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September 10, 2021

Jessica Lassetter
Senior Environmental Specialist
Division of Stormwater Management
Department of Transportation & Environmental Services
2900 B Business Center Drive
Alexandria, VA 22314

RE: City of Alexandria Resilience Plan Submission - CFPPF

Dear Ms. Lassetter,

Thank you for providing an overview of your Resilience Plan, and informing DCR of the various plans that the City of Alexandria will be utilizing to fulfill the Resilience Plan submission requirements. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on September 13, 2024.

The following elements were evaluated as part of this review:

1. Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE

Meets criteria as written.

- a. Project-based: Several projects are proposed within the *Northern Virginia Hazard Mitigation Plan (2017)*, the *FY 2022 - FY 2031 Stormwater Management Utility Ten-Year Plan*, the *City of Alexandria Storm Sewer Capacity Analysis (CASSCA, 2016)*, the *City of Alexandria Environmental Action Plan 2040*, the *Alexandria Waterfront Small Area Plan*, and in *Flood Action Alexandria*. The proposed projects cover various scopes, both in scale and location across the City of Alexandria, and combine to assist the City of Alexandria with continued flood control and resilience across the entirety of the community. Smaller scale projects with a more confined scope such as *The Four Mile Run Restoration Masterplan* and *Tidal Restoration Demonstration Project*, are also presented.

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*State Parks • Soil and Water Conservation • Outdoor Recreation Planning
Natural Heritage • Dam Safety and Floodplain Management • Land Conservation*

2. Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE

Meets criteria as written.

- a. Task 4, sections 4.1 through 4.9 of the *2016 City of Alexandria Storm Sewer Capacity Analysis* identifies multiple green infrastructure solutions for flood-prone areas within each of 7 watersheds that feed the Potomac. In section 6 (*Alternatives Analysis and Prioritization*) of each watershed analysis, green infrastructure solutions are evaluated for problem areas according to efficacy in decreasing overall flood duration and capacity, as well as their cost-effectiveness. Green infrastructure solutions for each of the watersheds were typically rated highly in these analyses and suggested for prioritization.

3. Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE

Meets criteria as written.

- a. All parts of a locality:
The City of Alexandria recently launched ALL Alexandria – Achieving Racial and Social Equity to ensure that all parts of a locality are considered in the planning process regardless of socioeconomics or race. Additionally, the multiple plans that were provided in support of the resilience plan submission encompass the entire locality of the City of Alexandria.
- b. Social vulnerability:
STAPLE/E assessments used to address vulnerabilities within each jurisdiction in the *Northern Virginia Hazard Mitigation Plan (2017)*. Additionally, Alexandria City Council adopted the Eco-City Charter, which outlines Alexandria’s commitment to ecological, economic, and social sustainability.
- c. Demographic Analysis:
Demographics, population and economic growth projections captured in the *Northern Virginia Hazard Mitigation Plan (2017)*.

4. Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE

Meets criteria as written.

- a. Coordination with other local and inter-jurisdictional projects, plans and activities:
Inter-jurisdictional coordination with projects, plans, and activities cited in the *Northern Virginia Hazard Mitigation Plan (2017)*.

- b. Clearly articulated timeline or phasing plan for implementation:
Timelines and phasing plans for individual projects can be found throughout the submitted Resilience Plan materials, but there does not appear to be an overarching timeline or phasing plan for implementing a city-wide flood resilience strategy.

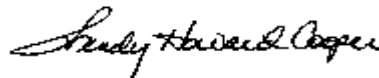
5. Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.

Meets criteria as written.

- a. Sea level rise projections, and climate change incorporated into the strategic approach presented in the *Northern Virginia Hazard Mitigation Plan*. Climate change was also considered in the *FY 2022 - FY 2031 Stormwater Management Utility Ten-Year Plan*. Sea level rise projections were incorporated into the modeling utilized in the *City of Alexandria Storm Sewer Capacity Analysis (CASSCA, 2016)*. The primary focus of the *City of Alexandria Environmental Action Plan 2040* is centered on climate change mitigation and adaptation. The Energy and Climate Change Action Plan was developed in 2012 and is currently being revised to include the latest climate change, sea level rise, storm surge, and current flood maps.

VA DCR looks forward to working with you as you work to make the City of Alexandria a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,



Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl M. Glover, DCR

City of Alexandria Resilience Plan | September 2021

In response to the resilience planning requirements of the **Community Flood Preparedness Fund** (“the CFPF” or “Fund”) outlined within the [2021 CFPF Grant Manual](#) (Appendix G: Elements of Resilience Plans), the City of Alexandria (“the City”) prepared the following Resilience Planning Overview of formal and relevant plans used to prioritize potential projects, and to assist the City in securing funding for critical resilience plans, studies, and projects.

The **Elements of Resilience Plans** in Appendix G of the 2021 CFPF Grant Manual lists elements that should be included in resilience plans for communities applying for CFPF grant funding. These elements include:

1. *It is project-based with projects focused on flood control and resilience.*
2. *It incorporates nature-based infrastructure to the maximum extent possible.*
3. *It includes considerations of all parts of a locality regardless of socioeconomics or race.*
4. *It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation.*
5. *It is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.*

Alexandria’s resilience planning elements are not currently contained within an adopted “stand alone” plan; however, the City has previously dedicated funding to this effort and is in the process of procuring consulting services to develop a ‘stand alone’ plan that incorporates the above elements and others germane to the City. This Resilience Planning Overview identifies how various resilience planning documents of the City of Alexandria satisfy all the CFPF Resilience Plan elements.

