May 2022 Approval Pending Adoption Version

Hampton Roads Hazard Mitigation Plan







City of Hampton
City of Newport News
City of Poquoson
City of Williamsburg
James City County
York County
City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach
City of Chesapeake
Isle of Wight County
Town of Smithfield
Town of Windsor
City of Franklin
Southampton County
Surry County
Town of Claremont
Town of Dendron

AECOM

REPORT DOCUMENTATION

TITLE	REPORT DATE
Hampton Roads Hazard Mitigation Plan	May 2022 Approval Pending Adoption Version

ABSTRACT

The *Hampton Roads Hazard Mitigation Plan* has been updated for 2022. The region is vulnerable to a wide range of hazards that threaten the safety of residents and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life. While the threat from hazards may never be fully eliminated, the *Hampton Roads Hazard Mitigation Plan* recommends specific actions designed to protect residents, business owners and the built environment.

GRANT/SPONSORING AGENCY

This report was funded by the Federal Emergency Management Agency through the Virginia Department of Emergency Management, via grant Agreement number PDMC-PL-03-VA-2019-003 for $150,000.

ACKNOWLEDGEMENTS

The HMPC would like to acknowledge the contributions of AECOM and Salter's Creek Consulting, Inc., Hampton, Virginia, throughout the planning process, as well as the contributions of the members of Steering Committee and the extended planning committee that made the planning process work.

#3781 RES

Form and Correctness Approved: BAP Contents Approved:

By: Margaret A. Kelly
Office of the City Attorney

By: Jim Redick
DEPT. Emergency Preparedness & Resp

NORFOLK, VIRGINIA

C-1 RESOLUTION NO. 1,869

A RESOLUTION APPROVING AND ADOPTING AN UPDATED PLAN ADDRESSING HAZARD MITIGATION ACTIONS TO PROTECT PEOPLE AND PROPERTY KNOWN AS THE "2022 HAMPTON ROADS HAZARD MITIGATION PLAN".

- - -

WHEREAS, the City of Norfolk has authority under its Charter to do all things whatsoever necessary or expedient to promote or maintain the general welfare, comfort, education, morals, peace, government, health, trade, commerce or industries of the City or its inhabitants;

WHEREAS, the City of Norfolk recognizes the threat that natural hazards pose to people and property within our community;

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences;

WHEREAS, an adopted Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs;

WHEREAS, the City of Norfolk fully participated in the FEMA-prescribed mitigation planning process to prepare and update the Hampton Roads Hazard Mitigation Plan for 2022, the result of which is referred to herein as the “2022 Hampton Roads Hazard Mitigation Plan” and a complete copy of which is on file with the City’s Department of Emergency Preparedness and Response, including all appendixes; and

WHEREAS, the Virginia Department of Emergency Management and Federal Emergency Management, Region III officials have reviewed the “2022 Hampton Roads Hazard Mitigation Plan” and approved it contingent upon official adoption by the participating governments and entities; now, therefore,

BE IT RESOLVED by the Council of the City of Norfolk:

Section 1:- That the Norfolk City Council hereby approves and adopts the “2022 Hampton Roads Hazard Mitigation Plan” as an official Plan of the City of Norfolk.

Section 2:- That the City Manager is hereby authorized and directed to do all things necessary and proper to carry out the “2022 Hampton Roads Hazard Mitigation Plan”; to submit a certified copy of this resolution to the Virginia Department of Emergency Management and the Federal Emergency Management Agency, Region III officials in furtherance of the Plan’s final approval; and to keep a complete copy of the “2022 Hampton Roads Hazard Mitigation Plan”, including all appendixes, on file with the City.

Section 3:- That this resolution shall be in effect from and after its date of adoption.

Adopted by Council July 12, 2022
Effective July 12, 2022

TRUE COPY
TESTE:

RICHARD ALLAN BULL

BY:

U.S. Department of Homeland Security
Federal Emergency Management Agency
Region 3

One Independence Mall
615 Chestnut Street, 6th floor
Philadelphia, PA 19106-4404

FEMA

August 3, 2022

The Honorable Kenneth Cooper Alexander, Ph.D.
Mayor
City of Norfolk
810 Union Street
Norfolk, Virginia 23510

Community:	City of Norfolk, Virginia
PDC:	Hampton Roads
Plan Adoption Date:	07/12/2022
Plan Approval Date:	05/25/2022
Plan Expiration Date:	05/24/2027

Dear Dr. Alexander:

I am pleased to tell you that FEMA has approved your hazard mitigation plan. The plan meets the requirements of Title 44, Chapter 1, Section 201.6, of the Code of Federal Regulations (44 CFR 201.6). It addresses these required elements: planning process, risk assessment and hazard identification, mitigation strategy, maintenance and implementation, and adoption.

Your hazard mitigation plan also met the requirements to address all dam risks based on the fiscal year 2022 Rehabilitation of High Hazard Potential Dams (HHPD) Notice of Funding Opportunity.

Participating communities are now eligible for FEMA non-emergency assistance and mitigation grants from the following programs:

- Hazard Mitigation Grant Program (HMGP)
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program

Funding from these grant programs can be used for qualified mitigation planning and projects that reduce disaster losses and protect life and property from future disasters. Approved mitigation plans can also earn points under the Community Rating System.

Within 5 years, your community must revise its plan and obtain approval to remain eligible for mitigation grant funding. You should review the plan annually to keep it relevant to mitigation goals in your community. Please consider the enclosed recommendations to further strengthen your plan during its next update.

