of control is necessary to comply with a TMDL." This section documents the performance of the RiverRenew facilities and demonstrates compliance with the Hunting Creek TMDL and the EPA CSO Control Policy's Presumption Approach.

9.4.1 Compliance with the Hunting Creek TMDL

The Hunting Creek TMDL assigns bacteria wasteload allocations to CSO Outfalls 002, 03, and 004 and a future growth wasteload allocation for the AlexRenew WRRF, as shown in Table 9-1. This table shows the expected bacteria loadings from each outfall following implementation of RiverRenew for the TMDL climate years of 2004 and 2005. The anticipated bacteria loadings following the program's implementation are less than the total wasteload allocation. Therefore, the RiverRenew facilities comply with the Hunting Creek TMDL. The AlexRenew WRRF growth allocation will serve as a safety factor to the aggregated CSO waste load allocation or will be used for future growth.

9.4.2 Compliance with EPA CSO Control Policy's Presumption Approach

EPA's CSO Control Policy Presumption Approach states that water quality standards are presumed to be reached if one of three criteria are met. One of those criteria is no more than four overflows per year based on a typical or average climate period. For the LTCPU, a climate period of 2000 to 2016 was used, which represents a wide range of rainfall conditions. Table 9-2 compares the number of overflows before and after the implementation of the RiverRenew, based on a sophisticated hydraulic model that was developed. The analysis confirms compliance with the Presumption Approach for all four outfalls.

Table 9-2: Average Overflows per Year for 2000–2016 Climate Period

Outfall	Existing	Following RiverRenew Implementation
001	34.1	2.3
002	78.4	1.8
003	60.4	1.6
004	71.4	<1

Table 9-1: RiverRenew Facilities and Hunting Creek TMDL

Outfall	RiverRenew E. coli loading (cfu/year)		Hunting Creek TMDL Wasteload Allocation (cfu/year)
	2004	2005	
002	2.77E+13	5.12E+13	6.26E+13
003	2.50E+11	0.00E+00	7.68E+11
004	5.00E+09	4.93E+12	8.52E+11
Wet Weather Treatment	2.76E+12	7.26E+12	N/A
Aggregated CSO Total	3.07E+13	6.33E+13	6.42E+13
WRRF Growth Allocation			2.10E+13
Aggregated CSO and WRRF Growth Total			8.52E+13

cfu = colony forming units

9.4.3 Benefits of RiverRenew

RiverRenew will prevent millions of gallons of sewage mixed with rainwater from contaminating Alexandria's rivers and streams. As shown on Table 9-3, upon its completion, RiverRenew will reduce the average volume of overflows to Alexandria's receiving waters from 140 million gallons to less than 17 million gallons.

This reduction in the frequency and volume of combined sewer discharges will limit the amount of bacteria, trash, and other pollutants flowing into Hooffs Run, Hunting Creek, and the Potomac River. This will achieve safer waterways for the community, a healthier environment for wildlife, and cleaner waterways for future generations.

Table 9-3: Average Overflow Volume per Year for 2000–2016 Climate Period

Outfall	Existing (million gallons)	Following RiverRenew Implementation (million gallons)
001	63	8
002	38	5
003	31	1
004	8	2
Total	140	16

Chapter 10
Sanitary Sewer Funding

10.1 Sanitary Sewer Enterprise Fund Overview

The City's sanitary sewer program is set up as an enterprise fund. Fund revenues come from the following two sources:

- Sanitary sewer system capital investment and maintenance fee (sewer user fee). This fee is charged to residential and commercial customers as part of their monthly sewer bill and is based on water consumption.
- Sewer connection fees. These fees are charged as part of development/redevelopment in the City as part of connecting to the sanitary sewer system.

The enterprise fund does not receive any money from the City's general fund. The enterprise fund is used to fund capital sanitary sewer projects and sanitary sewer operating expenses (personnel and non-personnel). It is not used to fund sanitary sewer capacity improvements related to development projects, the RiverRenew program, or AlexRenew's wastewater treatment costs.

The City also leverages sanitary sewer funds through the issuance of general obligation bonds, with the debt service covered by sewer revenues. General obligation bonds financed 100 percent by sanitary sewer fees are not counted by the bond rating agencies in municipal debt ratios.

This chapter of the Sanitary Sewer Master Plan update provides a review of the existing sewer user fees and connection fees and provides specific recommendations for updating these fees. This Sanitary Sewer Master Plan update does not provide the authority to change the sewer user fee or the connection fees; it only provides recommendations. Fee changes can only be implemented by revising the City Code, following a City Council public hearing and City Council vote to allow changes to the fee.

10.2 Sanitary Sewer User Fee Review

This section discusses the existing sewer user fee, a comparison of sewer billing with nearby jurisdictions, and analysis of changing the fee from monthly water usage to winter quarter consumption.

Section 5-6-26 of the City Code establishes the "sanitary sewer system capital investment and maintenance fee" (sewer user fee), which is charged to existing residential and commercial customers on the monthly sewer bill from Alexandria Renew Enterprises (AlexRenew). This fee is used to support operating, cash capital, and debt service expenditures. The current fee is set at $2.28 per 1,000 gallons of water supplied by the Virginia American Water Company (VAWC). The City receives approximately $10–11 million in sewer user fee revenues annually.

Increases are made to the sewer user fee as required to maintain the integrity of the City's sanitary and combined sewer infrastructure and provide sewer service to City customers. Rate increases require an update to the City Code and are subject to both a public hearing and City Council approval.

10.2.1 Sewer Billing Comparison

City customers receive a monthly sewer bill from AlexRenew, which includes the City sewer user fee and fees charged by AlexRenew for treatment of wastewater generated in the City. The other surrounding

jurisdictions own and operate both the wastewater treatment facility and the collection system. Therefore, to compare sewer user/treatment fees to neighboring areas, the City and AlexRenew fees must be added together. Table 10-1 presents a summary of how much in sewer charges a typical residential household pays per month.

Table 10-1: Sewer Billing Comparison

Jurisdiction	Estimated Monthly Sewer Bill
City of Alexandria	$51.61
Arlington County	$40.95
Fairfax County	$40.09
Loudoun County	$35.07
Prince William County	$41.35
District of Columbia	$65.71

Based on average residential water usage of 4,500 gallons per month and winter quarter consumption of 4,000 gallons per month

In the comparison presented in Table 10-1, the City is the only jurisdiction in Northern Virginia with a combined sewer system along with legislative requirements pertaining to the system that require significant investments in infrastructure. The District of Columbia was included in the table above because, like Alexandria, it has a combined sewer system. The District of Columbia's water and sewer authority (DC Water) is currently constructing significant combined sewer infrastructure through the Clean Rivers Program.

10.2.2 Winter Quarter Analysis

AlexRenew charges for wastewater treatment each month in a manner where the usage is capped based on the amount of water used during the three consecutive months of December, January, and February. Thus, water that is used during other times of the year for irrigation purposes does not impact the sewer billing. This type of billing (winter quarter basis) is typical of neighboring jurisdictions as well, including Fairfax, Loudoun, and Prince William counties. AlexRenew caps the winter quarter average to 4,000 gallons per month for a residential household or the actual usage during the winter quarter, whichever is greater.

The City currently charges a sewer user fee based on monthly water usage, versus the winter quarter basis. An analysis was performed to determine the loss of sewer user fee revenue that would occur if the City changed its method of sewer billing from actual water usage to a winter quarter basis. It is estimated that the City would receive 4 to 5 percent less revenue each year by going to a winter quarter basis for sewer billing. If the City changed its sewer user fee to a winter quarter basis, residents would save an average of $1.14 per month on their sewer bill.

This Sanitary Sewer Master Plan update recommends changing the sewer user fee billing basis from monthly water consumption to the winter quarter basis to more accurately reflect water that reaches the sewer system. This will also eliminate existing confusion on the sewer bill. Section 10.4 presents an analysis of the impacts of this lost revenue on the City's 10-year Capital Improvement Program (CIP) and whether adjustments to the sewer user fee would be required.