The following plans and studies for the City of Alexandria each have components which satisfy elements of the Resilience Plan requirements. Together they form a Resilience Plan. *Specific excerpts from each plan that satisfy the requirements outlined in Appendix G: Elements of Resilience Plans is found on page 12 of this document.*

- [Northern Virginia Hazard Mitigation Plan \(2017\)](#)
- [City of Alexandria Storm Sewer Capacity Analysis \(CASSCA, 2016\)](#)
- [FY 2022 – FY 2031 Storm Sewer Capacity Projects](#)
- [FY 2022 - FY 2031 Stormwater Management Utility Ten-Year Plan](#)
- [Four Mile Run Restoration Master Plan](#)
- [Alexandria’s Waterfront Plan](#)
- [Alexandria Floodplain Ordinance](#)
- [Emergency Operations Plan \(EOP\)](#)
- [Flood Action Alexandria](#)
- [Alexandria’s Masterplan and Small Area Masterplans](#)
- [Alexandria’s Housing Masterplan](#)

- [Resilient Alexandria Charter](#)
- [CRS Community Certification](#)
- [Eco-City Charter](#)
- [Eco-City Action Plan 2040](#)
- [Flood Response Plan](#)

Appendix G of the 2021 first round CFPF Grant Manuel also includes examples of elements of plans that would be “appropriate for inclusion in a submission.” These elements are listed in bold below. Below each element, the City has identified a corresponding Plan and specific plan section that addresses that item, thereby fulfilling the Resilience Plan requirement.

Equity based strategic polices for local government-wide flood protection and prevention.

[Northern Virginia Hazard Mitigation Plan \(2017\), Section 9.7.1 Alexandria Mitigation and Action Plan](#) prioritizes actions across local government departments including the Department of Transportation, Environmental Services, and Emergency Management. The actions range from compliance with FEMA’s NFIP and participation in the Community Rating System, to nature-based solutions, infrastructure upgrades, and building protections to enhance the resilience of residents.

[Alexandria’s Floodplain Ordinance No.4715](#) ensures that future development and major retrofits comply with flood-resilient building standards, which protect residents living in the floodplain.

Proposed projects that enable communities to adapt to and thrive through natural or human hazards.

[Northern Virginia Hazard Mitigation Plan \(2017\), Section 9.7.1. Alexandria Mitigation and Action Plan](#) prioritizes protection against natural and human hazards through the range of actions described above.

[The Four Mile Run Restoration Masterplan and Tidal Restoration Demonstration Project](#) advance the resilience of the Four Mile Run sub-basin through restoration of the streambank, the creation of a new recreation and green space, and enhancement of the riverine floodplain to better handle future floods.

Additionally, The City launched [Flood Action Alexandria](#) in Spring 2021 to expedite infrastructure improvements, including [11 high-priority Storm Sewer Capacity capital improvement projects](#) and additional neighborhood [Spot Improvement projects](#). The program also expands flood early warning systems and signage; implements a [Flood Mitigation Pilot Grant Program](#) to provide matching grants to property owners who install flood-proofing measures; increases [maintenance capacity](#); and enhances community outreach and engagement, including monthly newsletters. In May 2022, City Council approved the FY 2022 – FY 2031 Stormwater Management Utility Ten-Year Plan that included a new doubling of the [Stormwater Utility Fee](#) to increase operating and capital funding to implement Flood Action Alexandria elements, including a new \$197 million 10-year stormwater capacity and spot improvement capital program (with \$136 million planned for the next five years).

The recently-launched Flood Mitigation Grant Program for property owners impacted by a recent flood event. A brief description of the grant program announcement is included below.

“The City of Alexandria will now begin accepting applications for its new [Flood Mitigation Pilot Grant Program](#) on Monday, August 30. The program offers matching reimbursement grants to property owners who have installed flood mitigation measures on properties impacted by recent flash flooding events dating back to July 2019. Property owners may receive up to 50% reimbursement for completed project costs, up to a maximum of \$5,000, for implementing [eligible flood-proofing measures](#) on their property. Applications will be accepted on an ongoing basis.”

[Flood Action Alexandria](#) is an initiative to protect residents citywide from the impacts of flooding through the following programs and actions:

