2021

Stormwater Management Primer

Prepared for:

Stormwater Utility and Flood Mitigation Advisory Group

City of Alexandria, Virginia

CONTENTS

INTRODUCTION TO STORMWATER MANAGEMENT

WHAT IS STORMWATER RUNOFF?

Stormwater runoff is rainwater or melted snow that runs off streets, lawns, and other surfaces. When stormwater is absorbed into soil, it is filtered and ultimately replenishes aquifers or flows into streams and rivers. Stormwater runoff occurs when rain or snowmelt flows over hard surfaces — also called impervious surfaces — like roofs, driveways, parking lots, and streets and doesn't soak into the ground. If not managed properly, stormwater runoff can cause water pollution and/or flooding issues.

WHAT IS STORMWATER MANAGEMENT?

Stormwater management is the effort to manage the flow of rainwater or snowmelt to minimize adverse effects such as flooding and improve water quality. It includes regulating development in the City, the operations and maintenance of infrastructure, stream and channel maintenance, designing and implementing capital projects to mitigate flooding and to protect water quality, addressing potential illicit discharges, and maintaining a community flood management program. In the City, it also means complying with state and federal cleanup mandates for the Chesapeake Bay.

LINKS FOR ADDITIONAL INFORMATION

City of Alexandria Stormwater Management Webpage:
https://www.alexandriava.gov/Stormwater

STORMWATER MANAGEMENT IN ALEXANDRIA

HISTORY OF STORMWATER MANAGEMENT IN ALEXANDRIA

The City takes pride in being a waterfront community on the Potomac River – the nation's river – and understands the integral part that our water resources play in our economy, our environment, and the social well-being of our community. Being a waterfront community in the Chesapeake Bay, the City has long enacted local environmental ordinances to protect our water resources.

In 1992, the City incorporated requirements of the Chesapeake Bay Act for protection of land in the watershed and stormwater quality and quantity into local ordinance through Article XIII of the Zoning Ordinance – the Environmental Management Ordinance. Generally, development projects had to reduce phosphorus runoff by 10% and control the rate of runoff such that the peak discharge in the post-development condition was equal to or would not exceed the pre-development condition, while ensuring an adequate downstream outfall. During the process of adopting Bay Act requirements, the City took a more conservative route and chose to be more protective by implementing 100' Resource Protection Area (RPA) requirements in the City and designating all other non-RPA land acreage as Resource Management Areas (RMAs). The City exceeded the Bay Act requirements by implementing a 50' buffer requirement for natural intermittent streams and isolated wetlands. In addition to meeting the minimum water quality requirements for development and redevelopment, the City adopted a more stringent requirement to provide stormwater treatment for the first ½" of runoff from all onsite impervious surfaces, known as the water quality volume default, which provides reductions beyond those mandated.

Effective July 1, 2014, the City adopted amendments to the Environmental Management Ordinance that incorporate the Virginia Stormwater Management Program (VSMP) regulations, while retaining the more stringent water quality volume default requirements and 50' buffer application, and currently operates the VSMP locally. A new requirement in the VSMP regulations for channel protection that depend on whether the receiving channel is natural, restored, or constructed was incorporated into the City's Environmental Management Ordinance.

STORMWATER AND SANITARY SEWER SYSTEMS

There are two types of sewer systems in the City of Alexandria: a separate sewer system and a combined sewer system.

SEPARATE SEWER SYSTEM

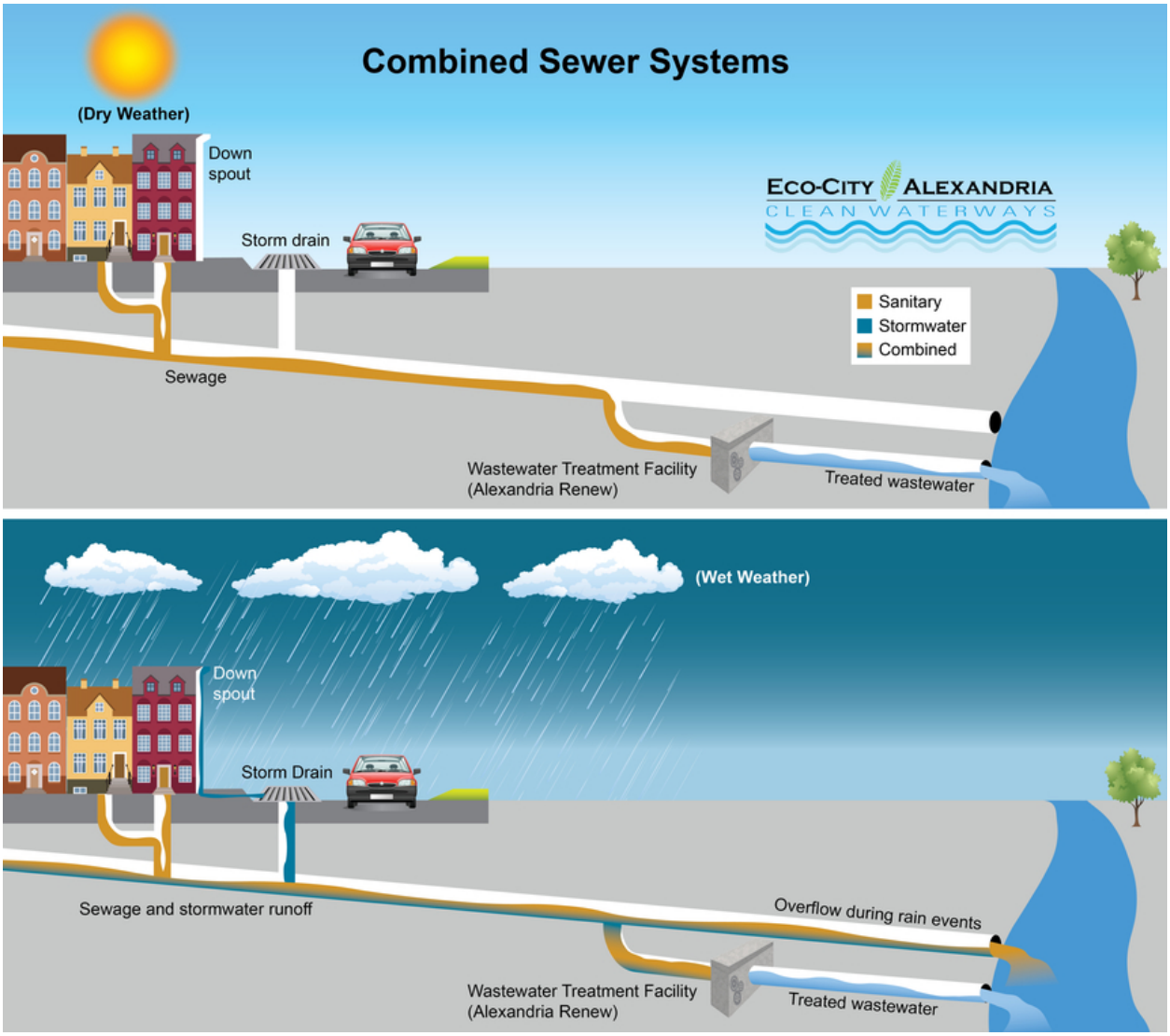
Separate sewer systems have two separate pipes. One pipe – the storm sewer system – carries stormwater runoff that picks up pollution and trash that enters storm drains and flows directly to local streams with little or no treatment.

A second pipe – the sanitary system – carries sanitary sewage from neighborhoods and businesses to the wastewater treatment facility, where Alexandria Renew Enterprises cleans the sewage before it's released back into the environment. The separate storm and sanitary sewer systems serve 95% of the City.

COMBINED SEWER SYSTEMS

Combined sewer systems only have one pipe to carry both sanitary sewage and stormwater runoff. Sanitary sewage from inside homes and businesses drains to the pipe. In dry weather, all sewage flows to the wastewater treatment facility, where Alexandria Renew Enterprises (AlexRenew) cleans the sewage before it is discharged. When it rains, stormwater runoff flows into the same pipe and mixes with raw sewage. When it rains, there can be nine times more stormwater than raw sewage that can fill up the pipe which can overwhelm the combined sewer system pipe. When this happens, the mixture may overflow into local streams through one of the four permitted combined sewer outfalls to relieve the pressure. The combined sewer system serves about 5% of the City in the historic Old Town area.