I commend you and the planning team for your hard work and continued commitment to building a safer, more resilient community. For questions about your plan or mitigation grant funding, please contact Debbie Messmer, State Hazard Mitigation Officer, at (804) 897-9975.

Sincerely,

Sarah Wolfe, Branch Chief
Floodplain Management and Insurance Branch
FEMA Region 3

Enclosure

cc: Debbie Messmer, State Hazard Mitigation Officer, VDEM
Christopher Bruce, All-Hazards Planner, Region 3, VDEM
John Sadler, Emergency Management Administrator, Hampton Roads Planning District Commission
Riana Rich, Emergency Management Planner, Hampton Roads Planning District Commission

Local Mitigation Plan Review Tool Annex
Recommendations for Improvement

FEMA Region III

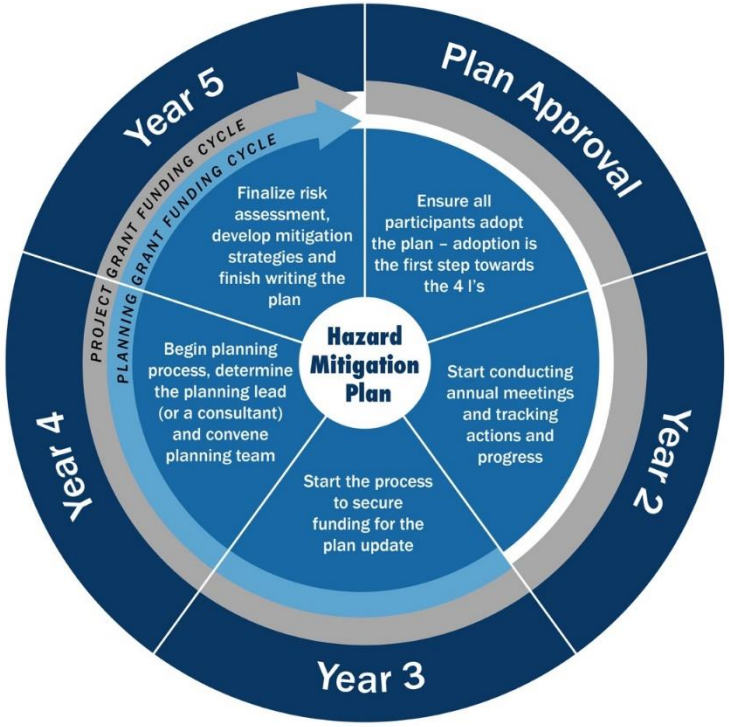
Jurisdiction: Hampton Roads PDC	Title of Plan: Hampton Roads Hazard Mitigtaion Plan	Date of Plan: 2022

Element A: Planning Process		
	☒	Where available, local plans should be integrated into the mitigation plan and vice versa. This should be described in more depth in the next plan.
	☒	The next plan should describe the results of the yearly plan maintenance meetings described in the plan. The same process was described in the previous plan with limited discussion of that process in this plan.
Element B: Hazard Identification and Risk Assessment		
	☒	Provide more information about "Relative Social Vulnerability in the Study Area" to describe areas that have High or Relatively High Social Vulnerability since the map scale covers the entire region, making it difficult to distinguish those areas. It is recommended to create larger scale maps to better indicate location for flooding and coastal erosion/landslides. At the current scale, floodplains and hazardous areas are impossible to discern.
	☒	The Risk and Vulnerability Assessment needs to be reviewed for readability and consistency, particularly the description of the methodology of the vulnerability assessment. It should be revised so that a lay person can get a general understanding of what the author of the plan is trying to convey.
	☒	Add narrative to the HMP describing explicitly how the Virginia state dam safety agency (Virginia Department of Conservation and Recreation)—such as Mark Kilgore, a VADCR Dam Safety Engineer and member of this plan's Hazard Mitigation Planning Steering Committee—coordinated with the jurisdiction and/or other local dam owners throughout the planning process.
Element C: Mitigation Strategy		
	☒	For all jurisdictions within the planning area, include detailed information on how participating communities manage the NFIP to ensure compliance with the local floodplain ordinance. Each floodplain manager should complete the NFIP Survey to identify how their communities are continuing to comply with floodplain requirements and regulations.

	☒	Increase community-level interactions and risk-based discussions, by improving descriptions and connections between the outcome of the risk assessment/vulnerability analysis with non-regulatory Flood Risk Products and the mitigation strategy. Content should flow from problem identification (risk/vulnerability) to mitigation strategy (goals/objectives/actions). The revised plan should describe the systems or processes in place whereby local plans, ordinances, and programs are in place for a town but managed by the county

Element D: Plan Review, Evaluation, and Implementation		
	☒	Utilize the 5-Year Planning Wheel, which reflects the continuous development, implementation and enhancement of your Hazard Mitigation Plan.
	☒	Submit annual progress reviews and plan discussion to state and FEMA
Additional Comments		

	☒	HHPD2 and HHPD4: Add narrative explaining how vulnerable populations in Washington County are impacted by HHPD dam risk, or add a mitigation action to collect and analyze data to determine dam risk impacts to vulnerable populations throughout the county for the purpose of integrating the information into county plans (such as the hazard mitigation plan) to inform decision-making.
	☒	Obtain the latest version of the FEMA: Region 3 High Hazard Potential Dams State and Local Mitigation Planning Tips Resource from FEMA Region 3 and/or State staff and use it to inform the development of the next plan update or ammendment.