- Storm Sewer Capacity Projects – The [2016 Storm Sewer Capacity Analysis \(CASSCA\)](#) included a modeling effort that identified 90 *problem areas* in the City where the model found potential capacity and flooding concerns. The top 11 capacity projects from CASSCA were prioritized based on planning-level cost-benefit analysis and identified capacity issues. These projects, which are funded in the City’s Capital Improvement Program, are intended to mitigate flooding for the greatest number of ratepayers, direct investment to areas where the most significant property damage is occurring and provide the greatest overall system benefit. Design of the top three projects begins in FY 2022.
- [Spot improvement projects](#) - Small capital projects managed by the Transportation & Environmental Services Stormwater Management Division (T&ES SWM) to help address localized flooding and drainage issues.
- [Storm & Sanitary Sewer Section](#) – This effort informs residents, business owners, and citizen groups of best practices to avoid sewer backups, and defines responsibilities of the City and the homeowner related to sewer connections. The ultimate goal is to reduce flooding by decreasing mainline blockages, minimizing the infiltration and inflow of storm water in the sanitary system, and evaluating the structural integrity of the entire sewer system.
- [Public Outreach](#) - The City provides information and updates on the progress of the flood mitigation program on the [Flood Action Alexandria website](#) and via subscription to the Flood Action Alexandria e-Newsletter. Residents can subscribe to receive information about how to help flood mitigation efforts, participate in community meetings, engage neighbors in the process, and provide feedback on the implementation of the program. Residents have been invited to log into [Alexandria eNews](#) and opt-in to “Flood Action Alexandria” to subscribe to this e-Newsletter.
- [Early Warning and Emergency Response](#) - The City of Alexandria [Emergency Operations Plan](#) (EOP) is a multi-discipline, all-hazards plan that establishes a single, comprehensive framework for the management of major emergencies and disasters within the city. The EOP is implemented when it becomes necessary to mobilize identified resources to save lives and protect property and infrastructure.
- [Ad Hoc Stormwater Utility and Flood Mitigation Advisory Group](#) – The Advisory Group’s responsibilities include: Reviewing and advising in regards to flood mitigation activities, monitoring and measuring progress of the City’s proposed flood mitigation efforts, serving as a general body for receipt and dissemination of information for the City’s flood mitigation implementation efforts, and reviewing and providing recommendations on proposed

Stormwater Utility operating and capital budgets

Documentation of existing social, economic, natural, and other conditions present in the local government.

[Alexandria's Masterplan and Small Area Masterplans](#) for each of its neighborhoods provides comprehensive demographic data and a contextual overview of the population, land use and development, and open space and recreation.

Review of the vulnerabilities and stressors, both natural and social in the local government.

[Alexandria's Masterplan and Small Area Masterplans](#) address vulnerabilities and stressors within the economy including small business, the environment, and community. Each plan involved extensive community engagement to identify the neighborhoods' priorities.

[Alexandria Storm Sewer Capacity Analysis](#) assessed and addressed natural stressors to the city's infrastructure which contribute to repetitive flooding.

[Alexandria's Housing Masterplan](#) addresses inequities in housing. As a result of sharply increasing real estate costs and regional development pressures over the past decade, the City faces a severe shortage of affordable housing. Since 2000, there have been dramatic declines in [market affordable rental units](#) (more than 15,500 units have been lost between 2000 and 2018) and in opportunities for affordable homeownership for low- and moderate-income individuals and families. As the growth in housing costs continues to outpace the growth in incomes, Alexandrians are increasingly becoming housing cost burdened (defined as paying 30% or more of household income on housing-related costs).

Resilient ALX focuses on utilizing Alexandria's Citizen Corps Council (CCC) to advise the City on how to enhance community resilience. The project will include creating a Charter, and Assessment and Report. The Charter offers an overarching vision to supplement the goal of Alexandria's Strategic Plan in the area of creating a Safe and Resilient Community. Charter The CCC Charter will utilize the FEMA Lifelines to categorize data from the study. The results of which will inform the Focus Areas of the Assessment and Report. CCC will work collaboratively with related advisory bodies to create a sound and unifying vision for the City.



Forward-looking goals, actionable strategies, and priorities as seen through an equity-based lens.

Under the direction of the City's first Race and Social Equity Officer, Jaqueline Tucker, City departments and an interdepartmental work group are building a framework (in collaboration with City employees, community members, and other stakeholders) to ensure policy decisions advance race and social equity for all Alexandria residents.

[Resolution 2974 All Alexandria: Committing to Race and Social Equity commits to:](#)

- 1) Ensure that race and social equity is incorporated and centered in all planning, including:
 - a. Center race and equity throughout the forthcoming FY 2022-FY 2027 Strategic Plan and departmental strategic planning processes;
 - b. Establish specific, measurable, attainable, relevant time-based (SMART) goals race and social equity action plans for City departments;
 - c. Incorporate race and social equity into all staff and leadership talent management programs;
 - d. Establish, strengthen and maintain key partnerships with the Alexandria City Public Schools, other public entities serving our community, community based, non-profit, and faith-based organizations, and businesses in Alexandria to advance racial equity.

- 2) Implement and sustain structures and systems to advance race and social equity, including:
 - a. Adopt and promote practices and policies centered on creating and ensuring racial and social equity through the use of a racial equity tool;
 - b. Conduct race and social equity trainings for City Council, City staff and City boards and commissions;
 - c. Create authentic community engagement best practices for use in evaluating City actions from creation to implementation;
 - d. Maintain membership and active participation in the Government Alliance on Race and Equity (GARE) and Metropolitan Washington Council of Governments (MWCOG) Racial Equity Work Group and newly established Chief Equity Officers Committee.

- 3) Align and implement policy efforts designed to advance race and social equity goals, including:
 - a. Incorporate greatly expanded language access into more City of Alexandria communications and platforms;
 - b. Reduce and eliminate racial and social inequities in the allocation of City resources through the use of a budget equity tool which may entail the adjustment of budgets and funding reallocation;
 - c. Present City Council with a Racial and Social Equity Action Plan, consisting of specific policy initiatives to advance the City's racial equity goals, informed by additional community engagement.