In 2010, the Virginia Department of Environmental Quality developed a total maximum daily load (TMDL) to reduce bacteria discharges to Hunting Creek, with three of the four CSO outfalls discharging to this surface water. In 2017, Virginia passed a law requiring that combined sewer overflows through the outfalls be addressed by July 1, 2025. In May 2018, the City entered into an agreement to transfer the four CSO outfalls to AlexRenew. The RiverRenew project by AlexRenew is underway to reduce overflows from the combined sewer systems.



LINKS FOR ADDITIONAL INFORMATION:

RiverRenew Project Website:
https://www.riverrenew.com/

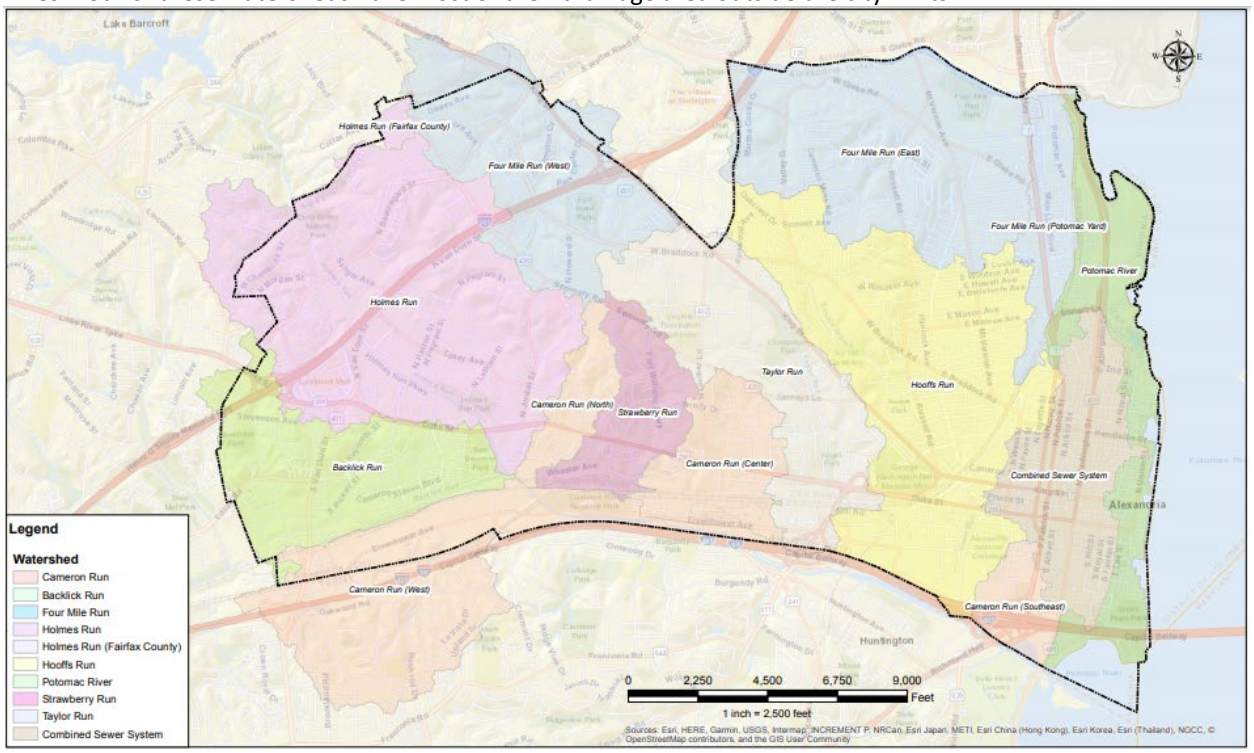
City of Alexandria Sanitary Sewer Webpage:
https://www.alexandriava.gov/Sewers

ALEXANDRIA WATERSHEDS

The City of Alexandria is about 15 square miles and bordered on the east by the Potomac River, on the north generally by Four Mile Run, and on the south generally by Cameron Run. The Potomac River is one of the five major rivers draining to the Chesapeake Bay, a 64,000 square mile watershed that spans six states and the District of Columbia, with the other tributaries being the Susquehanna, Rappahannock, James, and York rivers. The Potomac River is 405 miles long and drains 14,700 square miles of land which is about 22% of the entire Chesapeake Bay watershed.

In the City, we recognize eight local watersheds. These are: Four Mile Run, Potomac River, and Cameron Run, with Holmes Run, Strawberry Run, Taylor Run, Backlick Run, and Hooff's Run being part of the overall Cameron Run.

Overall, Cameron Run Watershed is approximately 45-square miles and Four Mile Run is approximately 20-square miles. Both of these watersheds have most of their drainage area outside the city limits.



LINKS FOR ADDITIONAL INFORMATION

City Watersheds Webpage:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50902

Map of City of Alexandria Watersheds:
https://www.alexandriava.gov/uploadedFiles/tes/oeq/info/WatershedsParcels.pdf

"Locate Your Watershed" Tool:
https://geoportal.alexandriava.gov/portal/apps/webappviewer/index.html?id=dc9226fd6b304512adcaf42106583156

Sewer Viewer Tool:
https://geo.alexandriava.gov/Html5Viewer/Index.html?viewer=sewerviewer

CITY STORMWATER INFRASTRUCTURE

About 48% of the City is covered by impervious surfaces. There are 25 miles of streams, 210 miles of streets, 185 miles of storm pipes, 13,520 stormwater structures (such as catch basins and inlets), 425 outfalls, and a mixture of about 500 public and private stormwater management best management practices (BMPs).

LINKS FOR ADDITIONAL INFORMATION

City of Alexandria Stormwater Management Webpage:
https://www.alexandriava.gov/Stormwater

Virginia Stormwater Management Program:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50216

Total Maximum Daily Loads (TMDL):
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=52652

Municipal Separate Storm Sewer System (MS4) Program:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=93364

FUNDING

CITY BUDGET PROCESS

The City's fiscal year begins on July 1 and ends on June 30 each year. Each year, the Alexandria City Council approves both an annual operating budget and a ten-year capital budget. Below is a high-level summary of the steps involved to get to budget approval:

- Fall:
  - Boards & Commissions submit budget priorities to the Office of Management and Budget (OMB)
  - CIP Work Sessions begin
  - City Council Budget Retreat takes place
  - City Council provides budget guidance to City staff
- Winter:
  - City Manager presents proposed budget to City Council
  - CIP Work Sessions continue
- Spring 2022:
  - CIP Work Sessions continue
  - Boards & Commissions may submit memos to Council on budget recommendations
  - City Council makes "add/delete" proposals to the proposed budget
  - City Council adopts a budget to be effective July 1

STORMWATER UTILITY FEE

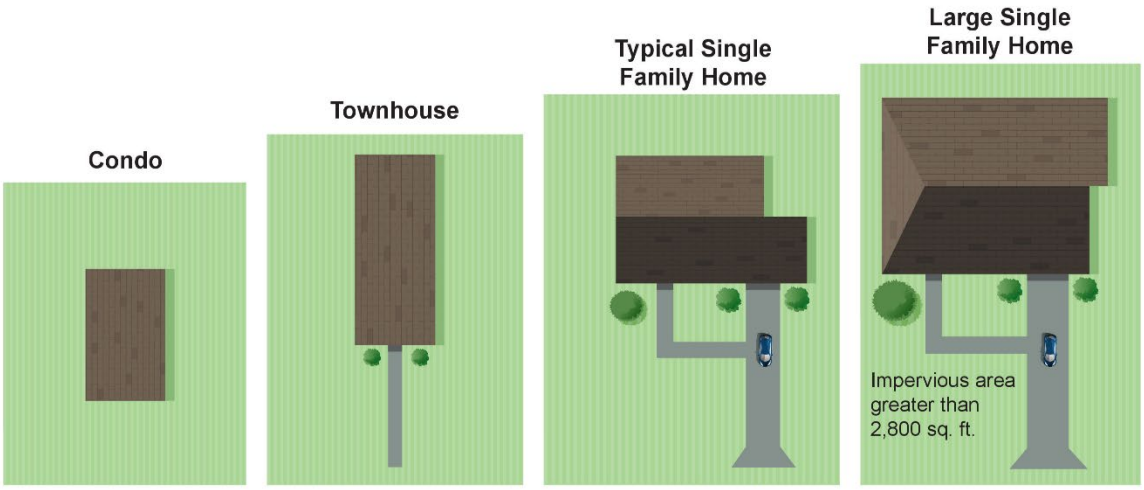
The Stormwater Utility Fee provides funding for the stormwater management program to reduce the impact of stormwater pollution and flooding, and to ensure compliance with state and federal stormwater regulations.