10.3 Sanitary Sewer Connection Fee Review

Section 5-6-25.1 of the City Code establishes sewer connection fees for "any person who is required, or who desires, to provide a connection for sewer service…" Connection fees are established for a variety of uses, including single-family homes, multi-family homes, hotels, and nonresidential properties. The current connection fees are provided in

Tables 10-2 and 10-3. The City Code also provides for credits for teardown of existing structures (at 50 percent) and conversions (change in use) of existing properties (at 100 percent). Per the City Code, the connection fees are adjusted "each year at the rate of inflation as determined by the annual CPI-U [Consumer Price Index – Urban]…" for the Washington, DC area and are effective on July 1. The updated connection fees are issued via a Memorandum to Industry. The current memorandum for FY 2022 fees is included in Appendix C.

Table 10-2: Residential Sewer Connection Fees

Type	Fee per Unit/Room
Single-family (detached, duplex, townhouse)	$9,446
Multi-family (apartment or condo)	$8,501
Hotel	$8,501

Table 10-3: Nonresidential Sewer Connection Fees

Meter Size	Fee
3/4-inch or smaller	$9,446
1-inch	$15,773
1.5-inch	$31,452
2-inch	$50,342
3-inch	$101,629
4-inch	$157,449
6-inch	$314,805
8-inch	$503,705
10-inch	$724,152

As part of the 2013 Sanitary Sewer Master Plan, an analysis of water consumption data was performed comparing multi-family and hotel water usage to single-family water usage. As a result of this, following the sewer plan adoption, the connection fees for multi-family homes was increased from 50 to 90 percent of single-family fees. In addition, hotels were established as their own use and set at 90 percent of the single-family connection fee, following a phase-in period.

The 2013 Sanitary Sewer Master Plan also provided for teardown credits (no teardown credits were previously provided) and established how conversions were to be assessed.

This Sanitary Sewer Master Plan update builds upon the previous connection fee study completed. Specifically, the following were focuses of this Sanitary Sewer Master Plan update:

- Teardown credits – review of credits with neighboring jurisdictions
- Conversions – review of conversion policy with neighboring jurisdictions
- Senior living facilities, including memory care and assisted living – review of these facilities with neighboring jurisdictions and an analysis of water consumption data
- Nonresidential connection fees – comparison with neighboring jurisdictions and an analysis of water consumption data

10.3.1 Teardown Credits

The City currently provides a 50 percent teardown credit that applies to "properties removed or demolished not longer than 3 years prior to the submission of the final site plan for the new structure." Table 10-4 summarizes the teardown credits provided by the City and neighboring jurisdictions.

Table 10-4: Teardown Credit Summary

Jurisdiction	Teardown Credit
City of Alexandria	50%
Arlington County	Partial, based on schedule drainage fixture unit values
Fairfax County	100%
Loudoun County	100%
Prince William County	100%

The City is not consistent with other local jurisdictions regarding providing teardown credits. If the teardown credits were provided at 100 percent (like neighboring jurisdictions), it is estimated that the City would receive approximately 2 percent less in sewer connection fee revenue each year. This estimation was made by looking at all connection fees collected over the past 5 years.

This Sanitary Sewer Master Plan update recommends that the teardown credit be increased from 50 to 100 percent to be consistent with neighboring jurisdictions.

10.3.2 Conversions

Conversions are when existing buildings change in use, such as a commercial office building being renovated to multi-family units. The City Code allows for a credit of 100 percent to be given to the existing use (versus 50 percent for the teardown credit), which is subtracted from the proposed use to calculate the sewer connection fee. If the credit is greater than or equal to the proposed use, then no fee is assessed. Table 10-5 shows how neighboring jurisdictions treat conversions.

Table 10-5: Conversion Connection Fee Summary

Jurisdiction	Conversion Fee Calculation
City of Alexandria	100% credit for existing use; full fee for proposed use
Arlington County	Partial teardown credit based on schedule of drainage fixture unit credit values; full fee for proposed use
Fairfax County	100% credit for existing use; full fee for proposed use
Loudoun County	No fee if no change in water meter size; otherwise, 100% credit for existing use, full fee for proposed use
Prince William County	No fee if no change in water meter size; otherwise, 100% credit for existing use, full fee for proposed use

The City is generally consistent with other jurisdictions in how conversions are treated. The exception is that Loudoun and Prince William counties connect the use with the water meter. Therefore, if there is no upsizing in the meter size, then no connection or availability fees are applied. However, there are organizational differences in that both Loudoun and Prince William counties are set up as separate water and sewer authorities that operate independently outside of local government.

No changes to how conversion credits are applied are proposed as part of this Sanitary Sewer Master Plan update as the City is generally consistent with how other jurisdictions treat conversions.

10.3.3 Senior Living Facilities

Senior living facilities cover nursing care, memory care, and assisted living. The connection fee applied to these facilities depends on the use. Assisted living has historically been treated as multi-family and memory or nursing care has been treated as nonresidential, with fees being assessed based on the water meter size. A review of neighboring jurisdictions, shown in Table 10-6, indicates that there is significant variability when it comes to these types of facilities, which may be treated as nonresidential/commercial or as its own specific use.

Table 10-6: Senior Living Connection Fee Summary

Jurisdiction	Senior Living Fee Calculation
City of Alexandria	Memory care – commercial; assisted living – multi-family
Arlington County	N/A – all connection fees based on number of drainage fixture units
Fairfax County	Fee equal to hotel and dormitory uses
Loudoun County	Fee per unit/room plus separate fee for commercial kitchen
Prince William County	Commercial less than 2-inch water meter; otherwise, case-by-case basis

The water consumption data was analyzed for four senior living facilities in the City that include a mix of memory care, assisted living, and independent living. The data shows that these types of facilities, on a per unit/room basis, use 99 percent of the water that a multi-family building uses on a per unit basis (multi-family fee equal to 90 percent of single-family fee).

Data was also collected for a sample of facilities in Arlington, Loudoun and Prince William counties, as shown on Figure 10-1. The data from Arlington County was similar to the four Alexandria facilities. However, the water consumption data collected from Loudoun and Prince William counties show that water usage is between 60 and 65 percent of the water usage for an average single-family home.

This Sanitary Sewer Master Plan update recommends that senior living facilities be established as their own use and that the connection fee be set at 75 percent of the single-family fee. Because of the variability in flows between the City and other jurisdictions, the City will continue to monitor flows from these types of facilities and may recommend future adjustments to the fee. It is estimated that the City would receive approximately 3.4 percent more in sewer connection revenue each year if senior living was established as its own use with a fee per unit equal to 75 percent of the single-family fee.

10.3.4 Nonresidential Connection Fees

The City's nonresidential connection fees were also reviewed. These fees were not reviewed as part of the 2013 Sanitary Sewer Plan. Table 10-7 shows the comparison of the City's fees with Prince William and Loudoun counties because these are the two counties that base the connection fee on water meter size. Both Arlington and Fairfax counties base these fees on the number of drainage fixture units a building has. For water meters greater than 2 inches, both Prince William and Loudoun counties compute the fee on an individual project basis.

Table 10-7: Nonresidential Connection Fee

Meter Size	City of Alexandria	Prince William County	Loudoun County
3/4-inch or smaller	$9,446	$10,800	$13,067
1-inch	$15,773	$43,200	$26,134
1.5-inch	$31,452	$75,600	$56,624
2-inch	$50,342	2-inch and greater calculated on individual basis	$104,357 (greater than 2-inch on individual basis)

Table 10-7 shows that the City's nonresidential fees are lower for meter sizes 3/4-inch and smaller and considerably lower for 1- and 2-inch water meters.

The City's connection fee for a water meter size 3/4-inch and smaller is equal to the connection fee for one single-family dwelling. A review of the water consumption data shows that a single-family dwelling (detached, duplex and townhouse) has an average daily water use of 115 gallons per day (gpd).

Water consumption data for all VAWC commercial customers (excluding multi-family, hotel, and senior living) were reviewed. Table 10-8 shows the water usage based on water meter size for all nonresidential/commercial customers, along with equivalent residential units (ERUs) for each meter size, setting the single-family usage of 115 gpd as 1 ERU.