- 4) Ensure accountability mechanisms related to the progression and transparency of work to advance race and social equity, including:
 - a. Develop equity data mechanisms, including equity indicators, equity mapping, and dashboards to transparently monitor, share, view and inform policy decisions that purposefully work toward reducing and eliminating disparities;
 - b. Develop quarterly listen and learn sessions, under the direction of the Race and Social Equity

Officer, to establish ongoing conversation with the community to understand their most pressing issues and to normalize the key concepts of race, social equity and government through collective learning opportunities.

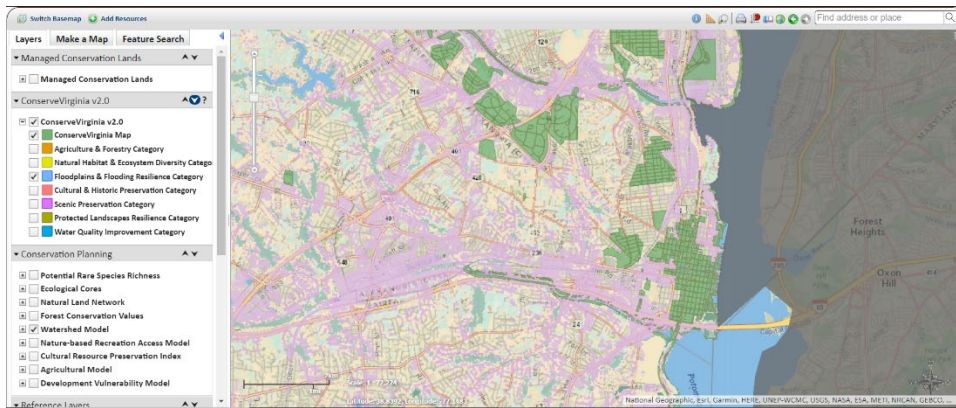
Strategies that guide growth and development away from high-risk locations that may include strategies in comprehensive plans or other land use plans or ordinances or other studies, plans or strategies adopted by a local government.

[Alexandria's Floodplain Ordinance No.4715](#) ensures that future development and major retrofits comply with flood-resilient building standards, which protect residents citywide living in the floodplain. This ordinance also ensures that development is directed away from Special Flood Hazard Areas.

Additionally, [Alexandria's Masterplan and Small Area Masterplans](#) and [Alexandria's Waterfront Plan](#), Chapter 2 – Section: A “Plan for Development” addresses properties along Alexandria’s waterbodies and within its floodplains.

Proposed acquisition of land or conservation easements or identification of areas suitable for conservation particularly areas identified as having high flood attenuation benefit by *ConserveVirginia* or similar data driven tools.

Alexandria is mapped within the ConserveVirginia tool. Additionally, Alexandria’s Floodplain Ordinance addresses areas to restrict future development due to increased flood risk.



Identification of areas suitable for property buyouts in frequently flooded areas.

The City continues to identify areas suitable for property buyouts in frequently flooded areas as needed.

Identification of critical facilities and their vulnerability throughout the local government such as water and sewer or other types identified as “lifelines” by FEMA.

Alexandria has identified and analyzed the vulnerabilities of its infrastructure system through the [Alexandria Storm Sewer Capacity Analysis](#).

Alexandria’s drinking water system through Virginia American Water has completed the EPA’s requirement for a Risk and Resilience Assessment and Emergency Response Plan.

Identified ecosystems/wetlands/floodplains suitable for permanent protection.

Relevant work includes:

- [Four Mile Run Restoration Master Plan](#)
- Waterfront Masterplan
- [Waterfront Schematic Landscape and Flood Mitigation Design](#)
- [Waterfront Flood Mitigation and Promenade Project](#)

Identified incentives for restoring riparian and wetland vegetation.

Relevant work includes:

- [Four Mile Run Restoration Master Plan](#)
- [City of Alexandria Landscape Guidelines](#)

A framework for implementation, capacity building and community engagement.

The [All Alexandria](#) Initiative focuses specifically on community engagement and outreach to build equity across the city and local government actions.

Strategies for creating knowledgeable, inclusive community leaders and networks.

Through All Alexandria, the city is using the [GARE](#) framework to empower community leaders and networks to elevate their voices in local government, and create more inclusive outcomes.

The City's racial and social equity initiative grew from the efforts of an interdepartmental Race and Social Equity Working Group, formed in 2018. These City employees developed and piloted social and racial equity programming in four City departments. The programming was based on the work of the [Government Alliance on Race and Equity](#) (GARE), a national network of governments working to achieve racial equity and advance opportunities for all. The City became a member of GARE in 2019, developing its inaugural Racial Equity Learning as part of the Metropolitan Washington Council of Governments' year-long [Advancing Racial Equity Cohort](#).

A community dam safety inventory and risk assessment posed by the location and condition of dams.

Extensive studies of the Alexandria dam were conducted after a major flood event. The components of these studies, flood mapping, and action plans can be found below.