INTRODUCTION

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2022 UPDATE

As part of the 2022 update process, participating communities and stakeholders were engaged in a facilitated process to review all plan components in light of new circumstances. Accordingly, each section of this plan has been updated. At the beginning of each section, there is a synopsis of the changes made to that section as part of the update. The biggest changes for 2022 are in Section 5 and include new information regarding social vulnerability and climate change impacts for each of the hazards assessed in detail in this plan. Pandemic Flu or Communicable Disease and Radon Exposure were added as hazards of interest in the region.

Section 1 was updated to modify the scope to include Surry County, the Town of Dendron and the Town of Claremont, which participated in this Hampton Roads planning process for the first time.

BACKGROUND

The Hampton Roads region of southeastern Virginia is vulnerable to a wide range of natural hazards that threaten the safety of residents and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life.

While the threat from hazards may never be fully eliminated, much can be done to lessen their potential impact. The concept and practice of reducing risks associated with known hazards is referred to as *hazard mitigation*. As discussed in the National Mitigation Framework, mitigation includes the capabilities necessary to reduce loss of life and property by lessening the impact of disasters.

FEMA Definition of Hazard Mitigation

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards."

Hazard mitigation techniques include both structural measures, such as strengthening or protecting buildings and infrastructure, and non-structural measures, such as the adoption of sound land use or floodplain management policies and the creation of public awareness programs. Effective mitigation measures are often implemented at the county or municipal level, where decisions that regulate and control development are made. A comprehensive mitigation approach addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, projected patterns of future development must be evaluated and considered in terms of how that growth will increase or decrease a community's hazard vulnerability over time.

As a community formulates a comprehensive approach to reduce the impacts of hazards, a key means to accomplish this task is through the development, adoption, and regular update of a local hazard mitigation plan. A hazard mitigation plan establishes the community vision, guiding principles, and the specific actions designed to reduce current and future hazard vulnerabilities.

The Hampton Roads Hazard Mitigation Plan (hereinafter referred to as "Hazard Mitigation Plan", "Plan", or "HMP") is a logical part of incorporating hazard mitigation principles and practices into routine government activities and functions. The Plan recommends specific actions designed to protect residents, business owners, and the developed environment from those hazards that pose the greatest risk. Mitigation actions should go beyond recommending structural solutions to reduce existing vulnerability, such as elevation of structures, retrofitting, and acquisition projects. Local policies that guide community growth and development, incentives tied to natural resource protection, and public awareness and outreach activities should be considered to reduce the region's future vulnerability to identified hazards.

In keeping with federal requirements and to present a review of Hampton Road's risk and vulnerability, state and regional capabilities, and current local capabilities, the Hampton Roads Planning District Commission (HRPDC) prepared this updated Hazard Mitigation Plan over the course of 2021. The planning committee worked throughout the planning period to update mitigation goals, objectives, and recommended actions, as outlined in detail in Section 2. As part of the ongoing mitigation planning process, this Plan is the result of the 2021/2022 mitigation evaluation.

DISASTER MITIGATION ACT OF 2000

In an effort to reduce the Nation's mounting natural disaster losses, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000). Section 322 of DMA 2000 requires that state and local governments develop a hazard mitigation plan in order to remain eligible for pre- and post-disaster mitigation funding. These funds include the Hazard Mitigation Grant Program (HMGP), Hazard Mitigation Assistance (HMA) and the Pre-Disaster Mitigation (PDM) program, which are administered by the Federal Emergency Management Agency (FEMA). Communities with an adopted and federally-approved hazard mitigation plan are eligible for available mitigation funds before and after the next disaster strikes.

This Plan was prepared and updated in coordination with FEMA and the Virginia Department of Emergency Management (VDEM) to make certain it meets all applicable state and federal mitigation planning requirements. In addition, guidance from the March 2013 FEMA manual, *Local Mitigation Planning Handbook* was used by the committee and professional consultants to guide the plan update process. The *Local Mitigation Plan Review Tool*, found in Appendix A, provides a summary of FEMA's current minimum standards of acceptability, and notes the location within the Plan where each planning requirement is met.

NATIONAL MITIGATION FRAMEWORK

The National Mitigation Framework establishes a common platform and forum for coordinating and addressing how the Nation manages risk through mitigation capabilities. Mitigation reduces the impact of disasters by supporting protection and prevention activities, easing response, and speeding recovery to create better prepared and more resilient communities. This Framework describes mitigation roles across a whole community. The Framework addresses how the Nation will develop, employ, and coordinate core mitigation capabilities to reduce loss of life and property by lessening the impact of disasters. Building on a wealth of objective and evidence-based knowledge and community experience, the Framework seeks to increase risk awareness and leverage mitigation products, services, and assets across a whole community or, in this case, across a region.

National Mitigation Framework, Second Edition, June 2016, was published by the Department of Homeland Security to further discuss seven core capabilities required for entities involved in mitigation:

threats and hazards identification, risk and disaster resilience assessment, planning, community resilience, public information and warning, long-term vulnerability reduction, and operational coordination. The document focuses on the need for the whole community (or region) to be engaged in examining and implementing the doctrine contained in the Framework and to create a culture that embeds risk management and mitigation in all planning, decision making and development.

The operational work plan for this Hazard Mitigation Plan Update considered the objectives of the National Mitigation Framework in many aspects of its implementation: building the committee and choosing committee leaders; providing risk and vulnerability data early in the planning process; requesting capability update information from communities to foster understanding of capability gaps early in the planning process; and creating regional mitigation actions that help create a culture of mitigation at the local and regional levels that brings together a larger group of stakeholders.

PURPOSE

The general purposes of this Hazard Mitigation Plan are to:

- protect life and property by reducing the potential for future damages and economic losses that result from natural hazards;
- qualify for additional grant funding, in both the pre-disaster and post-disaster environment;
- speed recovery and redevelopment following future disasters;
- integrate existing mitigation documents;
- demonstrate a firm local commitment to hazard mitigation principles; and
- comply with state and federal legislative requirements tied to local hazard mitigation planning.