Figure 10-1: Water Consumption for Senior Living Facilities

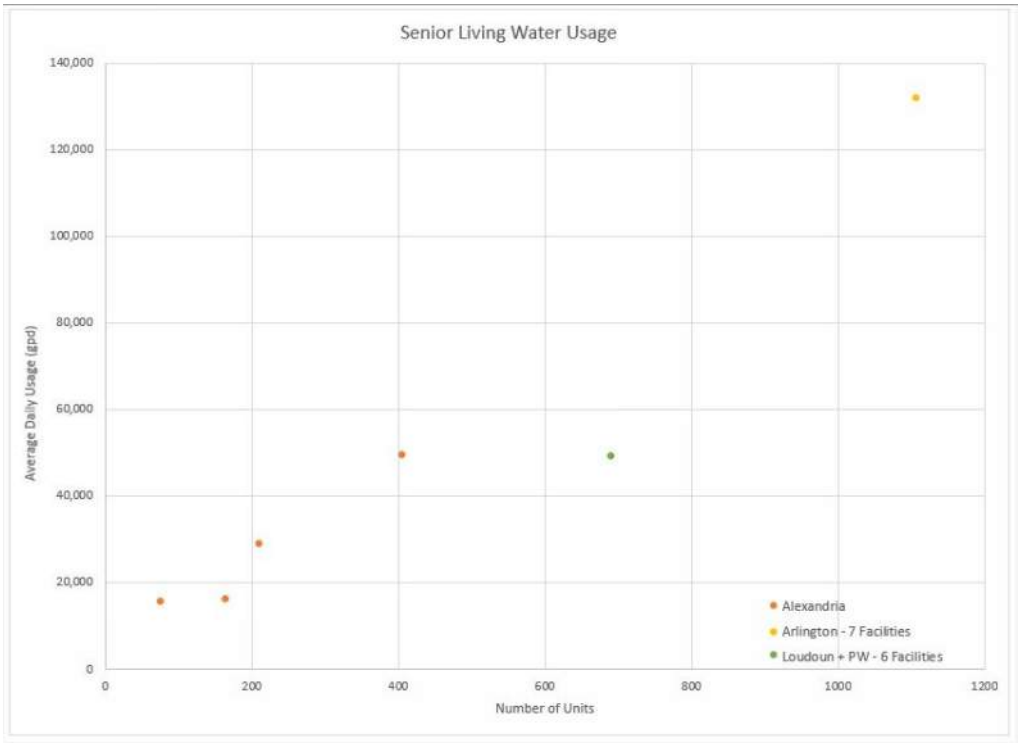


Table 10-8: City Nonresidential ERU Calculation

	¾-inch and smaller	1-inch	1.5-inch	2-inch
Current City Fee	$9,446	$15,773	$31,452	$50,342
ERU (based on current fee)	1.0	1.67	3.33	5.33
Average water usage (gpd)	157	353	688	1,750
ERU based on water usage (1 ERU=115 gpd)	1.4	3	6	15
Updated City fee based on ERU	$13,224	$28,338	$56,676	$141,690

If the nonresidential connection fees were revised using this ERU methodology, these fees would be closer to the fees being assessed by both Prince William and Loudoun counties. Overall, it is estimated that the City would receive an additional 1 percent in connection fee revenue using this ERU methodology; however, fees would decrease for certain projects. For instance, more credit would be given both to teardown projects and conversion projects. Fees would increase for new commercial connections. Finally, a review of the City's water meters shows that a 4-inch meter is the largest nonresidential meter size.

This Sanitary Sewer Master Plan update recommends using the ERU methodology to establish the nonresidential sewer connection fees to more accurately reflect the water usage and sewer generated from nonresidential properties. It is also recommended that the schedule of values be limited to water meter sizes up to 2 inches because that is the current maximum water meter size for nonresidential buildings in the City. If a larger water meter size is required to serve a nonresidential development project, the connection fee can be established on a case-by-case basis, using estimated flows from the proposed project and comparing them with the single-family ERU.

10.4 Sanitary Sewer Master Plan Update Recommendation Revenue Impacts

The changes to the sewer connection fees recommended above will result in 2.5 percent more revenue generated each year. It should be noted that this plan does not recommend lowering either the sewer user fees or connection fees but changing how those fees are assessed. Combined with the loss in revenue generated by changing the basis of the sewer user fee using the winter quarter, a total of approximately 3 percent less revenue will be generated each year.

The City has a 10-year CIP that includes both capital and operating costs. A copy of the FY 2022-2023 CIP is provided in Appendix A. The purpose of this section is to determine what adjustments, if any, to the CIP would be required if the recommended changes to the sewer user fee and/or connection fees are implemented. Even though the 10-year CIP shows sewer user fees for future years, any adjustment in fees are made on a year-by-year basis and are subject to change each year. The CIP requires balancing of expenditures (capital, operating, and debt service) and revenues (sewer user fees, sewer connection fees, sanitary sewer bond issuance, and prior year fund balance). The analysis completed indicates that changes to the sewer user fee and/or connection fees can be incorporated into the existing CIP without resulting in any additional fee increases or changes to the existing sanitary sewer program other than what is in the current CIP. To accomplish this, the City will be required to use additional available prior year funding to balance the CIP. Fund balances result from prior year funding when actual revenues are greater than the actual expenditures.

As stated previously, any changes in either the sewer user fee or sewer connection fees will require both public hearing (along with any outreach done) and City Council approval. Additionally, there could be future unforeseen changes in either operating or capital needs that may require adjustment to the sewer user or sewer connection fees in the future.

10.5 Sanitary Sewer CIP Needs Discussion

Several sanitary sewer capital programs and future needs are presented in this Sanitary Sewer Master Plan update. Some of these programs have already been funded in the CIP and some programs and projects will require updates to the CIP. The addition of new projects and programs to the CIP could require future increases to the sewer user fee and/or the sewer connection fees (for those projects specifically tied to growth) if the proposed expenditures exceed the revenues and total fund balance. The following planned or potential programs and projects may require additional funding in the CIP:

- Separation of sanitary sewers from the combined sewer system where sewer backups have occurred (Chapter 4): The City completed an initial study and is moving toward feasibility and design of separation projects. There is currently $2.2 million in funding for these separation projects, but additional funding may be required in a future CIP.
- Private property infiltration and inflow (I/I) disconnection program (Chapter 4): The City is currently reviewing these types of programs in other jurisdictions and will be developing options, recommendations, and a program framework for consideration. This framework will include a level of funding for successful program implementation. Currently, this type of program is not included in the CIP.
- Collection system capacity upgrades (Chapter 6): The City's sanitary sewer collection system modeling shows that approximately 12,000 feet of sewer do not have sufficient capacity under existing conditions. It is estimated that sewer capacity improvements to alleviate these capacity deficiencies will total as much as $9 million. These capacity improvements are expected to be funded out of the reconstruction and extension of sanitary sewers. Currently, a total of $9 million ($900,000 annually) is allocated for this program in the 10-year CIP. This program also funds other needs, such as replacing sanitary sewers because of their conditions. Additional funding may be required to implement all projects under this program.
- Wastewater treatment capacity at AlexRenew (Chapter 7): To meet the City's growth needs, an additional 4 million gallons per day (mgd) of wastewater treatment capacity will be required at AlexRenew sometime after 2040. The existing CIP identifies this need, but no funding is currently provided. A study is planned to begin in 2027 and funding for the study will be identified as a future CIP. Funding for the implementation to meet the 4-mgd need will likely be added to the CIP between 2030 and 2035. Given this need is driven by growth, it is possible that increases to the sewer connection fees will be required.
- AlexRenew interceptor sewer capacity improvements (Chapter 8): Future capacity improvements will likely be required for both the Holmes Run Trunk Sewer and the Potomac Yard Trunk Sewer. The City currently has approximately $6 million in prior CIP funding for Holmes Run Trunk Sewer capacity upgrades. The current estimate for capacity upgrades for this sewer is $24 million, which is to be

shared between the City and Fairfax County because it is a joint-use sewer.