- [2008 Lake Barcroft Inundation Study update](#)
- [2008 Lake Barcroft Probable Maximum Flood Inundation Mapping](#)
- [Presentation from June 24, 2009 Public Meeting](#)
- [Draft Flood Operations Plan](#)
- [Flood Trigger Action Matrix](#)

A characterization of the community including population, economics, cultural and historic resources, dependence on the built environment and infrastructure and the risks posed to such infrastructure and characteristics by flooding from climate change, sea level rise, tidal events or storm surges or other weather.

Alexandria is a city with a population of 159,467 (U.S. Census Bureau, 2020). The medium household income in Alexandria in 2019 was \$100,939. Of the thirty-eight census tracts in Alexandria, ten are below 80% of the median income, as shown in the map below. The census tract in which the green infrastructure pilot projects are located (201204), is not 80% below the median income. However, tract 201204 does have a diversity index score of 81, indicating a high-level of diversity. A diversity index score is measured from 0-100, where a higher diversity index score denotes a high-level of diversity; in other words, a community statistic representing the likeliness of two people chosen at random belong to different race or ethnic groups (ESRI, 2021). Median disposable income, as listed in the table below, is defined as the amount of money that an individual or household has available to save or spend on non-essentials.

Alexandria is located in Northern Virginia south across the Potomac River from Washington D.C. The city encompasses 15.75 square miles at an average elevation of 30 feet above sea level. On August 12, 2021, the U.S. Census Bureau released the first local level results from the 2020 Census. Data received indicates that the City of Alexandria's 2020 population is 159,467, an increase of 19,501 residents over the past decade. Alexandria, founded in 1749, has a fascinating history, and many of its historic buildings are still preserved today. During its long history, Alexandria was a tobacco trading post, one of the ten busiest ports in America, a part of the District of Columbia, home to both the largest slave-trading firm in the country and a large free-black community, a Civil War supply center for Union troops, and a street-car suburb for Federal workers. Alexandria was also the hometown of George Washington, Robert E. Lee, Jim Morrison and "Mama" Cass Elliot.

There are only a few other communities in the United States that have as many existing examples of Georgian and Federal period architecture. Old and Historic District, designated in 1946, was the third historic district in the United States, after Charleston and New Orleans. The historic African American community known as Uptown was designated as the Parker-Gray Historic District in 1984, and in 2008 was approved for listing on the Virginia Landmarks Register. Several 20th century neighborhoods have also been recognized for their historic and architectural significance, which are listed below. It is important to note that these older neighborhoods have had significant impacts from flooding from these recent severe storm events. A list of the neighborhoods the City is engaging with who have experienced severe impacts from recent flash flood events is available online at: <https://www.alexandriava.gov/122388>.

- Del Ray and the Town of Potomac. St. Elmo and Del Ray, two subdivisions platted in 1894, were joined together in 1908 to form the incorporated town of Potomac.
- Fairlington. Fairlington is on the National Register of Historic Places, as a notable example of community planning and publicly financed housing built for defense workers and their families during World War II. Learn more about this history of this community, from the Fairlington Historical Society.
- Parkfairfax. Parkfairfax was built during 1941 to 1943 to help alleviate the acute housing shortages resulting from the depression and World War II.
- Rosemont, located northwest of the Old and Historic District of Alexandria, adjacent to Alexandria's Union Station, is an unusually intact example of an early-twentieth century middle-class trolley suburb.

National Historic Landmarks are buildings, sites, districts, structures, and objects that have been determined by the Secretary of the Interior to be nationally significant in American history and culture. This program is administered by the National Park Service In Alexandria. The Alexandria Historic District, Gadsby's Tavern, the Stabler-Leadbeater Apothecary Shop, Christ Church and the Gerald R. Ford, Jr. House have been designated as National Historic Landmarks.

More than 40 Alexandria districts, sites, buildings and structures and six Historic Districts are listed on the National Register of Historic Places, the United States of America's official list of historic properties worthy of preservation.

The City of Alexandria is experiencing more frequent and severe flood events that damage residential and commercial properties, impact critical assets, and cause day-to-day disruptions and economic losses. Extreme precipitation events have occurred more frequently in the last few years. The City has experience four major flooding events since 2019, including July 8, 2019, July 23, 2020, September 10, 2020, and most recently August 15, 2021. All of these events are characterized between 50 to 100-yr level rainstorm events. Except for August 15 of this year, which was recorded by our new gauges, with actual accumulation of 5.19-inches in 2 hours, to be between 100 and 500-yr level rain when compared to the statistical expectations derived for the city's Intensity-Duration-Frequency (IDF) curves developed in the 1980's for the City, which actually is more conservative than NOAA's predictions for the region.

The Northern Virginia Hazard Mitigation Plan identified flooding as one of Alexandria's predominant hazards due to riverine, precipitation, tidal, and storm surge flooding. The HMP ranked natural hazards for Alexandria using historical weather-related events based on the Storm Event Database by NOAA's NCDC1. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrences;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

Alexandria's watersheds have a significant percentage of impervious surfaces. 43 percent of the City's surface area is comprised of roads, buildings, parking lots, and sidewalks. Impervious surface contributes to the accumulation of stormwater because water is not able to convey and recharge. This type of flooding threatens the continuous operation of roads, emergency access, and property during precipitation events.

Strategies to address other natural hazards that would cause, affect or result from flooding events including: Earthquakes, Storage of hazardous materials, Landslides/mud/debris flow/rock falls, Prevention of wildfires that would result in denuded lands causing flooding, mudslides or similar events more likely, Preparations for severe weather events including tropical storms or other severe storms, including winter storms.