SCOPE

This Hazard Mitigation Plan shall be updated and maintained to continually address those natural hazards determined to be of high and moderate risk as defined by the results of the risk assessment (see "Conclusions on Hazard Risk" in Section 5: *Vulnerability Assessment*). This enables Hampton Road's planning committees to prioritize mitigation actions based on those hazards which present the greatest risk to lives and property.

The planning area includes the following communities in Hampton Roads, which were further broken down into 3 categories based on geography:

The Peninsula:

City of Hampton
City of Newport News
City of Poquoson
City of Williamsburg
James City County
York County

The Southside:

City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach
City of Chesapeake

Western Tidewater:

Isle of Wight County
Town of Smithfield
Town of Windsor
City of Franklin
Southampton County
Surry County
Town of Claremont
Town of Dendron

AUTHORITY

This updated Hazard Mitigation Plan was adopted by each of the participating communities in 2022. A copy of each resolution adopting the Plan is included in Appendix B.

This Plan was developed and updated in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The Plan shall be monitored and updated on a routine basis to maintain compliance with the following legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390); and
- Title 44 Code of Federal Regulations, Part 201, used as the basis for the October 1, 2011, update to FEMA's *Local Mitigation Plan Review Guide*.

APPENDICES

Several appendices are used to provide additional background information and references for information included in this plan. The appendices are referenced within the text, but are included her as an additional tool for navigating the document:

Appendix A - Local Hazard Mitigation Plan Review Crosswalk
Appendix B – Resolutions of Adoption
Appendix C - Hazard Mitigation Planning Committee and Public Meeting Advertisements and Minutes
Appendix D – Public Participation Survey Responses
Appendix E – Review Comments
Appendix F – Mitigation Action Status
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Appendix H – Dam Safety Data Sheets for High Hazard Potential Dams
Appendix I – Hazardous Materials Incidents
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PLANNING PROCESS

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2022 UPDATE

Summaries of each meeting and the procedures followed during the update process were updated for each subsection. Summaries of previous planning processes were removed for brevity and because they are available in previous plans.

OVERVIEW OF MITIGATION PLANNING

Local hazard mitigation planning involves the process of organizing community resources, identifying and assessing hazard risks, and determining how to minimize or manage those risks. This process results in a hazard mitigation plan that identifies specific actions designed to meet the goals established by those that participate in the planning process. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department or agency along with a schedule for its implementation. Plan maintenance procedures are established to help ensure that the plan is implemented, as well as evaluated and enhanced as necessary. Developing clear plan maintenance procedures helps ensure that the Hazard Mitigation Plan remains a current, dynamic, and effective planning document over time.

Participating in a hazard mitigation planning process can help local officials and citizens achieve the following results:

- save lives and property;
- save money;
- speed recovery following disasters;
- reduce future vulnerability and increase future resiliency through wise development and post-disaster recovery and reconstruction;
- enhance coordination within and across neighboring jurisdictions;
- expedite the receipt of pre-disaster and post-disaster grant funding; and
- demonstrate a firm commitment to improving community health and safety.

Mitigation planning is an important tool to produce long-term recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery, and reconstruction. Furthermore, mitigation practices will enable local residents, businesses, and industries to re-establish themselves in the wake of a disaster, getting the community economy back on track sooner and with less interruption.

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, improving water quality, maintaining environmental health, and enhancing recreational opportunities. It is the intent of this document to help identify overlapping community objectives and facilitate the sharing of resources to achieve multiple aims, and to include information wherever possible to demonstrate when the plan is or has been implemented through other planning mechanisms.

PREPARING THE PLAN

44 CFR Requirement

44 CFR Part 201.6(c)(1): The plan shall include documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process and how the public was involved.