As part of the 2020 North Potomac Yard Coordinated Development District (CDD), several infrastructure upgrades are required within the plan area, to be constructed by the developer. However, the City will be responsible for the off-site sewer capacity improvements in the trunk sewer downstream of Potomac Yard because this sewer serves other areas of the City outside Potomac Yard. The timing of future improvements will depend on the timing of development in Potomac Yard and other areas of the City that connect into this sewer. These improvements are not required within the next 10 years based on current growth forecasts. The City and AlexRenew will be jointly monitoring the flows in this sewer through the installation of permanent flow meters.

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Chapter 11
One Water Infrastructure

11.1 Background

Water is essential human for human life and has significant impacts on the economy and well-being of a community, particularly in the City of Alexandria (City), which has a deep history as a river town associated with the Potomac River. Managing water resources wisely in a dense urban community sustainably is both vital and challenging. The City has embraced the "One Water" approach that integrates management of safe drinking water, stormwater, and wastewater resources in a sustainable manner.

Protection of the City's water resources is heavily governed by local ordinance as well as state and federal regulators. The City has prioritized protecting its water resources, recognizing them as a fundamental element of the quality of life in the community and an integral part of the City's thriving economy. This chapter provides an overview of the City's drinking water and stormwater regulations and programs to work to achieve a "One Water" vision for the City.

11.2 Stormwater

Stormwater runoff occurs when rain or snowmelt flows over the ground. Hard surfaces, like roofs, driveways, parking lots, and streets prevent stormwater from naturally soaking into the ground. If not managed properly, stormwater runoff can create stormwater pollution and/or flooding issues. The City's stormwater flows into local waterways that eventually drain into the Potomac River and Chesapeake Bay (Bay).

The Bay is a unique estuary. It is the largest estuary in the nation and third largest in the world. Its 64,000-square mile watershed encompasses parts of six states—Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia—and the District of Columbia. In the watershed, there are more than 100,000 streams and rivers that eventually flow into the Bay. All residents in the surrounding communities live within a few minutes of one of these streams and rivers, which are like pipelines from our communities to the Bay. The Bay and its watershed have remarkable ecological, economic, recreational, historic, and cultural value to the City of Alexandria and the region.

On December 29, 2010, the U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay total maximum daily load (TMDL). The Bay TMDL is a historic and comprehensive "pollution diet" for nitrogen, phosphorous, and sediment to restore clean water in the Bay and the region's streams, creeks, and rivers. This section presents an overview of how the City's Stormwater Management Program is meeting the Bay TMDL requirements along with the City's Eco-City Clean Waterways vision and goals. More information about the City's stormwater management program can be found at http://www.alexandriava.gov/stormwater.

11.2.1 Chesapeake Bay TMDL Stormwater Requirements

The City's Bay TMDL pollution reduction requirements have been incorporated into the City's 5-year municipal separate storm sewer system (MS4) Permit, administered by the Virginia Department of Environmental Quality (VDEQ). To meet the requirements of the Bay TMDL, the City has three full 5-year MS4 permit cycles to implement the required reductions:

- Phase 1: 2013 to 2018
- Phase II: 2018 to 2023

- Phase III: 2023 to 2028

Table 11-1 shows the overall amount of each pollutant, the required reductions, and the equivalent area that must be treated to meet these reductions.

The City developed a TMDL Action Plan that details the means and methods to meet the reduction requirements for each phase of the TMDL. The Phase I TMDL Action Plan was developed in 2015. The Phase II TMDL Action Plan was finalized in September 24, 2019 and is available at

https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/AlexandriaDraftPhase2ChesBayAP.pdf.

The City is currently developing a plan to meet the Phase III requirements of the Bay TMDL.

11.2.2 City MS4 Requirements

Along with the Bay TMDL reductions, the City's MS4 permit contains six minimum control measures, including:

- Public education and outreach
- Public involvement and participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management for new construction and development on prior developed lands
- Pollution prevention and good housekeeping for facilities owned or operated by the permittee

The City has developed effective and appropriate best management practices to control stormwater pollution to the maximum extent practicable.

11.2.3 City Stormwater Utility Fee

The City adopted a stormwater utility fee to provide a dedicated funding source for existing stormwater management services and new capital projects to reduce nutrient (nitrogen and phosphorous) and sediment pollution to meet the Bay TMDL. The stormwater utility fee is based on a property's impervious area, or hard surfaces like roofs and driveways that do not let rain soak into the ground. Residential properties are billed a flat fee based on the type of property. Nonresidential properties are billed a calculated fee based on their actual impervious area. Property owners may have their fee reduced by earning credits following implementation of stormwater management practices, as described in the City's Stormwater Utility Credit Manual.

In February 2021, City Council voted to increase funding for stormwater management to accelerate the implementation of stormwater capacity projects, spot projects, and maintenance of the storm sewer system throughout the City to help mitigate flooding.

11.2.4 Other City Stormwater Requirements

The City has adopted an environmental management ordinance to help protect the Bay from pollution and urban runoff. It sets forth requirements related to redevelopment in the City and establishes Resource Protection Areas, which consist of sensitive land areas including tidal wetlands, tidal shores, and nontidal wetlands and provides a buffer area of 100 feet for any water body with perennial flow. The ordinance establishes both water quality and quantity requirements as a condition of redevelopment in the City.

Table 11-1: Bay TMDL Pollutant Reduction Requirements

	Percent Reduction Required	Total Nitrogen Reduction (Pounds/Year)	Total Phosphorous (Pounds/Year)	Total Suspended Sediment (Pounds/Year)	Approximate Equivalent Acres Treated
Phase I 2013–2015	5%	395	39	43,242	120–300
Phase II 2018–2023	35%	2,675	354	302,749	660
Phase III 2023–2028	60%	4,585	607	518,999	1,440
Total Pollutant Reductions Required	100%	7,655	1,000	864,990	2,220–2,400

The City also has adopted an erosion and sediment ordinance, which sets forth requirements for land disturbance activities. Per the ordinance, any construction project that disturbs at least 2,500 square feet of land must have a City-approved construction pollution prevention plan and install appropriate construction site runoff controls.

11.2.5 Floodplain Management

Most homeowner insurance does not cover property damage due to flooding. Because Alexandria participates in the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), insurance agents are permitted to sell an NFIP flood insurance policy to both residents and businesses. The City also participates in the FEMA Community Rating System, which provides discounts on flood insurance. The City is a Class 6 community, which entitles residents and businesses to a discount on their flood insurance. Through the City's zoning ordinance, developers must meet requirements for developing in the floodplain. More information about the City's floodplain management program can be found at alexandriava.gov/floodmap.

11.2.6 Flood Action Alexandria

Flood Action Alexandria is an initiative to address stormwater flooding as a result of climate change and extreme wet weather events. The City has been developing a multipronged effort to mitigate flooding in the City including the following:

- Spot improvement projects to increase the functionality of the City's storm sewer system
- Increased maintenance efforts (catch basin cleaning, storm sewer cleaning)
- Flood mitigation grant program
- Early warning and emergency response system
- Community outreach and engagement

More information on Flood Action Alexandria can be found at alexandriava.gov/FloodAction.

11.3 Drinking Water

EPA's Safe Drinking Water Act (SDWA) is the federal law that protects public drinking water supplies throughout the nation. Under the SDWA, EPA sets standards for drinking water quality and works with its partners to implement various technical and financial programs to ensure drinking water safety. At the state level, the Virginia Department of Health Office of Drinking Water protects public

health and ensures Virginia residents have a safe and adequate supply of drinking water.

After water is drawn from the source, it is sent to a water treatment facility where modern systems use a combination of processes to assure high drinking water quality before it enters the distribution pipes. The City does not own the drinking water distribution system located in Alexandria—it is owned and operated by the Virginia American Water Company (VAWC). The City's drinking water is sourced from the Potomac River or Occoquan River by Fairfax County Water Authority (FCWA) for treatment and is supplied to VAWC, which is the drinking water distributor for the City. VAWC systems are required to comply with the federal and state regulations developed under the SDWA and the Clean Air Act.