The [Northern Virginia Hazard Mitigation Plan \(2017\)](#) uses a multi-hazard approach to address the hazards listed above. Additionally, this plan provided a hazard profile for Alexandria using both historical data and a statistical analysis to understand the level of future risk caused by each of these threats, summarized in the following table.

Table 7.1: Hazard Ranking for Alexandria									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Low	Med-Low	Med-Low

Specific Excerpts Utilized from Each Contributing Plan and Elements 1 – 5

1) It is project-based with projects focused on flood control and resilience.

Projects specific to the City of Alexandria focusing on flood control and resilience are indicated in the [Northern Virginia Hazard Mitigation Plan \(2017\)](#) in **Chapter 7.I, specifically, in the table on pages 7-3 through 7-6**. The 2017 Plan is currently undergoing revisions and does not yet include the specific projects outlined within the City’s FY 2022 – FY 2031 Capital Improvement Program.

Page vii of the 2016 City of Alexandria Storm Sewer Capacity Analysis (CASSCA) [Executive Summary](#) report – a multi-year study that can be found on the City’s website posted in separate sections [here](#) – provides a summary of priority “problem areas” for projects. These 90 “problem areas” on page vii and the associated projects to remediate the “problems” through a mix of capacity, storage, and green infrastructure practices. These projects are identified in each of the City’s local watersheds across the City and will help reduce flooding and increase resilience.

Page 15.15 identifies for funding in the [City’s FY 2022 – FY 2031 Stormwater Management Utility Ten-Year Plan, Capital Improvement Program \(CIP\) for the top 11 prioritized capacity projects](#) are currently. An overview of these projects per local watershed is indicated in Figure 1 (Table 6-1 in the CASSCA Report). **PDF page 65** of the Four Mile Run Fact Sheet in the [CASSCA Executive Summary](#) shows the top two priority projects that are denoted as problem area #101 and #102 in the Four

Watershed	Number of Problem Areas	Total Capital Cost (\$ Millions)	Total Benefit Score	Overall Benefit/Cost	Total Flood Reduction (MG)	Cost of Flood Reduction (\$/Gallon)	Preferred Alternative
Hooffs Run*	23	\$18.26	978	54	7.36	\$2.48	3
Four Mile Run	23	\$24.46	939	38	11.53	\$2.12	3
Holmes Run	9	\$5.76	433	75	2.78	\$2.07	2
Taylor Run	12	\$4.89	516	106	4.43	\$1.10	2
Cameron Run	8	\$3.65	360	99	2.27	\$1.61	1
Strawberry Run	3	\$0.27	88	322	0.05	\$5.77	3
Backlick Run	5	\$3.96	229	58	1.39	\$2.86	3
Potomac River	7	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	90	\$61.29	3543	58	29.81	\$2.06	n/a

MG = million gallons
Total existing volume of flooding in the problem areas (not including Potomac River) is 46.02 MG.

Figure 1. CASSCA Project Overview

Mile Run East local watershed.

The map on page 2-5 of the [“4.2 Problem and Solution Identification and Prioritization for Four Mile Run, Alexandria, Virginia”](#) shows problem areas 101 and 102, and subsequent pages speak to potential solutions and cost-benefit for these projects.

The [Stormwater Management Utility Ten-Year Plan](#) includes the Capital Projects slated for Utility Funding. This includes the [Capacity Improvement Projects](#), as well as funding for GI, and other flood control and resilience measures, such as the [Four Mile Run dredge project](#), across the City on page

4.

[Alexandria Waterfront Small Area Plan \(2012\)](#) provides the roadmap on the redevelopment of the Alexandria’s waterfront area in Old Town, including projects focused on nature-based solutions (i.e., Windmill Hill Park) and has lead into the larger [Waterfront Plan Implementation](#) – a 20-30 year vision for the City’s historic waterfront, which includes [Flood Mitigation Implementation](#). This plan is one of a 18 Small Area Plans and has a large flood mitigation component due to it’s nexus with the Potomac River. The [Alexandria Master Plan](#) is made up of 18 Small Area Plans covering neighborhoods throughout the city, as well as topical chapters of citywide relevancy, such as Historic Preservation, Urban Design, Transportation, and Open Space. The Alexandria Master Plan was adopted by the City Council on June 13, 1992, and chapters are added or updated on an ongoing basis as needed through Master Plan Amendments. The City’s re-development is guided through the Master Plan and Small Area Planning process as well as the [Housing Master Plan](#). Small Areas Plans that are more recent incorporate the goals of the [Environmental Action Plan 2040](#) as well as the [City’s 2019 Green Building Policy](#) which requires green infrastructure for stormwater treatment, thereby increasing the City’s overall resilience.

2) It incorporates nature-based infrastructure to the maximum extent possible.

The [2016 City of Alexandria Storm Sewer Capacity Analysis \(CASSCA\)](#) report identifies 90 “problem areas” and the associated projects to remediate the “problems” by capacity and storage activities. This report also identifies areas that could be served by nature-based infrastructure. Specifically, under “Task 4”, for each watershed, Appendix D includes the “Green Infrastructure Concept Plans” per watershed. Figure 2 (Task 4, GI Program Concept Plan Locations for Hooffs Run) provides an example of what this looks like in the report. The report goes into further details about each of the concept locations for GI.