The Stormwater Utility (SWU) Fee was adopted to provide a dedicated funding source for stormwater management program services and capital projects to reduce sediment and nutrient (nitrogen and phosphorous) pollution into our local waterways, the Potomac River, and the Chesapeake Bay and mitigate drainage and flooding impacts. Funds raised by the fee go toward:

- Flood management program (Flood Action Alexandria)
- Capital water quality and flooding projects
- Stormwater quality initiatives,
- MS4 stormwater permit compliance,
- Operation and maintenance of public stormwater infrastructure & separate storm sewer system
- Street sweeping
- Leaf pickup
- Operation and maintenance of public stormwater infrastructure & separate storm sewer system
- Plan review
- Staff support, and
- Stream and channel maintenance

The SWU was first billed the 2nd half of Fiscal Year 2018 in May of that year. The SWU is a dedicated funding source for the City's stormwater management program that is billed twice a year on the City's Real Estate bill that is issued in May and October, with each bill being based on ½ of the annual fee. The fee more equitable distributes the amount property owners pay to fund the program based on the amount of impervious area on the property, that is directly related to the amount and degree of pollution in the stormwater runoff. The SWU established an Equivalent Residential Unit (ERU) as the "billing unit" based on the median amount of impervious area for a typical single-family home of 2,062 square feet. The residential fee is based on a tiered structure, where a single-family homeowner pays one billing unit, townhome and condo owners pay 0.42 and 0.28, respectively of one billing unit, and a large single-family home over 2,800 square feet of impervious pays 1.67 of a billing unit.

The stormwater utility fee has increased to accelerate capital stormwater projects and maintenance to mitigate flooding impacts from more intense rainfall events that have occurred over the last two-years. City Council voted on the increase via revision to the ordinance at the January 26, 2021, Legislative Session and adopted on second reading at the February 20 Public Hearing. The stormwater utility is billed twice a year in May and October and each billing is based on half (½) the billing rate. The May 2021 billing rate increased from $140 to $210 and is being billed at $105 (half of $210). The October 2021 billing rate will increase to $280 and be billed at $140 (half of $280).



0.28 ERU	0.42 ERU	1 ERU	1.67 ERU
$29.40 (May 2021)	$44.10 (May 2021)	$105.00 (May 2021)	$175.35 (May 2021)
$39.20 (Oct. 2021)	$58.80 (Oct. 2021)	$140.00 (Oct. 2021)	$233.80 (Oct. 2021)

In the City's FY2022-2031 Capital Improvement Program budget, approximately $266 million is planned for stormwater management capital investments over the next ten years.

ALTERNATIVE FUNDING SOURCES

In addition to local funding, additional alternative funding sources are available for stormwater management and flood mitigation projects:

American Rescue Plan Act Funding

On March 11, President Joseph R. Biden signed the $1.9 trillion American Rescue Plan Act of 2021 (ARPA), which established the Coronavirus State and Local Fiscal Recovery Fund. As part of ARPA, $360 billion of this one-time aid will be directly allocated to states and localities on a formulaic basis. Through the passage of ARPA, the City will be allocated $59.4 million in two equal allotments (May 2021 and May 2022).

On July 6, the Alexandria City Council unanimously approved a $29.8 million allocation plan for the City's first half of funding. The projects in the plan align with the City's strategic COVID-19 recovery framework goals to ensure that businesses thrive; everyone has access to their basic needs; recovery lifts everyone; and the City makes long-term investments for its future.

The allocation plan includes $4.4 million for flood mitigation, specifically:

- $1.9 million for Flash Flooding and Spot Improvements
- $3.5 million for State of Good Repair and Resiliency

U.S. Economic Development Initiative Community Project Funding (Congressman Don Beyer)

EDI community project requests may be used for economic and community development activities, including land or site acquisition, demolition or rehabilitation of housing or facilities, construction, and capital improvements of public facilities (including water and sewer facilities), and public services. Requests may also include planning and other activities consistent with the underlying authorization for the Community Development Block Grant program within HUD.

The House Committee on Appropriations will be accepting Community Project Funding (CPF) requests from Members. Each Member is limited to no more than 10 Community Project Funding requests across all subcommittees for Fiscal Year 2022 and there is no guarantee that all requested projects will be funded.

The City of Alexandria recently requested $420,000 for Clifford Ave, Fulton Street, and Manning Street Storm Sewer Improvements and expects that determinations of the funding will be made by October this year.

Federal Emergency Management Administration (FEMA) Building Resiliency Infrastructure and Communities (BRIC) Grant Program

BRIC supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program.

The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

The City submitted a BRIC application for the Four Mile Run Dredging project being implemented in collaboration with Arlington County and scheduled to start this fall; however, the application did not result in a grant award. Nonetheless, the project has adequate funding and will continue to move forward. Staff will continue to work at identifying and submitting applications for projects to be considered for award.

Virginia Community Flood Preparedness Fund

The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia pursuant to Chapter 13, Title 10.1, Article 4, Section 10.1-603.24 and Section 10.1-603-25 and the provisions of § 10.1-1330. Clean Energy and Community Flood Preparedness Fund, which was passed during the 2020 session of the General Assembly. Money in the fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative (RGGI).

The fund was established to provide support for regions and localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change. The fund will prioritize projects that are in concert with local, state, and federal floodplain management standards, local resilience plans and the Virginia Coastal Resilience Master Plan. The fund will empower communities to complete vulnerability assessments and develop and implement action-oriented approaches to bolster flood preparedness and resilience. The fund is administered by the Virginia Department of Conservation & Recreation and Virginia Resources Authority.

Virginia Stormwater Local Assistance Fund (SLAF)

The Stormwater Local Assistance Fund (SLAF) provides matching grants to local governments for the planning, design, and implementation of stormwater best management practices (BMPs) that address cost efficiency and commitments related to reducing water quality pollutant loads. Eligible capital project types can include:

- New stormwater BMPs
- Retrofits of stormwater BMPs
- Stream restoration
- Low impact development projects
- Buffer restoration
- Pond retrofits
- Wetland restoration

The SLAF program can also be used to fund the purchase of permanent, certified non-point source nutrient credits.

The City was awarded a FY2014 SLAF of $1.2 million for the implementation of the Lake Cook Retrofit and a FY2015 SLAF of $1.8 million for the Ben Brenman Pond Retrofit that have been completed and count toward the pollutant reductions mandated in the City's MS4 General Permit Chesapeake Bay TMDL Special Conditions. The City was also awarded a FY2017 SLAF of $.668 million for the Lucky Run Stream Restoration project that is scheduled to begin construction late 2021. Additionally, the City was also awarded FY 2019 SLAF grants of $2.225 million and $.800 million, respectively, for the proposed Taylor Run and Strawberry Run stream restoration projects. Currently, those projects are in an extended public engagement phase based on City Council direction at the April 27, 2021 Legislative meeting.

LINKS FOR ADDITIONAL INFORMATION

Stormwater Utility Fee Property Search Tool:
https://realestate.alexandriava.gov/index.php?action=address

Stormwater Utility Fee Map Viewer:
https://www.alexandriava.gov/101010

Stormwater Utility Fee Credit Manual:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/SWU_Credit_Manual.pdf

History of the Stormwater Utility Fee:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=112941

Approved Stormwater Utility Ten-Year Capital Improvement Plan (FY2022-2031):
https://www.alexandriava.gov/uploadedFiles/budget/info/budget_2022/J60%20-%20Stormwater%20Management(1).pdf

Approved City Budget:
https://www.alexandriava.gov/budget/info/default.aspx?id=123003

Alexandria Office of Management & Budget:
https://www.alexandriava.gov/Budget

American Rescue Plan Allocation Plan:
https://alexandria.legistar.com/LegislationDetail.aspx?ID=5015170&GUID=E1A4AAE4-2BCF-4C43-9C43-C0AB102378A6

FEMA BRIC Program:
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

U.S. Economic Development Initiative Community Project Funding (Congressman Don Beyer):
https://beyer.house.gov/blog/?postid=5133

DCR Community Preparedness Fund:
https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Virginia Stormwater Local Assistance Fund:
https://www.deq.virginia.gov/water/clean-water-financing/stormwater-local-assistance-fund-slaf

City Stream Restoration Projects
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=51332

PROGRAMS

FLOODPLAIN MANAGEMENT

The City's floodplain management efforts include the following:

Community Rating System (CRS) and National Flood Insurance Program (NFIP)
The National Flood Insurance Program's (NFIP's) Community Rating System (CRS) is a voluntary incentive program that recognizes communities for implementing floodplain management practices that exceed the Federal minimum requirements of the NFIP to provide protection from flooding.