VAWC has a program to inspect and replace distribution pipes in the City. This program helps to minimize the number of emergency repairs and interruptions in water service. VAWC also has a water quality inspection and reporting program. Water quality reports can be accessed online at https://amwater.com/corp/water-quality-wastewater-service/water-quality-reports, which also includes reports for lead. VAWC has a program to reduce lead in its distribution system to ensure compliance with drinking water quality standards. However, lead may come from individual water service lines and plumbing systems. The best way to determine what kind of plumbing system and service line you have in your home is to hire a licensed plumber.

To ensure an adequate supply of water to the City, the City and VAWC participate in the Northern Virginia Regional Commission's Water Supply Plan (WSP). The WSP was developed to:

- Ensure that adequate and safe drinking water is available to all citizens within the region
- Encourage, promote, and protect all other beneficial uses of the region's water resources
- Encourage, promote, and develop incentives for alternate water sources
- Promote conversation

More information about the WSP can be found at:

https://www.novaregion.org/1214/Water-Supply-Plan

11.4 Eco-City Alexandria

Eco-City Alexandria is a collaborative strategic effort to achieve sustainability throughout the City. Eco-City works to harmonize natural resources and environmental assets with existing policies, regional realities, and economic and business markets while engaging the community in a collaborative and transparent decision-making process. Alexandria City Council adopted the Eco-City Charter in June 2008, which was the first environmental charter adopted in the Commonwealth of Virginia. The Eco-City Charter defined Alexandria's commitment to ecological, economic, and social sustainability. The core values and 10 guiding principles formed the basis for the City's first Environmental Action Plan (EAP) in 2009 and was updated in July 2019 (2040 EAP). The 2040 EAP is a comprehensive road map and affirms the City's commitment to lead by example for a thriving, sustainable community.

Water Resources (including sanitary sewer, drinking water and stormwater) is one of the 2040 EAP's topic areas with specific goals and

action items (short-, mid-, and long-term) for each goal. The 2040 EAP can be found at:

https://www.alexandriava.gov/uploadedFiles/tes/EAP2040v25.pdf

11.5 Conclusions

As the City continues to grow and become increasingly more densely populated, well thought-out planning for development activities and infrastructure improvements has become critically important. Through forward thinking and planning, the City protects and enhances its existing water resources, reduces water use, and mitigates instances of flooding to protect property. Through outreach, education, and the enhancement of opportunities for water-related recreation and water use reduction actions, the City connects people to its waterways and the importance of their protection. Ultimately, the City strives to see its waters once again become fishable and swimmable.

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Appendix A
FY 2022 10-Year Sanitary Sewer Capital Improvements Plan

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SANITARY SEWERS

Note: Projects with a $0 total funding are active capital projects funded in prior CIP's that do not require additional resources.

	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	FY 2022 - FY 2031
Sanitary Sewers											
Sanitary Sewers											
AlexRenew Wastewater Treatment Plant Capacity	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD	-
Combined Sewer Assessment & Rehabilitation	5,000,000	3,900,000	0	0	0	0	0	0	0	0	8,900,000
Holmes Run Trunk Sewer	0	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	-
Reconstructions & Extensions of Sanitary Sewers	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	9,000,000
Sanitary Sewer Asset Renewal Program	4,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	36,000,000
Sanitary Sewers Total	10,400,000	8,300,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	53,900,000
Sanitary Sewers Total	10,400,000	8,300,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	53,900,000
Grand Total	**10,400,000**	**8,300,000**	**4,400,000**	**4,400,000**	**4,400,000**	**4,400,000**	**4,400,000**	**4,400,000**	**4,400,000**	**4,400,000**	**53,900,000**

Sanitary Sewers Ten-Year Plan
Proposed FY 2022 – FY 2031 Capital, Operating and Debt Service

Sanitary Sewer Rate	FY 2021 Approved	FY 2022 Proposed	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 22-31
Sanitary Sewer Rate ($ per 1,000 gallons)	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	
Proposed Rate Increase	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	
New Sanitary Sewer Rate	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28	

Revenues	FY 2021 Approved	FY 2022 Proposed	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 22-31
Sewer Line Maintenance Fee	11,322,663	10,756,140	10,836,811	10,918,087	10,999,973	11,082,473	11,165,591	11,249,333	11,333,703	11,418,706	11,504,346	**111,265,163**
Sewer Connection Fee	4,000,000	6,000,000	6,180,000	6,365,400	6,556,362	6,753,053	6,955,644	7,164,314	7,379,243	7,600,620	7,828,639	**68,783,276**
New Debt Issuance	0	0	0	0	0	0	0	0	0	0	0	**0**
Fund Balance	0	0	0	0	0	0	0	0	0	0	0	**0**
Use of Fund Balance	36,749	5,898,855	3,080,520	1,777,269		0	0	0	0	0	0	**10,756,644**
Total Revenues	**15,359,412**	**22,654,995**	**20,097,331**	**19,060,756**	**17,556,335**	**17,835,525**	**18,121,236**	**18,413,647**	**18,712,946**	**19,019,326**	**19,332,985**	**190,805,083**
All Operating	7,783,270	8,932,717	9,135,547	9,343,081	9,556,183	9,773,868	9,996,154	10,226,056	10,462,591	10,704,778	10,953,635	99,084,608
All Capital Projects	4,898,020	11,253,000	9,199,000	5,344,000	5,392,000	5,441,000	5,493,000	5,548,000	5,605,000	5,666,000	5,729,000	64,670,000
All Debt Service	2,678,122	2,469,278	1,818,712	1,792,534	1,727,995	1,473,213	1,427,870	1,520,677	1,580,324	1,527,581	1,335,810	16,673,994
Total Expenditures	**15,359,412**	**22,654,995**	**20,153,259**	**16,479,615**	**16,676,178**	**16,688,081**	**16,917,024**	**17,294,733**	**17,647,915**	**17,898,359**	**18,018,445**	**180,428,602**

Operating Costs	FY 2021 Approved	FY 2022 Proposed	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 22-31
T&ES Personnel Charges (incl. Worker's Comp)	3,455,535	4,038,914	4,160,000	4,285,000	4,414,000	4,546,000	4,682,000	4,822,000	4,967,000	5,116,000	5,269,000	**46,299,914**
DEC Personnel Charges	48,300	44,511	46,000	47,000	48,000	49,000	50,000	52,000	54,000	56,000	58,000	**504,511**
Professional Services												
Additional Consulting Services	347,270	357,688	368,000	379,000	390,000	402,000	414,000	426,000	439,000	452,000	466,000	**4,093,688**
Leaf Collection in CSO Areas	247,453	130,000	134,000	138,000	142,000	146,000	150,000	155,000	160,000	165,000	170,000	**1,490,000**
Fat, Oil, Grease (FOG Program)	200,000	206,000	209,000	212,000	215,000	218,000	221,000	224,000	227,000	230,000	233,000	**2,195,000**
Sanitary Sewer Capacity Study - Flow Metering, Sewer Modeling, CMOM	463,500	470,453	478,000	485,000	492,000	499,000	506,000	514,000	522,000	530,000	538,000	**5,034,453**
Sewer Billing	170,000	172,550	175,000	178,000	181,000	184,000	187,000	190,000	193,000	196,000	199,000	**1,855,550**
Infrastructure Repairs												
Sewer Jet Cleaning	260,000	263,900	268,000	272,000	276,000	280,000	284,000	288,000	292,000	296,000	300,000	**2,819,900**
Annual CCTV of Sewers	325,000	329,000	334,000	339,000	344,000	349,000	354,000	359,000	364,000	369,000	375,000	**3,516,000**
Heavy Cleaning of Sewers	315,000	318,450	323,000	328,000	333,000	338,000	343,000	348,000	353,000	358,000	363,000	**3,405,450**
Equipment Replacement	66,800	553,975	562,000	570,000	579,000	588,000	597,000	606,000	615,000	624,000	633,000	**5,927,975**
Corrective Maintenance	150,800	152,800	155,000	157,000	159,000	161,000	163,000	165,000	167,000	170,000	173,000	**1,622,800**
Other Non-Personnel (Training, Utilities, Rentals, etc.)	232,150	262,875	267,000	271,000	275,000	279,000	283,000	287,000	291,000	295,000	299,000	**2,809,875**
Building Maintenance												
Rodent Abatement in Sewers	90,000	90,000	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	**945,000**
Indirect Costs (Tr to G.F.)	1,411,462	1,541,601	1,565,547	1,590,081	1,615,183	1,640,868	1,667,154	1,694,056	1,721,591	1,749,778	1,778,635	**16,564,492**
Subtotal, Operating Costs	***7,783,270***	***8,932,717***	***9,135,547***	***9,343,081***	***9,556,183***	***9,773,868***	***9,996,154***	***10,226,056***	***10,462,591***	***10,704,778***	***10,953,635***	**99,084,608**