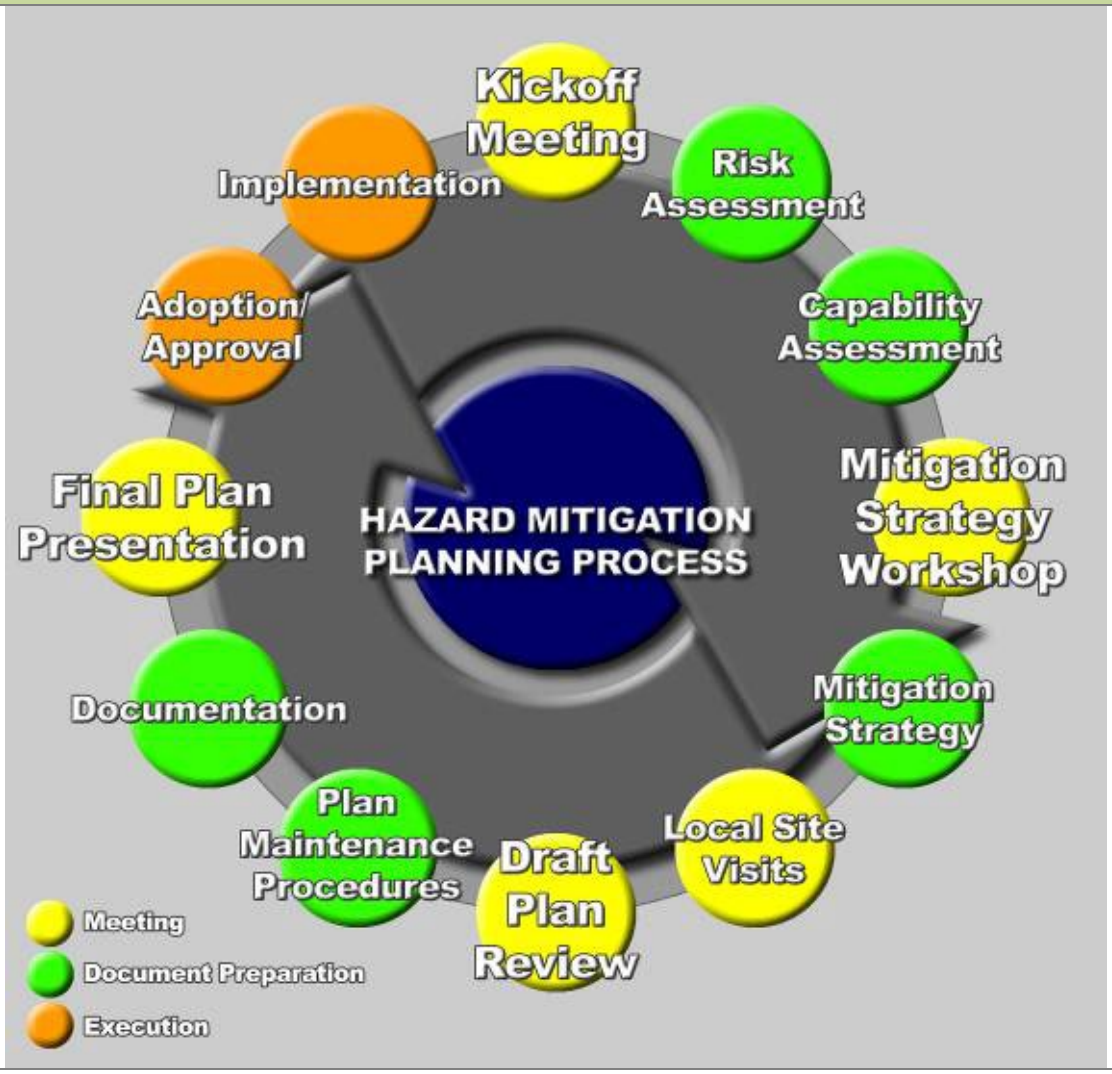
The HRPDC used FEMA guidance (FEMA Publication Series 386) to develop and update this Hazard Mitigation Plan. A Local Mitigation Plan Review Tool, found in Appendix A, provides a detailed summary of FEMA's current minimum standards of acceptability for compliance with DMA 2000 and notes the location where each requirement is met within the Plan. These standards are based upon FEMA's Interim Final Rule as published in the Federal Register on February 26, 2002, and October 31, 2007, in Part 201 of the Code of Federal Regulations (CFR).

The planning process included eight major steps that were completed during 2021 through 2022; they are shown in green and yellow in **Figure 2.1**. Each of the planning steps illustrated in Figure 2.1 resulted in work products and outcomes that collectively make up the Hazard Mitigation Plan.

Table 2.1 provides a summary of the National Flood Insurance Program's Community Rating System (CRS) User's Manual 10-step guidance for plan preparation and how that guidance fits within the 10-step, 4-phase process advocated by FEMA. This plan strives to accomplish the steps in each of these processes.

TABLE 2.1: FEMA GUIDANCE AND CRS HAZARD MITIGATION PLANNING GUIDANCE	
FEMA Guidance	**CRS Guidance**
Phase I: Organize Resources Step 1. Get Organized Step 2. Plan for Public Involvement Step 3. Coordinate with Other Departments & Agencies	 Step 1. Organize Step 2. Involve the Public Step 3. Coordinate
Phase II: Assess Risk Step 4. Identify the Hazards Step 5. Assess the Risks	 Step 4. Assess the hazard Step 5. Assess the Problem
Phase III: Develop Mitigation Plan Step 6: Review Mitigation Alternatives Step 7: Draft an Action Plan Step 8: Set Planning Goals	 Step 6. Set Goals Step 7. Review Possible Activities Step 8. Draft an Action Plan
Phase IV: Adopt & Implement Step 9: Adopt the Plan Step 10: Implement the Plan	 Step 9. Adopt the Plan Step 10. Implement, Evaluate, Revise

FIGURE 2.1: HAMPTON ROADS HAZARD MITIGATION PLANNING PROCESS



THE PLANNING COMMITTEE

A community-based planning team made up of local government officials and key stakeholders has continually helped guide the development of this Plan. The committee organized local meetings and planning workshops to discuss and complete tasks associated with preparing the Plan, including reviewing plan drafts and providing timely comments. Additional participation and input from residents and other identified stakeholders were sought through public meetings that described the planning process, the findings of the risk assessment, and the proposed mitigation actions. The committee convened in 2021.

HAMPTON ROADS MITIGATION PLANNING COMMITTEE

Due to the large geographic area covered and the number of communities participating, the project leaders felt that a Steering Committee was necessary to help more efficiently guide the planning process

and facilitate the numerous Working Group members. Thus, the representatives for the communities and stakeholders were divided into a primary Steering Committee and a Working Group. The division was based on discussions with potential committee members from each community and stakeholders and a determination as to which members were most willing to commit themselves to the entire process, to do the majority of the work, to debate goals and objectives and discuss alternatives, and to report back to their constituencies and Working Group members. The participants listed in **Table 2.2a** are the Steering Committee and **Table 2.2b** shows the Working Group members for the 2022 Hampton Roads Hazard Mitigation Plan Update. Names marked with an asterisk indicate the lead person responsible for that community in the planning, update and maintenance process. Specifically, the tasks assigned to the Steering Committee members included:

- participate in mitigation planning meetings and workshops;
- provide best available data as required for the risk assessment portion of the Plan;
- provide copies of any mitigation or hazard-related documents for review and incorporation into the Plan;
- support the development of the Mitigation Strategy, including the design and adoption of community goals and objectives;
- help design and propose appropriate mitigation actions for incorporation into the Mitigation Action Plan;
- review and provide timely comments on all study findings and draft components of the plan; and
- support the adoption of the Hazard Mitigation Plan by community leaders.