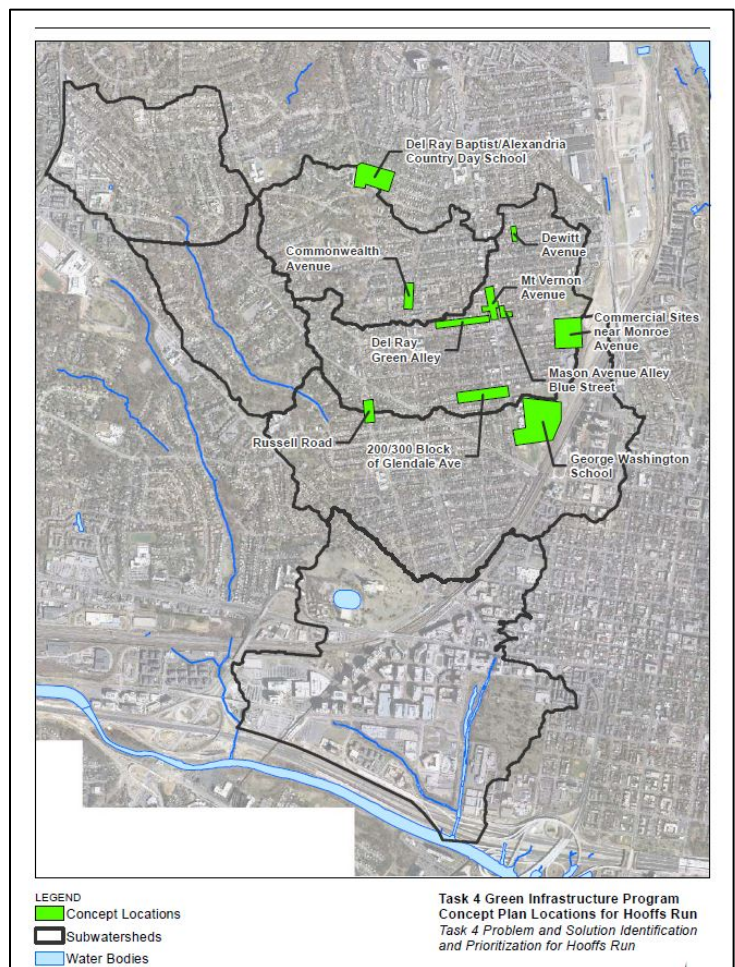


Figure 2. CASSCA Hooffs Run GI Concept Plan

3) It includes considerations of all parts of a locality regardless of socioeconomics or race.

The City recently launched [ALL Alexandria – Achieving Racial and Social Equity](#) to ensure that all parts of a locality are considered in the planning process regardless of socioeconomics or race.

Eco-City Alexandria is a collaborative strategic effort to achieve sustainability throughout the City of Alexandria. Eco-Cities work to harmonize their 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 and was the first Environmental Charter adopted in the Commonwealth of Virginia. The Charter defined Alexandria’s commitment to ecological, economic, and social sustainability:

“Use environmentally responsible flood management, stormwater control, and wastewater treatment to protect the public’s health and property.” – Eco-City Charter, 2008

The core values and ten guiding principles formed the basis for the City’s first Environmental Action Plan (EAP) in 2009 and the updated [Environmental Action Plan \(EAP\) 2040](#). The EAP 2040 incorporates ten topic sections with an average of two goals and four to six actions in each goal.



Figure 3. Flood Action Logo

The City’s [Flood Action](#) initiative was launched in early 2021 in response to the severe flood events that impacted the City in 2019 and 2020. This initiative includes an education and outreach component aimed to reach all residents of Alexandria impacted by flooding, via a new eNews channel and an eNewsletter. Figure 3 is the Flood Action Logo.

The City of Alexandria’s FY 2017 to FY 2022 Strategic Plan highlights the importance of a Safe and Resilient Community. Alexandria’s Citizen Corps Council (CCC) is designed to advise the City on how to enhance community resilience. The project will include creating a [Resilient ALX Charter](#), and Assessment and Report. The Charter offers an overarching vision to supplement the goal of Alexandria’s Strategic Plan in the area of creating a Safe and Resilient Community. Anticipated Resilient ALX project outcomes include:

- Clearer vision for preparedness planning in the City.
- Reduced impact of disasters and emergencies to individuals, households, businesses, nonprofit organizations, and local government agencies.
- Improved individual preparedness to reduce strain on public safety groups (such as Alexandria’s first responders and volunteer organizations) during a disaster.
- Faster recovery from disasters across factors including: 1) physical; 2) financial and economic; 3) psycho-social and 4) governmental.

- 4) **It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation.**

Coordination with other localities is prevalent in the [Northern Virginia Hazard Mitigation Plan \(2017\)](#), which is further described under #1. The 2017 is currently undergoing the 5-year review and revision. The updated plan will list 'capacity projects' to mitigate flooding, which right now it is more general.

The [Four Mile Run Master Plan](#) was developed and coordinated by Arlington and Alexandria to restore Four Mile Run and does include a large flood mitigation component as administered and approved by USACE. Arlington and Alexandria currently are working together to maintain the channel through dredging in 2021/2022. Visit the Four Mile Run Dredge Project [website](#) to learn more.