In exchange for a community's proactive efforts to reduce flood risk, policyholders can receive reduced flood insurance premiums for buildings in the community. These reduced premiums reflect the reduced flood risk resulting from community efforts toward achieving the three CRS goals:

- Reduce flood damage to insurable property
- Strengthen and support the insurance aspects of the NFIP
- Encourage a comprehensive approach to floodplain management

Alexandria is the first community in the Commonwealth of Virginia which has applied for and been accepted as a Class 6 CRS community, thus entitling its citizens to up to a twenty percent (20%) discount on their flood insurance premiums. Alexandria officially became a Class 6 community on October 1, 2013.

Development Site Plan Review
City staff review all development site plans to ensure compliance with Section 6-300 of the Alexandria Zoning Ordinance, which regulates uses, activities, and development which increase the frequency and severity of flooding in floodplain districts.

FEMA Flood Map Revisions
Alexandria is participating in a Flood Insurance Study being conducted by FEMA to update current floodplain maps. Floodplain maps inform communities about local flood risk. The maps help set minimum floodplain standards, which helps communities build safely and resiliently, and they also determine the cost of flood insurance, which helps property owners financially protect themselves against flooding.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) PERMIT

The federal Clean Water Act of 1970 promulgated the National Pollutant Discharge Elimination System (NPDES) stormwater requirements which are administered by the Virginia Department of Environmental Quality (DEQ) Virginia Pollution Discharge Elimination System (VPDES) permitting program. The City is regulated to discharge stormwater from the separate storm sewer conveyance system under a VPDES permit known as our Municipal Separate Storm Sewer System (MS4) General Permit.

Per the MS4 General Permit and Coverage Letter effective November 2018 - October 2023 issued under the VPDES) regulations, the City is required to control stormwater pollution to the maximum extent practicable and to develop a MS4 Program Plan. Under previous permit cycles, the City's initial plan was developed in 2003 and was revised in 2008, 2013, 2019, and 2020. The permit contains Six Minimum Control Measures (MCMs) of stormwater controls:

- MCM 1: Public Education and Outreach
- MCM 2: Public Involvement and Participation
- MCM 3: Illicit Discharge Detection and Elimination
- MCM 4: Construction Site Stormwater Runoff Control
- MCM 5: Post-Construction Stormwater Management for New Development and Development on Prior Developed Lands
- MCM 6: Pollution Prevention and Good Housekeeping for Facilities Owned or Operated by the Permittee within the MS4

Under these regulations, the City is required to submit an annual report to the DEQ on compliance activities, to include progress towards meeting the Bay TMDL Special Conditions. The report provides details of the pollution control measures the City performs as part of the MS4 Program to meet or exceed the control measures (MCMs) of the MS4 permit. The City is required to keep all annual reports online for the current permit.

VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSMP)

Effective July 1, 2014, the City administers the Virginia Stormwater Management Program (VSMP) locally for development and redevelopment projects during the site plan. This includes review and approval of Stormwater Pollution Prevention Plans (SWPPPs) for coverage under the Virginia Pollutant Discharge Elimination System (VDPES) Construction General Permit for land-disturbance projects, and the state water quality and water quantity requirements. The City has reserved the right to implement more stringent water quality requirements for development projects to treat the first ½" of stormwater runoff from all impervious areas using water quality BMPs.

The VSMP regulations require 'Chesapeake Bay Land-Disturbing Activities' of greater than or equal to 2,500 square feet and less than one acre, and land disturbing activities of 1 acre or greater except for detached single family homes within or outside a common plan of development or sale, to meet water quality and quantity requirements, as applicable, with the latter also required to apply for coverage under the VPDES construction general permit.

SPOT IMPROVEMENT PROGRAM

Spot improvement projects are small capital projects managed by Transportation & Environmental Services Stormwater Management Division (T&ES-SWM) with the Department of Project Implementation (DPI), as applicable, to help address localized flooding and drainage issues. Spot improvement projects support the increased functionality of the storm sewer system that is comprised of hundreds of miles of underground pipes, culverts, inlets, grates, manholes, and "flap gates" or "check valves".

Typically, the City completed three to five spot improvement projects annually based on existing Capital Improvement Program funding, community and stakeholder engagement, and staff resources. However, due to the increased frequency of severe storms, City Council voted to increase the SWU Fee in FY 2022 to provide additional capital resources to accelerate the delivery of 8-11 spot improvement projects annually. Staff receives requests through Alex311 (Flooding Concerns and Inquiries) that initiate the further investigation and potential identification of spot improvement projects. More recently, in response to City Council direction to engage more closely with flood-impacted properties, staff has conducted numerous neighborhood engagements consisting of onsite and/or virtual meetings and have followed up with consultant-led neighborhood investigations to determine potential future projects.

Spot improvement projects follow a prescribed order of project management:

1. Investigation
2. Planning
3. Design
4. Construction/Implementation

Design includes conceptual design and/or preliminary design considerations. These projects differ from large CIP capacity projects in that they typically do not require the additional steps of formal procurement for design and construction as most of the work is done in-house and using on-call contractors, so these spot improvement projects can be delivered faster. Small to midsize maintenance and repair projects on public property are coordinated by the City's Public Works Services Division.

FLOOD MITIGATION PILOT GRANT PROGRAM

As part of the City's Flood Action Alexandria initiative, the new Flood Mitigation Pilot Grant Program is launching in Summer 2021. The program offers financial assistance as matching reimbursement grants to property owners who have installed flood mitigation measures on properties impacted by flooding from recent flash flooding events.

The City's Legislative Package included updates to the Code of Virginia to explicitly allow municipalities to provide local monies as grant funding for flood mitigation efforts. The City's work with State leadership and constituents ushered in this legislative change, effective July 2021, which enabled the City to move forward with developing the Flood Mitigation Pilot Grant Program.

The pilot phase of the program will last for at least a year to allow for gathering of data and lessons learned to shape the future of the program. After which time, staff may adjust eligibility requirements to expand the program to more properties and more practices to receive funding.

The program will offer up to 50% reimbursement of the completed project costs, up to $5,000, for implementing eligible floodproofing measures on their property following staff review. Floodproofing and mitigation techniques provide a quick, short-term mitigation effort to protect properties while larger capital projects are considered. During this pilot phase, priority will be given to property owners who have documented flood issues from storms dating back to July 2019, and the reimbursement will be retroactive back to practices installed after the July 2019 flooding event. The pilot grant is somewhat modeled on the City's Backflow Preventer grant program which offers reimbursement to residents who install backflow preventers.

Qualifications for reimbursement include the following:

- Residential properties are eligible during the pilot phase of the program; the program is anticipated to be open to other eligible entities after the commencement of the pilot program.
- Applicant is the property owner of the property that experienced flooding.
- Applicant can provide documented damage from flooding from any of the recent severe storm events dating back to July 8, 2019. Documentation may include, but is not limited to: photographs, videos, Alex311 service requests, and/or insurance claims.

- Applicant can provide itemized receipts for purchase and/or installation for eligible expenses incurred on or after July 2019.
- All applicable permits and/or application reviews have been completed through Department of Code Administration, Department of Planning & Zoning, or Transportation & Environmental Services, as applicable. Practices requiring permits and/or reviews that were not secured prior to installation are ineligible for reimbursement unless later remedied by the representative department.
- Photographic evidence that measures have already been installed and can be confirmed by the City or its contractor(s) if requested.