The Working Group includes the Steering Committee members. Working Group members were provided the opportunity and invitation to participate in workshops and public meetings, asked for best available data, asked to review and comment on plan elements, and relied upon to ensure successful adoption of the plan in their community. In many cases, the Working Groups for individual communities also met with additional local staff outside of the more official planning process in additional meetings facilitated by Steering Committee members. Additional participation and input from other identified community staff and stakeholders was sought by the Steering Committee during the planning process primarily through e-mails and phone calls. Stakeholder involvement is discussed in more detail later in this section.

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
Tracy Hanger, Emergency Planner	City of Hampton, Emergency Management	Fire Department/Emergency Management
*Hui-Shan Walker, Deputy Coordinator	City of Hampton, Emergency Management	Emergency Management, Public Information
*George Glazner, Deputy Coordinator	City of Newport News, Emergency Management	Emergency Management/Public Information
Heather Brown, Emergency Operations Planner	City of Newport News, Emergency Management	Emergency Management/Public Information
*Michael Bryant, Emergency Management Coordinator	City of Poquoson, Emergency Management	Emergency Management, Public Information
Ken Somerset, Building Official	City of Poquoson, Community Development	Preventive Measures, Property Protection
Michael Teener, Emergency Management Planner	James City County, Emergency Management	Emergency Management, Public Information
*Sara Ruch, Deputy Coordinator	James City County, Emergency Management	Emergency Management/Public Information

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
*Sean Segerblom, District Captain	York County, Fire and Life Safety	Fire Department/Emergency Management, Public Information
Kent Henkel, Environmental Specialist	York County, Public Works	Property Protection, Natural Resource Protection
*Matthew Simons, Coastal Resiliency Manager	City of Norfolk, Office of Resilience	Planning/Preventive Measures, Property Protection, Resiliency
Tristian Barnes, Floodplain Administrator and Principal Planner	City of Norfolk, Planning	Planning/Preventive Measures, Property Protection, Resiliency
*Joseph Rubino, Response & Recovery Specialist	City of Portsmouth, Fire Rescue & Emergency Services	Fire Department/Emergency Management, Public Information
John Millspaugh, Senior Engineer	City of Portsmouth/Arcadis (consultant)	Preventive Measures, Property Protection
Whitney McNamara, Environmental Planner	City of Virginia Beach, Wetlands & Shoreline Construction Team, Planning Administration	Planning/Preventive Measures, Property Protection, Resiliency
*Danielle Spach, Emergency Management Planner	City of Virginia Beach, Emergency Management	Emergency Management, Public Information
Lucy Stoll, Principal Planner	City of Chesapeake, Planning Department	Planning/Preventive Measures, Property Protection, Resiliency
*Robert Gelormine, Senior Planner	City of Chesapeake, Office of Emergency Management	Emergency Management, Public Information
*Will Drewery, Emergency Management Coordinator	Isle of Wight County, Emergency Services	Emergency Management, Public Information
*Vernie Francis, Deputy Chief	City of Franklin, Emergency Services	Emergency Management, Public Information
Carlee Smith, Environmental Specialist	City of Franklin, Community Development Department	Planning/Preventive Measures, Property Protection, Resiliency
Markiella Moore, Citizen member	Stakeholder: Chesapeake National Event Mitigation Advisory Committee (NEMAC)	Public Information, Property Protection
Noelle Slater, Senior Water Resources Engineer	Stakeholder: AECOM	Planning/Preventive Measures, Property Protection, Resiliency, Natural Resource Protection
Bill Egerton, Disaster Program Manager	Stakeholder: American Red Cross, Coastal Chapter	Emergency Services, Public Information
Ed Barnette, Government Liaison	Stakeholder: American Red Cross, Coastal Chapter	Emergency Services, Public Information
Judy Hinch, Citizen	Stakeholder: Old Dominion University Ph.D. student and climate researcher; also Citizen member of Chesapeake NEMAC	Property Protection, Resiliency, Natural Resource Protection
Alex Gurchinoff Schlebach, Emergency Management Specialist	Stakeholder: U.S. Army Corps of Engineers	Structural Flood Control Projects, Property Protection
Robert Angrisoni, Emergency Management Specialist	Stakeholder: U.S. Army Corps of Engineers	Structural Flood Control Projects, Property Protection
Judy Shuck, Regional Coalition Coordinator	Stakeholder: Eastern Virginia Healthcare Coalition	Emergency Services, Public Information
Harrison Bresée, Chief Regional Coordinator, Region 5	Stakeholder: Virginia Department of Emergency Management	Emergency Services
Elaina Dariah, Outreach Manager	Stakeholder: Virginia 211	Emergency Services
Mari Radford/Renee Hupp, Community Planning Lead	Stakeholder: FEMA, Region III	Emergency Services