Sanitary Sewers Ten-Year Plan
Proposed FY 2022 – FY 2031 Capital, Operating and Debt Service
(continued)

Capital Projects	FY 2021 Approved	FY 2022 Proposed	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 22-31
Reconstruction and Extension of Sanitary Sewers	0	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	9,000,000
Sanitary Sewer Asset Renewal Program	1,250,000	4,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	36,000,000
Combined Sewer Assessment and Rehab	2,805,000	5,000,000	3,900,000	0	0	0	0	0	0	0	0	8,900,000
AlexRenew WWTP Expansion	0	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD	0
Capitalized DPI Positions	790,730	800,000	844,000	886,000	931,000	977,000	1,026,000	1,077,000	1,131,000	1,188,000	1,247,000	10,107,000
Capitalize Sustainability Coordinator	52,290	53,000	55,000	58,000	61,000	64,000	67,000	71,000	74,000	78,000	82,000	663,000
Subtotal, Capital Projects	*4,898,020*	*11,253,000*	*9,199,000*	*5,344,000*	*5,392,000*	*5,441,000*	*5,493,000*	*5,548,000*	*5,605,000*	*5,666,000*	*5,729,000*	*64,670,000*
Debt Service	**FY 2021 Approved**	**FY 2022 Proposed**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**FY 2030**	**FY 2031**	**Total FY 22-31**
Debt Service Payments	*2,678,122*	*2,469,278*	*1,818,712*	*1,792,534*	*1,727,995*	*1,473,213*	*1,427,870*	*1,520,677*	*1,580,324*	*1,527,581*	*1,335,810*	**16,673,994**
Total Expenditures, All Categories	**15,359,412**	**22,654,995**	**20,153,259**	**16,479,615**	**16,676,178**	**16,688,081**	**16,917,024**	**17,294,733**	**17,647,915**	**17,898,359**	**18,018,445**	**180,428,602**

ALEXRENEW WASTEWATER TREATMENT PLANT CAPACITY

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	1500 Eisenhower Ave.
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Southwest Quadrant
		PROJECT CATEGORY:	3
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	21 - 25 Years

AlexRenew Wastewater Treatment Plant Capacity

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	-	**0**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	-
Financing Plan													
Sanitary Sewer Fund	-	0	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD	-
Financing Plan Total	-	**0**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	-
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

A placeholder for future funding (TBD) has been included in the 10-year CIP starting in FY 2025.

PROJECT DESCRIPTION & JUSTIFICATION

This project will include a feasibility study and planning level engineering to be performed jointly between the City and AlexRenew, to determine whether the existing AlexRenew facility can be expanded to treat an additional 4 million gallons per day (MGD). The exact scope, timing, and feasibility of this project is to-be-determined, however the cost is likely to be significant. It is not anticipated that the City will reach its existing treatment capacity until after Year 2040, construction of additional wastewater treatment capacity will not be needed until after 2030.

As a part of the City's 2013 Sanitary Sewer Master Plan (Master Plan) and in anticipation of future growth, it was recommended that the City seek an additional 4 MGD of wastewater treatment capacity at Alexandria Renew Enterprises (AlexRenew). This future treatment capacity was added to the FY 2014 - 2023 CIP. In 2017, state legislation was passed that required the City to accelerate the mitigation of the impacts of combined sewer overflows (CSO). Following the 2017 CSO legislation, the City transferred ownership of the combined sewer outfalls to AlexRenew. AlexRenew is currently in the preliminary design phases of its RiverRenew initiative, which will include significant construction and new facilities in order to convey combined sewer flows to the AlexRenew facility for treatment. This infrastructure which is estimated to cost approximately $613 million must be constructed and operational by July 1, 2025 to comply with the 2017 CSO legislation. With the construction of RiverRenew, the City and AlexRenew will need to reassess options for additional wastewater treatment.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

Sanitary Sewer Master Plan

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

CAPITAL SUPPORT OF CSO MITIGATION PROJECTS

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	Citywide
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Citywide
		PROJECT CATEGORY:	1
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	Varies

Capital Support of CSO Mitigation Projects

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	**1,355,990**	**1,355,990**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Financing Plan													
Sanitary Sewer Fund	1,355,990	1,355,990	0	0	0	0	0	0	0	0	0	0	0
Financing Plan Total	**1,355,990**	**1,355,990**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

No changes from previous CIP.

PROJECT DESCRIPTION & JUSTIFICATION

As part of legislation passed by the 2017 Virginia General Assembly, the City has been required to accelerate its efforts to address combined sewer discharges from all four outfalls in the City. The bill mandated combined sewer overflow (CSO) mitigation and construction at all outfalls be completed no later than July 1, 2025.

In order to meet this very aggressive mandated schedule for completion of the project, an agreement was reached with AlexRenew on May 1, 2018 that transferred the ownership of the CSO outfalls, along with the responsibility for construction and financing of future infrastructure to meet the timeline mandated by the General Assembly, to AlexRenew. AlexRenew, established as the Alexandria Sanitation Authority, is a City created, rate payer funded, public body that owns and operates the large interceptors, pump stations and wastewater treatment facility in the City. The outfall transfer between the City and AlexRenew was finalized at the June 23, 2018 City Council Public Hearing.

AlexRenew is currently in the design phase of the project, which is currently estimated at $613 million (total program cost). AlexRenew will be funding the project through issuance of rate-payer funded revenue bonds, along with funding provided by the State.

Although AlexRenew has taken ownership of the CSO's and responsibility for the outfall mitigation projects outlined in the LTCPU, the City is still responsible for supporting AlexRenew's efforts to complete these mitigation projects on the schedule set by the General Assembly. This funding provides support for the CSO mitigation efforts, including coordination on development special use permits and other City permits, inspection and monitoring during the construction phase, stakeholder coordination, public meetings and City Council updates, data collection, historical records research and other associated work associated with regulatory review and oversight.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

Sanitary Sewer Master Plan

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

COMBINED SEWER ASSESSMENT & REHABILITATION

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	Old Town CSO Area
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Old Town
		PROJECT CATEGORY:	3
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	30+ Years

Combined Sewer Assessment & Rehabilitation

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	**18,210,000**	**9,310,000**	**5,000,000**	**3,900,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8,900,000**
Financing Plan													
GO Bonds (Stormwater)	6,505,000	6,505,000	0	0	0	0	0	0	0	0	0	0	0
Sanitary Sewer Fund	11,705,000	2,805,000	5,000,000	3,900,000	0	0	0	0	0	0	0	0	8,900,000
Financing Plan Total	**18,210,000**	**9,310,000**	**5,000,000**	**3,900,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8,900,000**
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

Project funding increased in FY 2022 from $3.9 million to $5.0 million to allow for the acceleration of this project.

PROJECT DESCRIPTION & JUSTIFICATION

This project provides for the condition assessment of sewers in the combined sewer service area in Old Town and remediation of structurally deficient sewers.

The City will perform condition assessments including cleaning and televising lines, assessing information to determine condition of lines, and determining if rehabilitation is needed. Structurally deficient sewers will be identified, and the results of the field work will be evaluated to develop remediation projects which are expected to include the relining of sewers and manhole repairs. Project funding may be adjusted upon completion of the assessment period based on the condition of the sewers and need for rehabilitation.