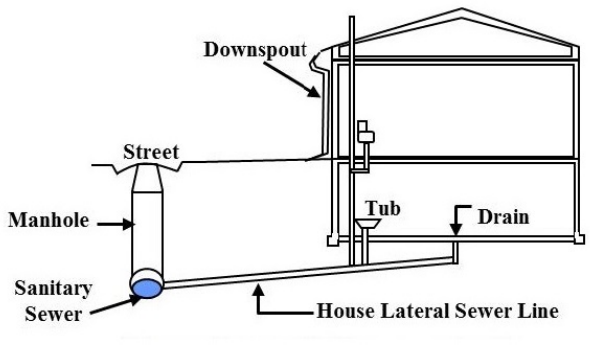
Eligible floodproofing measures include:

- Floodproofing windows – Glass protection materials; fixed, translucent, water-tight covers; custom window wells and associated drains
- Floodproofing doorways – Flood gates or panels; flood socks: temporary quick dams and sandless sandbags; traditional sandbags
- Floodproofing basements – Battery-powered sump pumps; drain tiles below a basement floor; flood vents
- Floodproofing utilities – Elevating electrical outlets and switches, heating, ventilation, and air conditioning (HVAC) systems, and other appliances (indoors and outdoors); floodwalls, covers and shields for appliances
- Modifying topography – Surface grading; protective walls; impermeable soil materials
- Other preventative measures include a flood alert system; portable submersible water pumps and hoses; installing flood-damage resistant thermal insulation and flood-resistant building materials; applying polyurethane concrete sealer to decrease concrete wall water absorbency

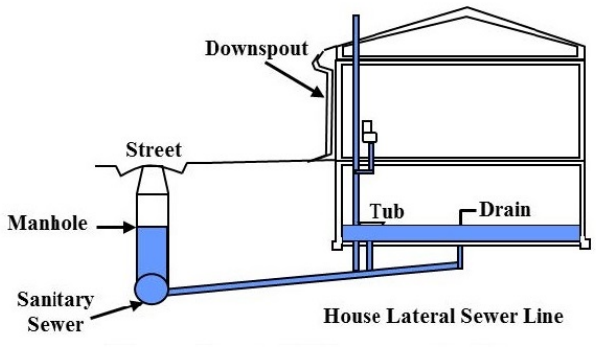
BACKFLOW PREVENTER ASSISTANCE PROGRAM

Basement back-ups or flooding can occur when water from a heavy or intense rain flows into the sanitary sewer system. The sanitary sewer system is a network of pipes and manholes in City streets that collects wastewater from homes and businesses. The wastewater collected is transported for treatment to the plant operated by Alexandria Renew Enterprises. The plant is located along the beltway at the foot of S. Payne Street. Homes and businesses are connected to the sanitary sewer system by a house sanitary sewer also called a house lateral or lateral sewer.

Rainwater can enter street and house sewers through cracked pipes or leaky joints and manholes. Sometimes homes and businesses connect sump pumps and roof downspouts to the sanitary sewers – these connections are not allowed and discharge unwanted storm water to the sanitary sewers during rain events.



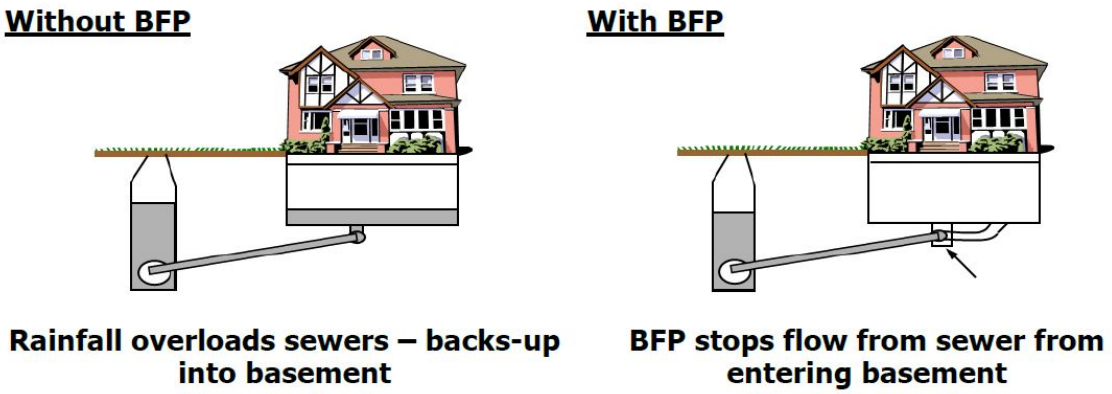
Street Sewer and House Lateral



A Basement Back-Up

If the amount of rainwater entering the sanitary sewers is excessive, the street sewers become overloaded and can back-up into the basements of homes and businesses.

The City of Alexandria sewer Backflow Preventer (BFP) Assistance Program, funded through the Sanitary Sewer budget, reimburses homeowners for up to 50 percent of the cost of installing a BFP device by a licensed plumbing contractor, up to a maximum of $2,000. The program began on July 1, 2018, and will continue through 2021, subject to available program funding. The program is open to all City of Alexandria homeowners. The City offers assistance only to those residents who have submitted an application and have been approved reimbursement.



Qualifications for reimbursement include the following:

- 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 payment in full
- Owner must accept responsibility and release City

LINKS FOR ADDITIONAL INFORMATION

Community Rating System and National Flood Insurance Program Webpage:
https://www.alexandriava.gov/tes/info/default.aspx?id=3516

Floodplain District Zoning Ordinance:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/Alexandria%20Zoning%20Ordinance_Article%20VI%20Sec%206-300%20et.seq._FloodplainDistrict.pdf

FEMA Flood Map Webpage:
https://www.alexandriava.gov/FloodMap

Municipal Separate Storm Sewer System (MS4) Permit Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=93364

Virginia Stormwater Management Program (VSMP) Webpage:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50216

City Spot Improvements Program Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=122680

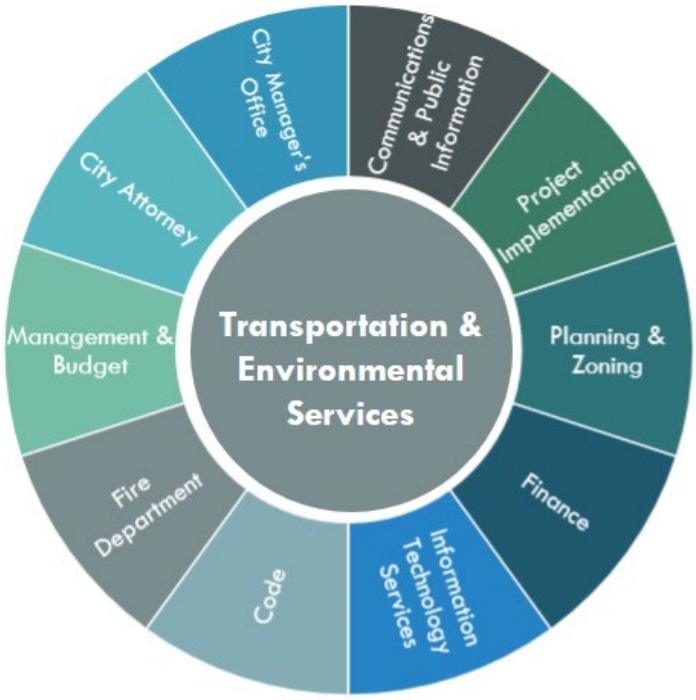
Near-Term Spot Improvement Projects List:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/NeartermSpotImprovementProjects2021.pdf

City Floodproofing Grant Program Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=121974

Backflow Preventer Assistance Program Webpage:
https://www.alexandriava.gov/tes/info/default.aspx?id=105378#AlexandriasBFPAssistanceProgram

ORGANIZATIONAL STRUCTURE

In September 2020, in response to recent flash flooding as a result of climate change-induced severe rain events, City Manager Mark Jinks established an Interdepartmental Flooding Management Task Force to develop plans to address flooding-related policy, planning, and funding issues. The team included representation from numerous departments, including but not limited to Transportation & Environmental Services, Office of Management and Budget, Office of Emergency Management, the City Attorney's Office, and the Office of Communications and Public Information. The interdepartmental team is shown below:

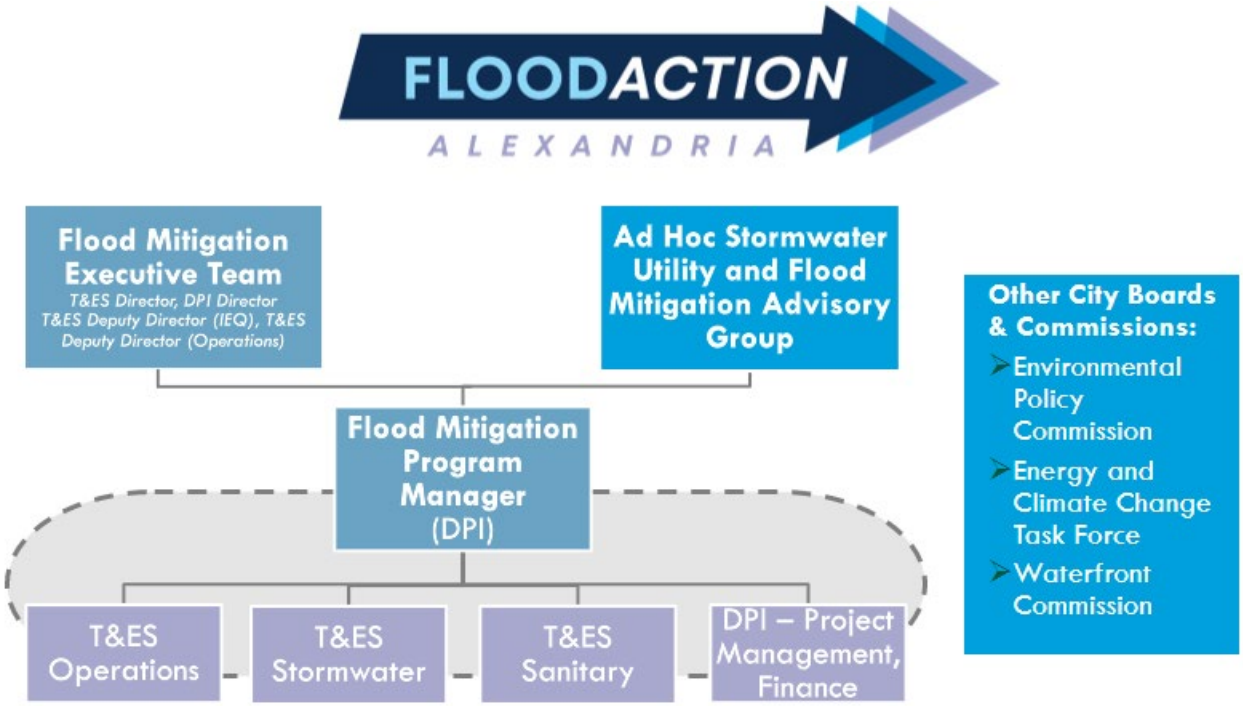


The team's objective was to produce a written report to the City Manager that provides interdepartmental staff recommendations addressing:

a. Identification of needed capital investments, needed staffing levels, and operating budget program enhancements
b. Prioritization and acceleration of needed capital investments (both CIP planned and new projects)
c. Funding strategies to re-prioritize existing CIP projects, including accelerating funding for existing stormwater capacity and maintenance projects
d. City-sponsored grant and tax-incentive programs to incent better flood protection on private property
e. Multi-year Stormwater Utility Fee sources and uses plan with associated fee rates needed to support such plans
f. Initial legislative requests to include in the City's state and federal legislative agenda

g. Immediate actions to expand the City's flood warning sign and rain gauge program, as well as expanded access to online rain gauges and early warning systems
h. Improved program communication measures

In January 2021, the Interdepartmental Flooding Management Task Force presented recommendations to City Council. An interdepartmental team supporting Flood Action Alexandria continues to work to implement the recommendations. Below is the organizational structure for Flood Action Alexandria:



T&ES = Transportation & Environmental Services; DPI = Department of Project Implementation

LINKS FOR ADDITIONAL INFORMATION

Flood Action Alexandria Program Webpage:
https://www.alexandriava.gov/FloodAction

DEVELOPMENT STANDARDS

Since the 1990s, the City's oversight of Stormwater Management for development has focused on three areas: *Erosion and Sediment Control*, *Water Quality*, and *Water Quantity*. The regulatory process and requirements in most cases are the same regardless of whether it is a "by right" site plan, Development Special Use Permit (DSUP) or "infill" development. Currently, the main controlling factor is whether the proposed development disturbs 2,500 square feet or more.

If a development does not disturb more than 2,500 square feet, the City's regulatory capacity is currently limited. However, the City is currently considering the appropriate regulatory approach for additions and/or modifications to single-family detached residential structures where land disturbance is less than 2,500 square feet. This may involve future legislative requests.

If a development does exceed 2,500 square feet of disturbance, then the applicant must comply with stormwater management requirements. This includes provisions to:

1. Submit an *Erosion and Sediment Control* plan to reduce pollution during construction.
2. Satisfy *Water Quality* requirements. First: All development must meet certain performance criteria designed to reduce pollution (measured as phosphorous removal) once construction is completed. Second: The "first flush" (defined as the first ½" to 1-inch of rain) run off from all impervious surfaces must be treated. Both are achieved through the installation and maintenance of structures, called Best Management Practices (BMPs), on the sites that treat stormwater and reduce the amount of pollution leaving the site. For commercial developments and residential development other than single family homes, City conditions typically require installation of such structures. The City is also more stringent by requiring the use of green infrastructure.
3. Demonstrate *Water Quantity* improvements. The applicant must control the rate of stormwater runoff leaving their site so that the post runoff rate is equal to or less than the pre-development condition and prove that the impact from their development will not cause harm downstream. The City's design storm standards are more conservative (stringent) than the state standards for controlling the rate of stormwater runoff.

To control the rate of stormwater runoff to meet these requirements, developers may reduce a site's impervious area or install detention facilities to slow the rate of runoff. This demonstrates that new development or redevelopment will not have negative impacts on the existing capacity of the existing infrastructure. The City may also ask for additional detention in known problem areas.

The current stormwater requirements for development can be found in the City's Environmental Management Ordinance, Chapter 13 of the City's Zoning Ordinance. Section 13-109 specifically addresses development requirements.

Several Memos to Industry (MTI) also supplement these requirements such as MTI 01-18 which requires 65% of the stormwater treatment on a site to be accomplished through green infrastructure.

In addition, the City has implemented Green Streets and Sidewalks Guidelines designed to treat runoff from public rights of way that were updated in 2020.

LINKS FOR ADDITIONAL INFORMATION

City Environmental Management Ordinance:
https://library.municode.com/va/alexandria/codes/zoning?nodeId=ARTXIIIENMA

Memos to Industry:
https://www.alexandriava.gov/tes/info/default.aspx?id=3522

City Green Streets and Sidewalks Guidelines:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=117278

OPERATIONS & MAINTENANCE

The City's Public Works Division is responsible for operations and maintenance of the City's public facilities, including streets, sidewalks, and stormwater infrastructure. Maintenance of the City's stormwater infrastructure includes:

- Inspecting and cleaning storm lines every 3 to 5 years
- Inspecting and clearing storm inlets and outlets in anticipation of upcoming storm events
- Maintenance of Best Management Practices (BMPs) as needed or by permit cycle
- Repairing stormwater infrastructure, including storm inlets, manholes, and pipes, as needed
- Stream and channel maintenance

- Maintaining large infrastructure components, such as cleaning Hooff's Run Culvert
- Inspecting internal sewers via CCTV
- Sweeping and cleaning streets
- Additional maintenance in response to service requests received via Alex311

The City's Public Works Division regularly shares updates on its stormwater maintenance activities via Facebook, Instagram, and Twitter. Residents can follow @AlexandriaVATES for updates.

LINKS FOR ADDITIONAL INFORMATION

City Sewer Maintenance Webpage:
https://www.alexandriava.gov/tes/info/default.aspx?id=6444

PROCUREMENT PROCESS & PROJECT TIMELINES

The time it takes to complete a project varies significantly depending on the scope, cost, and complexity of the project. The amount and duration of steps involved in project development also vary. Generally, the more costly or complex a project is, the longer it takes to complete due to factors like procurement requirements, detailed design, community outreach, funding timelines, and oversight. The process for completing large capacity projects and smaller spot improvements is summarized below:

MAJOR STORMWATER CAPACITY PROJECTS

Major stormwater capacity projects generally cost over $1 million in total. This total cost includes all project components such as design, community outreach, data collection and surveying, construction, and construction management. These large projects generally take between 3 and 5 years from the time funding is available. The steps included in that timeline are outlined below:

- Procurement for Design Services: 4-8 months
  - Includes developing a scope of work and advertising the design solicitation
  - Must follow state and federal procurement requirements for competitively bid projects
- Design Phase: 12-24 months
  - From start of design to deliver of signed and sealed bid documents
  - Length of time may vary depending on funding sources and amount of oversight required
- Procurement for Construction Services: 4-6 months
  - Includes developing scope and advertising the construction solicitation
  - Must follow state and federal procurement requirements for competitively bid projects
- Construction: 10-24 months