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
Mark Heckler, Representative	Stakeholder: Hampton Roads Association, Chiefs of Police (also Chief of Police in Chesapeake)	Emergency Services
John Sadler, Emergency Management Administrator	Stakeholder: Hampton Roads Planning District Commission	Planning/Preventive Measures, Property Protection, Resiliency
Ben McFarlane, Senior Regional Planner	Stakeholder: Hampton Roads Planning District Commission	Planning/Preventive Measures, Property Protection, Resiliency
Anas Malkawi, Chief of Asset Management	Stakeholder: Hampton Roads Sanitation District	Structural Flood Control Projects, Property Protection
Leigh Ann Erdman, Emergency Management Specialist	Stakeholder: U.S. Department of Veterans Affairs	Emergency Services
Mark Killgore, Dam Safety Engineer	Stakeholder: Virginia DCR, Dam Safety	Structural Flood Control Projects
David Luke, Safety & Health Program Manager	Stakeholder: Jefferson Labs	Planning/Preventive Measures, Property Protection
Kaleen Lawsure, Senior Project Scientist	Stakeholder: Old Dominion University, Virginia Modeling and Simulation Center	Emergency Management, Public Information
Michael Player, Executive Director	Stakeholder: Peninsulas EMS Council	Emergency Management, Public Information
Steve Pincus, EMS Planner & Emergency Mgmt Coordinator	Stakeholder: Peninsulas EMS Council	Emergency Management, Public Information
Leigh Chapman, Senior Planner & Hampton property owner	Stakeholder: Salter's Creek Consulting	Planning/Preventive Measures, Property Protection, Resiliency
David Long, Executive Director	Stakeholder: Tidewater EMS Council	Emergency Management, Public Information
Ross Weaver, Program Assistant Director	Stakeholder: Wetlands Watch	Property Protection, Resiliency, Natural Resource Protection
Kenton Towner, Emergency Management Coordinator	Stakeholder: William & Mary	Emergency Management, Public Information, Property Protection
Jim Kaste, Professor of Geology	Stakeholder: William & Mary	Property Protection

* Lead person responsible for that community in the planning, update and maintenance processes outlined in Section 8.

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
* Larry Snyder, Deputy Fire Chief	City of Williamsburg, Fire Department	Emergency Management, Public Information, Property Protection
* Richard Stephens, Deputy Coordinator	City of Suffolk, Fire & Rescue	Emergency Management, Public Information, Property Protection
* Michael Stallings, Town Manager	Town of Smithfield	Public Information
* William Saunders, Town Manager	Town of Windsor	Public Information
* Beth Lewis, Community Development Director	Southampton County, Community Development	Planning/Preventive Measures, Public Information, Property Protection
* Ray Phelps, Chief	Surry County, Emergency Management	Emergency Management, Public Information, Property Protection
Angela King, Asst City	City of Hampton, City Attorney's Office	Public Information

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
Attorney		
Mohammed Shar, Senior Civil Engineer	City of Hampton, Public Works	Property Protection
Scott Smith, Senior Civil Engineer	City of Hampton, Public Works	Property Protection
Tamara Bullock, Business Services Administration	City of Hampton, Parks & Rec	Natural Resource Protection
Carolyn Heaps, Resiliency Officer	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection, Resiliency
Hanna Sabo, Zoning Administrator	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Cashayla Rodgers, Neighborhood Development Associate	City of Hampton, Housing & Neighborhood Services	Planning/Preventive Measures, Property Protection
Sara Snowden, Planner	City of Hampton, Emergency Management	Emergency Management
Brian Lewis, Water Resource Engineer	City of Hampton, Public Works	Property Protection
Jonathan McBride, Divisional Manager	City of Hampton, Housing & Neighborhood Services Division	Planning/Preventive Measures, Property Protection
Bruce Sturk, Director	City of Hampton, Federal Facilities	Public Information
Anna Hammond, Neighborhood Development Associate	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Phil Prisco, Building Official	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Mike Hayes, Planning & Zoning Administration Manager	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection, Natural Resource Protection
Tim Drewry, Deputy City Attorney	City of Hampton, City Attorney's Office	Public Information
Robin McCormick, Communications Strategist	City of Hampton, Marketing	Public Information
Gwen Pointer, Emergency Mgmt Planner	City of Hampton, Emergency Management	Emergency Management
Nicole DelValle, Emergency Operations Planner	City of Newport News, Emergency Management	Emergency Management
Kathie Angle, Civil Design Engineer	City of Newport News, Public Works	Property Protection
Louis Bott	City of Newport News	Emergency Management
John Anderson, Director	City of Poquoson, Public Works	Property Protection
Thomas Cannella, Planner	City of Poquoson, Planning	Planning/Preventive Measures, Property Protection, Natural Resource Protection
Tonya O'Connell, Asst City Manager	City of Poquoson, City Manager's Office	Public Information
Jessica Davis, Finance Specialist	City of Poquoson, Finance	Public Information
Caroline Dunlap, Emergency Management Planner	James City County, Emergency Management	Emergency Management , Public Information
Mike Woolson, Section Chief, Resource Protection	James City County, General Services	Planning/Preventive Measures, Property Protection
Steve Kopczynski, Fire Chief, Director	York County, Fire & Life Safety	Emergency Management , Planning/Preventive Measures, Property Protection