In addition to the health and environmental benefits of this project, completion of this project will repair and renew the City's sewer infrastructure, extend the infrastructure's useful life, and reduce the number of pipe collapses and other emergency repairs.

The City is responsible for the ownership and maintenance of the sewers located in the combined sewer service area. The combined sewer outfalls are owned by Alexandria Renew Enterprises (AlexRenew). AlexRenew is also responsible for compliance with requirements of the combined sewer system permit issued by the Department of Environmental Quality and for complying with the legislation passed by the Virginia General Assembly in 2017, which requires that combined sewer discharges be mitigated to comply with the legislation by July 1, 2025. The City continues to work with AlexRenew to ensure this deadline is met.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

N/A

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

HOLMES RUN TRUNK SEWER

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	AlexRenew Plant to the City/Fairfax Border
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Landmark/Van Dorn
		PROJECT CATEGORY:	3
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	30+ Years

Holmes Run Trunk Sewer

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	**9,002,000**	**9,002,000**	**0**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	-
Financing Plan													
Cash Capital	500,000	500,000	0	0	0	0	0	0	0	0	0	0	0
GO Bonds (Sanitary)	4,100,000	4,100,000	0	0	0	0	0	0	0	0	0	0	0
Sanitary Sewer Fund	4,402,000	4,402,000	0	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	-
Financing Plan Total	**9,002,000**	**9,002,000**	**0**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	-
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

A placeholder for future funding (TBD) has been included in the 10-year CIP starting in FY 2026.

PROJECT DESCRIPTION & JUSTIFICATION

This project provides for an increase in capacity in the Holmes Run Trunk Sewer (HRTS) line, which is owned and operated by Alexandria Renew Enterprises (AlexRenew). Both the City of Alexandria and Fairfax County send wastewater flows to this sewer and share in the capacity of this sewer. The City has a sanitary sewer Service Agreement with AlexRenew that provides for peak flow capacities in this sewer, as well as the other AlexRenew interceptor sewers.

Increased capacity is required to support development occurring in the Eisenhower Valley, as well as future development and redevelopment in the West End. In 2008, the western portion of the trunk sewer from I-395 to Cameron Run was lined for additional capacity. Additional follow-up engineering and analysis has determined further improvements are needed to address long term capacity issues.

Engineering analysis between the City, Fairfax County, and AlexRenew was completed in FY 2017 which evaluated capacity issues in the HRTS, and provided a recommendation to enlarge an existing parallel, Fairfax County Holmes Run Sewer so that flows from the AlexRenew HRTS could be diverted to this sewer. Enlargement of the Fairfax County Holmes Run Sewer are proposed from the City/County line to Cameron Run, where the Fairfax sewer discharges in the the AlexRenew HRTS. A subsequent study was completed in FY 2019 that confirms construction of this sewer will have sufficient capacity to serve the proposed growth as anticipated in the Eisenhower West Small Area Plan. This study also included analysis of the Fairfax County Backlick Sewers, located in the City, and concluded that no infrastructure improvements would be required. The timing of the capacity upgrades is anticipated sometime after 2025. Design of the capacity upgrades is anticipated to be completed in two years and construction in three years.

The FY 2019 study also identified portions of the HRTS in the East Eisenhower Valley where the City will eventually exceed its peak flow capacities as stated in the Service Agreement. Development forecasting and hydraulic modeling show that the City will not exceed its Service Agreement capacities in this section of the HRTS until after 2035. Capacity improvements in this section of the HRTS have not yet been determined.

A total of $9.0 million from the sanitary sewer fund has been budgeted in prior fiscal years for this project. The City will coordinate with AlexRenew and Fairfax County regarding implementation of projects, along with cost sharing to resolve remaining capacity issues on the Holmes Run Trunk Sewer. Depending on the outcome of these discussions, additional funding may be required in future years for both design and construction.

Completion of this project will improve the City's sanitary sewer infrastructure, which will help mitigate any potential sanitary sewer overflows during periods of wet weather. Additionally, the project will improve the City's readiness for accommodating quality economic growth.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

Sanitary Sewer Master Plan

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

RECONSTRUCTIONS & EXTENSIONS OF SANITARY SEWERS

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	Citywide
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Citywide
		PROJECT CATEGORY:	1
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	30+ Years

Reconstructions & Extensions of Sanitary Sewers

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	**24,492,959**	**15,492,959**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**9,000,000**
Financing Plan													
Cash Capital	2,146,105	2,146,105	0	0	0	0	0	0	0	0	0	0	0
GO Bond Interest Earnings	250,000	250,000	0	0	0	0	0	0	0	0	0	0	0
GO Bonds (Sanitary)	3,473,708	3,473,708	0	0	0	0	0	0	0	0	0	0	0
Sanitary Sewer Fund	18,623,146	9,623,146	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	9,000,000
Financing Plan Total	**24,492,959**	**15,492,959**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	**9,000,000**
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

Funding added to project for FY 2031.

PROJECT DESCRIPTION & JUSTIFICATION

This project provides for the construction of new sewer mains, the replacement and rehabilitation of old sewer lines as needed, repairs to City streets disturbed by sewer line repairs, and reconstruction and funds for the City's share of the cost of sewer extensions required for development.

Prior year balances, along with annual funding will be utilized to fund multiple projects in this request.Some projects are in early planning stages, while others are currently in design and construction. Obstacles to construction may include the moving of buried utility lines, such as power, water, and gas lines by the various utility owners that if not moved would interfere with the construction.

Projects currently under study/design and scheduled for construction in FY 2022 include:

- Wheeler Avenue Sewer Lining
- Franklin Street Sewer Replacement Project
- N Saint Asaph Street/Madison Street Sewer Improvements
- Miscellanous Sanitary Sewer Upsizing Projects (study ongoing)

Completion of these projects improves the City’s sanitary sewer infrastructure while reducing the frequency of unplanned repairs due to deferred maintenance.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

Sanitary Sewer Master Plan

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

SANITARY SEWER ASSET RENEWAL PROGRAM

DOCUMENT SUBSECTION:	Sanitary Sewers	PROJECT LOCATION:	Citywide
MANAGING DEPARTMENT:	Department of Transportation and Environmental Services	REPORTING AREA:	Citywide
		PROJECT CATEGORY:	2
PRIMARY STRATEGIC THEME:	Theme 8: Environmental Sustainability	ESTIMATE USEFUL LIFE:	30+ Years

Sanitary Sewer Asset Renewal Program

	A (B + M)	B	C	D	E	F	G	H	I	J	K	L	M (C:L)
	Total Budget & Financing	Through 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	Total FY 2022 - FY 2031
Expenditure Budget	**38,500,000**	**2,500,000**	**4,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**36,000,000**
Financing Plan													
GO Bonds (Sanitary)	1,250,000	1,250,000	0	0	0	0	0	0	0	0	0	0	0
Sanitary Sewer Fund	37,250,000	1,250,000	4,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	36,000,000
Financing Plan Total	**38,500,000**	**2,500,000**	**4,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**3,500,000**	**36,000,000**
Operating Impact	0	0	0	0	0	0	0	0	0	0	0	0	0

CHANGES FROM PRIOR YEAR CIP

Project funding increased by $1 million in FY 2022. Funding added to project for FY 2031.

PROJECT DESCRIPTION & JUSTIFICATION

The City's sanitary sewer system is comprised of over 240 miles of sewer line, some lines dating back over 100 years. This program provides for annual inspection, condition assessment, and rehabilitation of sanitary sewers, City-owned lateral sewers, and sewer appurtenances as part of an ongoing sewer asset management initiative.