SPOT IMPROVEMENT PROJECTS

Spot improvement projects are smaller projects than major capacity projects, but they are complex enough that they still require study and/or design. With these smaller projects, the City can often use on-call design contracts to limit the amount of time spent on procurement and expedite project development. Spot improvement projects typically take 8-20 months to complete from the time funding is available. The steps included in that timeline are outlined below:

- Design Phase: 1-6 months
- Procurement for Construction: 4-6 months (if needed)
- Construction Phase: 3-8 months

COMMON SOURCES OF DELAY AND PROJECT RISK

Not every project goes according to plan. Every project has some level of risk, which can impact project delivery. Some common reasons for project delay include:

- The need to obtain right-of-way or easements from private property owners
- Conflicts with utilities/need for utility relocation
- Changes in funding (deferral, reprioritization, etc.)
- Contested procurements or lack of responsive bidders on projects
- Project prioritization changes based on new data or issues
- Regulatory approval processes or time-of-year restrictions
- Extended review and comment periods, or changes in funding requirements for state or federal grants
- Providing additional time and opportunity to engage stakeholders and work through issues or concerns
- Unforeseeable circumstances, such as:
    - Change in property ownership, or new stakeholder engagement
    - Changes in regulatory or environmental requirements
    - New development or redevelopment

FUNDING

Traditionally, sufficient funding for the project needs to be allocated before a project can begin. However, the City is developing a progressive funding strategy to allow funds to be allocated for the upcoming fiscal year according to estimated costs for that period. Effectively, this creates the potential for projects to begin sooner.

LINKS FOR ADDITIONAL INFORMATION

City Purchasing Webpage:
https://www.alexandriava.gov/Purchasing

Virginia Public Procurement Act:
https://law.lis.virginia.gov/vacodepopularnames/virginia-public-procurement-act/

CITY OF ALEXANDRIA STORM SEWER CAPACITY ANALYSIS (CASSCA) STUDY

SCOPE & PURPOSE

The Storm Sewer Capacity Analysis (CASSCA) Study began in 2009 and finalized in 2016 in response to repeated and increasingly frequent flooding from storm events attributable to old infrastructure, inconsistent design criteria, and climate change. The purpose of the CASSCA Study was to analyze the storm sewer system, identify problem flooding areas, and develop and prioritize solutions.

The CASSCA Study included field survey work, GIS storm sewer system updates, condition assessments, and hydraulic modeling (XP-SWMM by Innovyze) of the storm sewers in each watershed. The Combined Sanitary Sewer area was not included in the study.

The Study used a 10-year, 24-hour storm standard based on the existing Intensity-Duration-Frequency (IDF) rainfall curves. While this standard was developed in the mid-1980s, it is still considered more conservative than many methods employed by other jurisdictions and the National Oceanic Atmospheric Administration's (NOAA) point precipitation frequency estimates.

The Study included a planning-level and "pipe-level" view of capacity analysis to identify "bright line" capacity deficiencies in conveying a 10-year storm. Street (curb/gutter) capacity, inlet capacity, and overland relief were not integrated into the model. However, a cursory review of inlet capacity was performed.

The study was used to identify large capacity projects where the modeling results coincided with multiple complaints of flooding.

ASSUMPTIONS & METHODOLOGY

The study explored three methods of flood mitigation, both alone and in combination:

- Conveyance – Making pipes bigger
- Storage – Slowing the transmission of stormwater by holding some volume in place
- Green Infrastructure – Modeled as a reduction of impervious area in the sub-watersheds

STUDY RESULTS & PROJECTS IDENTIFIED

The hydraulic model predicted that portions of the storm system in the City may experience capacity limitations during the 10-year, 24-hour storm event.

Approximately 22 percent of the system may experience flooding and 16 percent may have a water level within 2 feet below the surface, referred to as insufficient freeboard, at some point during the storm. Also 16 percent of the system may be surcharged such that the water surface rises above the crown of the pipe and cause the system to backup. Using criteria determined in collaboration with City staff, including but not limited to proximity to critical infrastructure and roads, predicted magnitude of flooding, and problems reported by the public and city staff, problem flooding locations were identified and prioritized. Flooding locations were grouped into high priority problem areas.

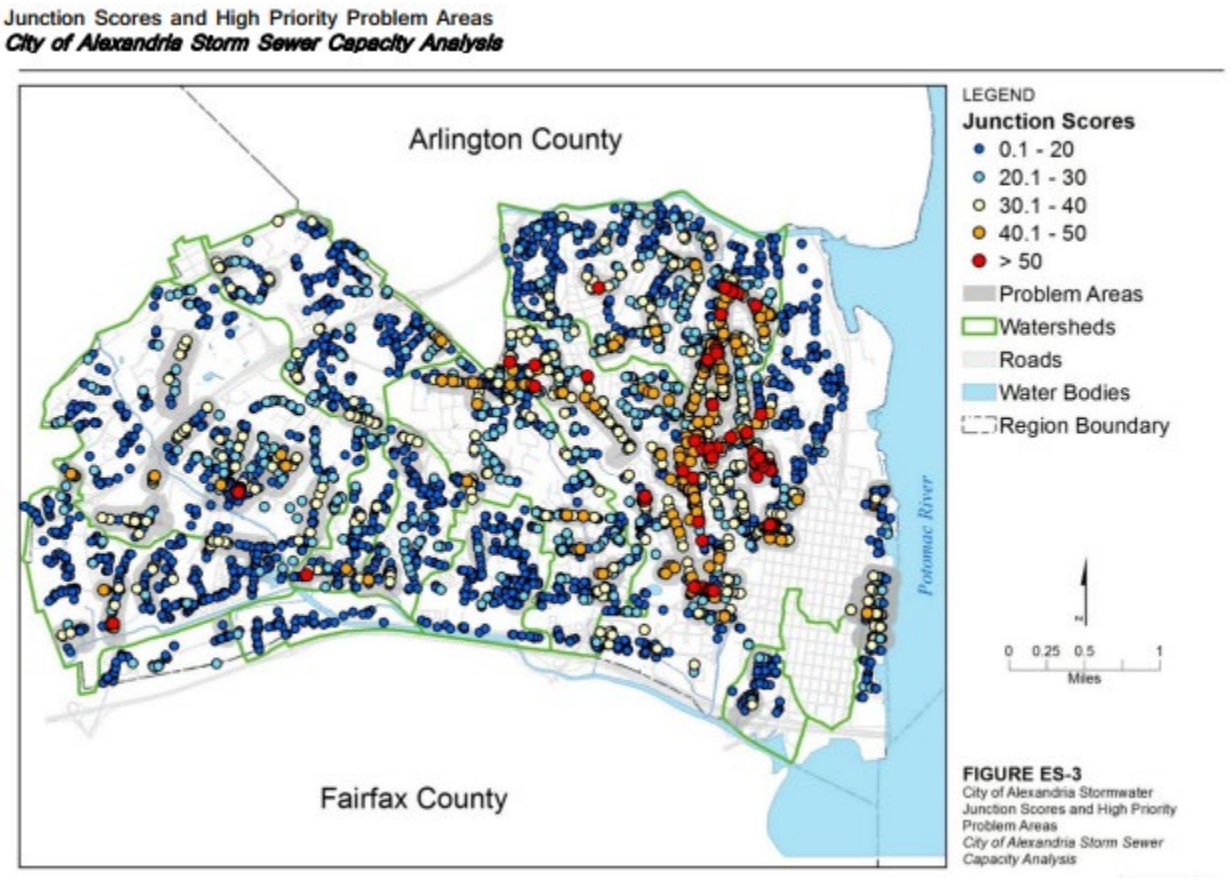


FIGURE ES-3
City of Alexandria Stormwater Junction Scores and High Priority Problem Areas
City of Alexandria Storm Sewer Capacity Analysis

The CASSCA Study identified 90 projects citywide. The projects were ranked and prioritized, with the top three projects selected for implementation in Fiscal Year 2022.