"The flood control channel, constructed during the 1970s and early 1980s, has safely conveyed the high storm flows through the two jurisdictions. When the channelization project was conceived in the 1960s, the sole objective of the project was flood protection and, in this respect, the project has been a success; no floods have breached the banks along the 2.3-mile channel since its construction. Although successful in flood control, however, the channelized portion of Four Mile Run leaves much to be desired in terms of aesthetic and environmental attributes. The maintenance requirements for the channel include yearly thinning of vegetation and periodic excavation of the sediment that deposits on the channel bed."

[City of Alexandria Emergency Operations Plan \(2021\)](#) includes emergency operations relating to the "...City's vulnerability to a variety of hazards, most notably flooding." The EOP includes inter-jurisdictional planning efforts. Specifically, the City's [Flood Response Plan](#) outlines the response from five departments within the City as well as several support agencies. The Plan provides an overview of responsibilities and response activities.

- 5) **It is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**

The [2009 Sea Level Rise Potential report](#) was incorporated into the CASSCA modeling. **CASSCA, Task 1 documents** review rainfall data and the City's stormwater design criteria, develop projections for rainfall and tidal boundary conditions based on climate change, and propose potential revisions as appropriate

[Waterfront Flood Mitigation](#) plan includes flood level evaluations (Figure 5) for planning purposes in Old Town (see Figure 4).

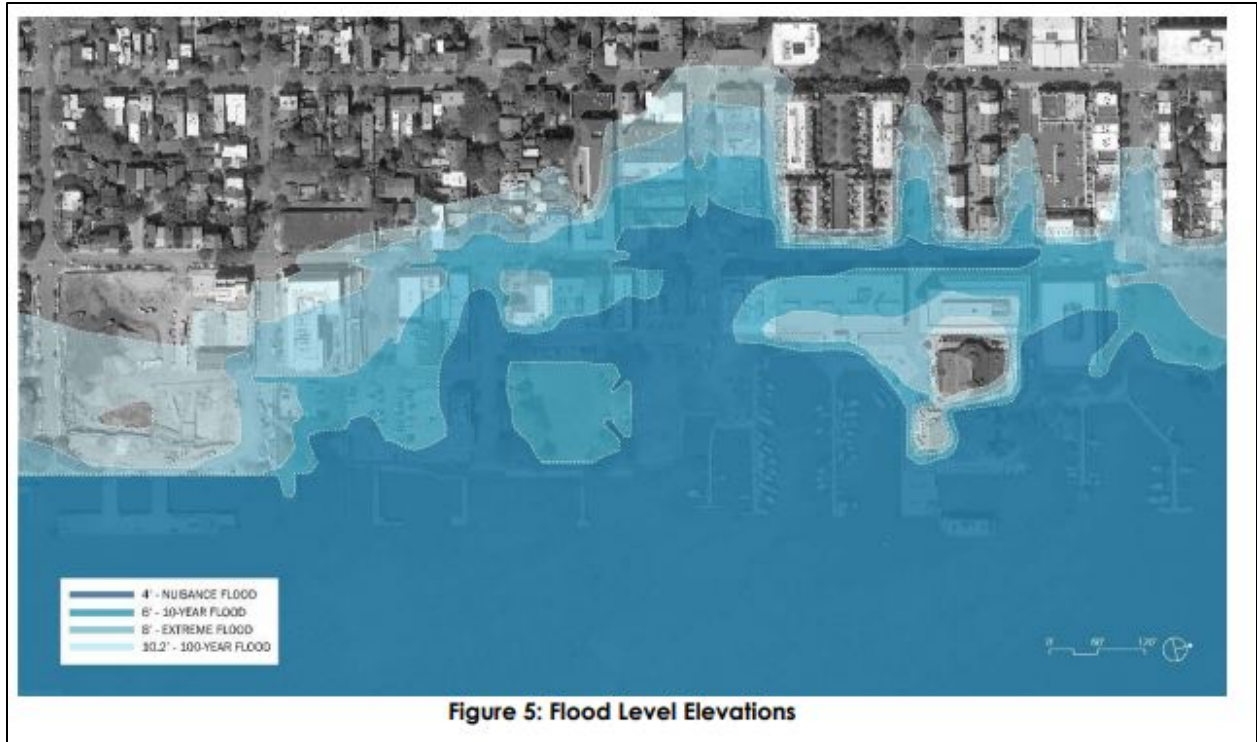


Figure 4. Waterfront Flood Mitigation Plan Flood Level Elevations (Figure 5 in the Plan)

[Floodplain District Ordinance No. 4715](#) outlines the City's Zoning Ordinance as required by FEMA, the City's Flood Map [webpage](#) includes a comprehensive overview of the City's FEMA FIRMs. The City's FIRMs were recently updated by FEMA and are currently under review by the City and its residents. The City is a [Verified Class 6 CRS Community](#).

The City currently is revising the [Energy and Climate Change Action Plan](#) with the latest climate change, sea level rise, storm surge, and current flood maps. This plan was previously completed in 2012. The new Action Plan is being guided by a 13-member Task Force and continues to incorporate racial and social equity into the plan in addition to the latest science. The plan is anticipated to be launched in 2022.