This program provides for closed circuit television (CCTV) inspection of all sewers and City-owned laterals and visual inspection of all sewer appurtenances (manholes and other structures). Inspections will be performed with a goal of inspecting 10 percent of the system each year. The condition of all sewers and sewer appurtenances will be assessed using industry standards of cataloguing inspections and recommendations will be made as to which sewers and sewer appurtenances are vulnerable to breakage or collapse. Sewers and sewer appurtenances that are vulnerable will be rehabilitated primarily using trenchless technologies, which are significantly less costly than dig-and-replace repairs. A total of $36 million is being budgeted for this program over the ten-year budget period. Funding in FY 2022 has been increased by $1 million to accelerate implementation of the program.

Implementation of this project improves the City's sanitary sewer infrastructure and extends the infrastructure's useful life by reducing the potential of pipe collapse and other emergency repairs. Additionally, this project will help reduce the amount of infiltration and inflow (I&I) into the sanitary sewer system, which helps reduce the frequency and magnitude of sanitary sewer overflows and sewer back-ups into homes and businesses.

EXTERNAL OR INTERNAL ADOPTED PLAN OR RECOMMENDATION

Sanitary Sewer Master Plan

ADDITIONAL OPERATING IMPACTS

No additional operating impacts identified at this time.

Appendix B
Modeled Sewers Over Capacity

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Modeled Sewers Over Capacity

Model Basin Number	Condition When Sewer is Over Capacity	Diameter (inches)	Length (feet)	GIS ID
9	Existing	8	360.692812	000453SEWP
9	Existing	8	314.617634	001866SEWP
9	Existing	8	255.162757	001867SEWP
9	Existing	12	140.43336	000447SEWP
9	Existing	12	157.068185	002210SEWP
9	Existing	12	200.564438	002212SEWP
9	Existing	15	299.893237	000338SEWP
9	Existing	15	427.808208	000341SEWP
9	Existing	15	161.28	500018SEWP
9	Existing	18	94.07757	001623SEWP
9	Existing	18	299.713596	001625SEWP
9	Existing	18	59.623009	001645SEWP
9	Existing	18	327.117021	001646SEWP
9	Existing	18	211.112071	002213SEWP
9	Future	8	108.157919	001300SEWP
9	Future	10	72.74565	001898SEWP
9	Future	12	125	000454SEWP
9	Future	12	108.632012	002211SEWP
9	Future	15	283.364909	000455SEWP
9	Future	15	46.657	500019SEWP
9	Future	18	587.0487	001647SEWP
11	Existing	15	306.861969	000255SEWP
11	Existing	15	185.239219	000260SEWP
11	Existing	15	91.904694	001451SEWP
11	Existing	15	203.497404	001901SEWP
11	Existing	15	150.963754	009240SEWP
11	Existing	15	7.350786	009241SEWP
11	Existing	15	28.331614	009242SEWP
11	Existing	15	76.057	009254SEWP
11	Existing	15	60.176	009255SEWP
11	Existing	15	71.661	009256SEWP
11	Existing	15	695.108359	009259SEWP
11	Existing	15	576.182	009260SEWP
11	Existing	15	526.53279	009261SEWP
13	Future	12	147.125248	007103SEWP
13	Future	12	121.791505	007299SEWP
13	Future	15	49.270827	007102SEWP
13	Future	15	300.29793	007572SEWP
14	Existing	12	381.25078	006504SEWP
14	Existing	12	212.075877	007110SEWP
14	Existing	12	48.473093	007111SEWP
14	Existing	12	363.987185	007128SEWP
14	Existing	12	308.80645	007129SEWP

Model Basin Number	Condition When Sewer is Over Capacity	Diameter (inches)	Length (feet)	GIS ID
14	Existing	12	308.527153	007130SEWP
14	Existing	12	84.139341	007148SEWP
14	Existing	12	62.082903	007149SEWP
14	Existing	12	6.73324	007150SEWP
14	Existing	12	31.149639	007151SEWP
14	Existing	12	134.787422	007154SEWP
14	Existing	12	148.993515	007904SEWP
14	Existing	12	331.978254	007974SEWP
14	Existing	15	57.15804	005918SEWP
14	Existing	15	51.167318	005919SEWP
14	Existing	15	121.854353	005920SEWP
14	Existing	15	177.696043	007248SEWP
14	Existing	15	6.410317	007318SEWP
14	Existing	15	25.478756	007519SEWP
14	Existing	15	28.645908	007905SEWP
14	Existing	15	157.842433	007907SEWP
14	Existing	15	174.903086	007910SEWP
14	Existing	15	145.903092	007946SEWP
14	Existing	15	159.615448	007947SEWP
14	Future	12	75.659998	007976SEWP
14	Future	12	62.354962	007977SEWP
16	Existing	10	257.358943	005892SEWP
16	Existing	10	210.067692	005893SEWP
16	Existing	10	307.11339	005925SEWP
16	Existing	15	182.912208	005929SEWP
16	Existing	15	304.139941	007604SEWP
16	Existing	15	247.579853	007605SEWP
16	Existing	15	131.879934	007618SEWP
16	Existing	15	130.900345	007619SEWP
16	Existing	18	66.131172	007133SEWP
29	Existing	10	417.675202	008347SEWP
29	Existing	10	276.224312	008711SEWP

Appendix C
Sanitary Sewer Connection Fees for FY 2022 Memorandum

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City of Alexandria, Virginia

MEMORANDUM

MEMORANDUM TO INDUSTRY NO. 02-22

DATE: JUNE 23, 2021

TO: DEVELOPERS, ARCHITECTS, ENGINEERS & SURVEYORS

FROM: ERIN BEVIS-CARVER, P.E., ACTING DIVISION CHIEF, SANITARY INFRASTRUCTURE DIVISION, TRANSPORTATION AND ENVIRONMENTAL SERVICES

SUBJECT: SANITARY SEWER CONNECTION FEES FOR FY2022
CITY CODE SECTION 5-6-25.1

Effective July 1, 2021, for Final Site Plans and Grading Plans, the sanitary sewer connection fees are hereby increased as outlined in the revised fee schedule below. The plan submission date governs the applicable fee schedule which shall be determined by the date that the Final 1 Site Plan or initial Grading Plan was received by the City. For Site Plans, please note that the date the plan was submitted to ESI for Minimum Submission Review is not the same as the Final 1 Submission Date.

For FY2022: July 1, 2021 through June 30, 2022:

- **$9,446** single-family detached, semi-detached, duplex or townhouse
- **$8,501;** per dwelling unit; multi-family building, i.e. condominium apartments (90% of single-family rate)
- **$8,501;** per unit; hotel/motel (90% of single-family rate)

Nonresidential property (commercial buildings), fee is calculated based on the meter servicing the property. The non-residential fee chart is located on Page 2.

Fee Chart for Nonresidential Property

Meter Size (inches)	*Maximum Capacity (GPM)*	*3/4" Meter Equivalent*	*Fee*
3/4 or smaller	30	1.00	**$9,446**
1	50	1.67	**$15,773**
1 1/2	100	3.33	**$31,452**
2	160	5.33	**$50,342**
3	320	10.76	**$101,629**
4	500	16.67	**$157,449**
6	1000	33.33	**$314,805**
8	1600	53.33	**$503,705**
10	2300	76.67	**$724,152**

The sanitary sewer connection fee increases reflect the requirements of City Code Section 5-6-25.1. On July 1 of each fiscal year, these fees shall be increased by the annual rate of inflation as determined by the CPI-U for the Washington, DC-MD-VA-WVA Combined Statistical Area. For Fiscal Year 2021 an increase of 2.62% was used based on the CPI-U rate from March 2020 to March 2021.

Tear-down credits: For connections that involve the removal of an existing structure with an existing tap, a credit will be provided, equal to 50 percent of the current fee that would be applied to the structure(s) being removed. For mixed-use properties, the credit will be based on the sum of the residential credit and nonresidential credit, in accordance with Section 5-6-25.1 of the City Code. The credit shall only apply to properties removed or demolished not longer than three years prior to the submission of the final site plan or grading plan for the new structure.

Conversions: For conversions of existing buildings that increase the number of units or change use, a full credit (100 percent) for the existing use will be applied to the tap fee calculation.

If you have any questions, please call 703.746.4154 or email erin.beviscarver@alexandriava.gov.

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CDM Smith