PROJECT CONCEPTUAL COST ESTIMATES

The CASSCA Study estimated planning-level costs to construct each of the 90 projects, which total more than $60M (in 2016 dollars). These estimates were for construction only and did not include:

- Feasibility analysis
- Survey and engineering design
- Utility relocation
- Property acquisition (easements, etc.)
- Public outreach and communications
- Escalation of costs since 2016 (i.e. inflation)

LINKS FOR ADDITIONAL INFORMATION

City of Alexandria Storm Sewer Capacity Analysis (CASSCA) Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=117415

ADDITIONAL RESOURCES & REFERENCE

LINKS REFERENCED IN THIS DOCUMENT

City of Alexandria Stormwater Management Webpage:
https://www.alexandriava.gov/Stormwater

RiverRenew Project Website:
https://www.riverrenew.com/

City of Alexandria Sanitary Sewer Webpage:
https://www.alexandriava.gov/Sewers

City Watersheds Webpage:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50902

Map of City of Alexandria Watersheds:
https://www.alexandriava.gov/uploadedFiles/tes/oeq/info/WatershedsParcels.pdf

"Locate Your Watershed" Tool:
https://geoportal.alexandriava.gov/portal/apps/webappviewer/index.html?id=dc9226fd6b304512adcaf42106583156

Sewer Viewer Tool:
https://geo.alexandriava.gov/Html5Viewer/Index.html?viewer=sewerviewer

City of Alexandria Stormwater Management Webpage:
https://www.alexandriava.gov/Stormwater

Virginia Stormwater Management Program:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50216

Total Maximum Daily Loads (TMDL):
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=52652

Municipal Separate Storm Sewer System (MS4) Program:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=93364

Stormwater Utility Fee Property Search Tool:
https://realestate.alexandriava.gov/index.php?action=address

Stormwater Utility Fee Map Viewer:
https://www.alexandriava.gov/101010

Stormwater Utility Fee Credit Manual:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/SWU_Credit_Manual.pdf

History of the Stormwater Utility Fee:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=112941

Approved Stormwater Utility Ten-Year Capital Improvement Plan (FY2022-2031):
https://www.alexandriava.gov/uploadedFiles/budget/info/budget_2022/J60%20-%20Stormwater%20Management(1).pdf

Approved City Budget:
https://www.alexandriava.gov/budget/info/default.aspx?id=123003

Alexandria Office of Management & Budget:
https://www.alexandriava.gov/Budget

American Rescue Plan Allocation Plan:
https://alexandria.legistar.com/LegislationDetail.aspx?ID=5015170&GUID=E1A4AAE4-2BCF-4C43-9C43-C0AB102378A6

FEMA BRIC Program:
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

U.S. Economic Development Initiative Community Project Funding (Congressman Don Beyer):
https://beyer.house.gov/blog/?postid=5133

DCR Community Preparedness Fund:
https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Virginia Stormwater Local Assistance Fund:
https://www.deq.virginia.gov/water/clean-water-financing/stormwater-local-assistance-fund-slaf

City Stream Restoration Projects
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=51332

Community Rating System and National Flood Insurance Program Webpage:
https://www.alexandriava.gov/tes/info/default.aspx?id=3516

Floodplain District Zoning Ordinance:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/Alexandria%20Zoning%20Ordinance_Article%20VI%20Sec%206-300%20et.seq._FloodplainDistrict.pdf

FEMA Flood Map Webpage:
https://www.alexandriava.gov/FloodMap

Municipal Separate Storm Sewer System (MS4) Permit Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=93364

Virginia Stormwater Management Program (VSMP) Webpage:
https://www.alexandriava.gov/tes/oeq/info/default.aspx?id=50216

City Spot Improvements Program Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=122680

Near-Term Spot Improvement Projects List:
https://www.alexandriava.gov/uploadedFiles/tes/Stormwater/NeartermSpotImprovementProjects2021.pdf

City Floodproofing Grant Program Webpage:
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Memos to Industry:
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City Green Streets and Sidewalks Guidelines:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=117278

City Sewer Maintenance Webpage:
https://www.alexandriava.gov/tes/info/default.aspx?id=6444

City Purchasing Webpage:
https://www.alexandriava.gov/Purchasing

Virginia Public Procurement Act:
https://law.lis.virginia.gov/vacodepopularnames/virginia-public-procurement-act/

City of Alexandria Storm Sewer Capacity Analysis (CASSCA) Webpage:
https://www.alexandriava.gov/tes/stormwater/info/default.aspx?id=117415

GLOSSARY

A glossary is enclosed to explain technical terminology related to stormwater management in Alexandria.

Glossary of Stormwater and Flood Terms

The purpose of this document is to explain the terminology commonly used that is related to stormwater and flooding in the City of Alexandria.

Catch basin: Curbside opening that collects rainwater from streets and serves as an entry point to the storm drain system.

Capital Improvement Program (CIP): Outlines the large infrastructure projects to be undertaken across City departments during a 10-year time horizon. The list of Capital Projects is updated annually during the budgeting process undertaken by the Mayor, City Council, and City Manager's Office in coordination with all City departments. As a basic tool for prioritizing and scheduling anticipated capital projects and capital financing, the CIP is a key element in planning and managing future debt service requirements.

Capital Improvement Projects: Include many of the City's large infrastructure projects and those that had an active public engagement process as part of the planning of the project.

Capacity Project: Aim to increase storm sewer capacity and help mitigate flooding.

CASSCA: In February 2016, the City finalized a summary report of the City of Alexandria Storm Sewer Capacity Analysis (CASSCA) project, the purpose of which was to analyze the storm sewer system, identify problem flooding areas, and develop and prioritize solutions. As a high-level conceptual planning exercise, the storm sewer system was modeled to predict potential capacity issues for the City' current design standard, which is a 10-year storm.

Channel: A long, narrow excavation or surface feature that conveys surface water and is open to the air.

Culvert: A closed conduit such as a pipe or concrete box structure which drains open channels, swales, or ditches under a roadway or embankment typically with no catch basins or manholes along its length.

Drainage: The collection, conveyance, containment, and/or discharge of surface and stormwater runoff.

Erosion: The detachment and transport of soil or rock fragments by water, wind, ice, etc.

Federal Emergency Management Agency (FEMA) 100-year floodplain: The area that has a 1% chance of being inundated by at least 1-foot deep flooding in any given year. Put another way, it has about a 26% chance of being flooded over the life of a 30-year mortgage. Smaller floods have a greater chance of occurring in any year and can still create a significant flood hazard to people and property close to the channel.

Flash flood: Flooding that is sudden and unexpected and of short duration; flash floods are often caused by heavy rainfall. Also known as inland flooding.

Flash flood warning: A warning issued by the National Weather Service (NWS) to warn of flash flooding that is imminent or occurring.

Flash flood watch: A statement issued by the NWS which alerts communities to the possibility of flash flooding in specified areas.

Floodproofing: Any combination of property changes which reduces or eliminates flood damage to buildings or property.

Floodplain: Land adjacent to a waterway, subject to predictable periodic flooding.

Gutter: The edge of a street (base of the curb) designed to drain water runoff from streets, driveways, parking lots, etc. into storm drain inlets.

Outfall: A point where collected and concentrated surface and stormwater runoff is discharged from a pipe system or culvert.

Riverine flood: This flooding occurs when streams and rivers swell to beyond their banks and flood adjacent properties.

Runoff: Water originating from rainfall and other precipitation that ultimately flows into drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands as well as shallow groundwater.

Sanitary sewer system: The system of pipes and pump stations that collect and transport wastewater from homes and businesses to a wastewater treatment plant.

Spot improvement projects: Small capital projects to help address localized flooding and drainage issues. Spot improvement projects support the increased functionality of the City's storm sewer system which is comprised of hundreds of miles of underground pipes, culverts, inlets, grates, manholes, and "flap gates" or "check valves".

Storm sewer system: A network of underground pipes, culverts and open channels, the purpose of which is to allow for stormwater to be drained away and prevented from accumulating to cause a nuisance. They usually lead to nearby receiving bodies of water, such as lakes, oceans, streams and rivers.

Stormwater: Rainwater that runs off an area and enters the storm drain system and empties into streams, rivers, and other bodies of water.

Stormwater pollution: Everything in rainwater runoff that is harmful to the environment. Storm sewers carry runoff from more than just the rain. All runoff from irrigation, garden hoses, or other activities that drops water onto the ground or street can pick up pollutants before entering the storm sewer system that leads straight to local streams and rivers.

Tidal flood: Also known as coastal flooding. Some areas of the Potomac River and its tributaries are influenced by the ocean tides and fluctuate high and low relative to the shoreline. Some tides can be higher than normal, causing some coastlines to become inundated by the waterbody. This can be seen when Spring tides swell the Potomac River and flood the foot of King Street on the waterfront on a sunny day.

Watershed: An area of land that drains water or runoff to a single point.