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
Susan Kassel, Director	York County, Planning & Development Services	Planning/Preventive Measures
Amy Parker, Senior Planner	York County, Planning Division	Planning/Preventive Measures
Gail Whittaker, Public Information Officer	York County, Public Affairs	Public Information
Daniel Hudson, Deputy Emergency Mgmt Coordinator	City of Norfolk, Emergency Management	Emergency Management
Jalesha Smith, Management Analyst	City of Norfolk, City Manager's Office of Diversity, Equity & Inclusion	Public Information
Jim Redick, Director	City of Norfolk, Emergency Preparedness & Response	Emergency Management
Scott Mahone, Deputy Emergency Mgmt Coordinator	City of Norfolk, , Emergency Preparedness & Response	Emergency Management
Kyle Spencer, Chief Resilience Officer	City of Norfolk, Office of Resilience	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection
David Topczynski, Deputy Emergency Management Coordinator	City of Portsmouth, Office of Emergency Management	Emergency Management
Stephen Davis, Deputy Emergency Management Coordinator	City of Portsmouth, Office of Emergency Management	Emergency Management
Danielle Progen, Director	City of Virginia Beach, Office of Emergency Mgmt	Emergency Management
Marissa Jones, Office Asst	City of Virginia Beach, Emergency Mgmt	Emergency Management
PJ Scully, Landscape Architect	City of Virginia Beach, Office of Planning	Planning/Preventive Measures, Natural Resource Protection
Brian Spicer, Emergency Mgmt Coordinator	City of Suffolk, Suffolk Fire & Rescue	Emergency Management
Michael Barber, Director	City of Chesapeake, Parks, Recreation & Tourism	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection
David Jurgens, Director	City of Chesapeake, Public Utilities	Property Protection
Ana Elezovic, Planner	City of Chesapeake, Planning	Resilience, Natural Resource Protection
Patrick Hughes, Citizen member	City of Chesapeake, NEMAC	Planning/Preventive Measures
James Haluska, Citizen member	City of Chesapeake, NEMAC	Planning/Preventive Measures
Heather Stanton, Public Utilities Representative	City of Chesapeake, Public Utilities & NEMAC	Property Protection, Planning/Preventive Measures
Michael Johnson, County Administrator	Southampton County	Public Information
Regan Prince, Environmental Specialist	Southampton County, Environmental Services Division	Property Protection
Natalie Rountree, Director	City of Franklin, Community Development	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection

* Lead person responsible for that community in the planning, update and maintenance process outlined in Section 8.

2021/2022 COMMITTEE MEETINGS AND WORKSHOPS

Below is a summary of the key meetings and committee workshops during the 2021/2022 update process. Routine discussions and additional meetings were held by local officials to accomplish planning tasks specific to their department or agency. A consultant team (AECOM, partnered with Salter's Creek Consulting, Inc., of Hampton, Virginia) was hired with grant funds to update the hazard identification and vulnerability analysis, to guide the committee through the planning process based on the revised information and to assist each community with adoption of the final plan. All meeting summary information is included in Appendix C, which includes committee and public meeting minutes, attendance sheets, and correspondence with committee members and stakeholders.

FEBRUARY 25, 2021: PROJECT KICKOFF MEETING

Participants in the Kickoff Meeting discussed the overall approach to updating the Hazard Mitigation Plan, including strategies for outreach and public participation, as well as the steps necessary to meet the requirements of the DMA 2000, and the Community Rating System (CRS) of the National Flood Insurance Program (NFIP). The consultant initiated data collection efforts at the meeting and reviewed the existing list of hazards with the representatives present.

The group discussed project schedule and potential stakeholders and how they would be asked to participate, including tasks such as: reviewing drafts, participating on the committee, and/or attending public meetings. Due to the ongoing COVID-19 safety protocols in place at the time , the group and the consultant decided that each of the main three meetings would be held virtually through online meeting software. Committee meetings would be held virtually, as well.

JULY 27, 2021: FIRST PLANNING COMMITTEE MEETING

The consultant provided an overview of the proposed update approach to committee members. The Committee reviewed the Hazard Identification and Vulnerability Assessment information presented. Committee members discussed the hazards of most critical concern to the region, and concurred to adjust the names of several hazards, removed several hazards and added hazards.

The committee members present voted on their mitigation priorities and ranked hazards using the methodology described in Section 5. The committee considered a list of hazards that included flooding, sea level rise and land subsidence, coastal and tropical storms, severe thunderstorm/hail/lightning, winter storm, drought, high hazard dam failure, tornado, extreme heat, earthquake, wildfire, coastal erosion and landslides, hazardous materials incidents and pandemic flu.

The first part of the meeting focused on the flood analysis, including the hybrid analysis conducted using HAZUS. Participants discussed their frustration with obtaining NFIP repetitive flood loss data and the inability to know flood insurance coverage happening in private flood insurance market. The group discussed nomenclature for Infectious Disease/Pandemic Flu. Surry County requested that landslides not be deleted as it is a significant hazard in their region, and several participants indicated Extreme Heat and Winter Storm should be moved up in the risk assessment.

SEPTEMBER 28, 2021: SECOND PLANNING COMMITTEE MEETING

The second Planning Committee meeting was the beginning of the "Mitigation Strategy Workshops." The meeting began with a presentation on how a complete capability assessment contributes to identification of effective mitigation strategies. The discussion focused on local capabilities and the capability matrix each community was asked to complete.

The consultant helped Committee members review several documents in preparation for the goal setting exercise which was the focus of the workshop. This background helped Committee members maintain continuity and to develop linkages between various local, regional, and state planning efforts.

Data, documents, plans and procedures reviewed as part of the goal setting portion of the planning process included, but were not limited to the following:

- *2018 Commonwealth of Virginia Hazard Mitigation Plan* goals and objectives –
    - These items were reviewed by committee members prior to the work on updating the goals and objectives to help ensure that the regional plan supports and does not contradict the State's goals and objectives;
- Goals, objectives and recommendations from Virginia Beach, Hampton and Norfolk Resiliency planning efforts;
- Goals and objectives from the Virginia Coastal Resilience Master Planning Framework, 2020;
- *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, FEMA January 2013;
- Hampton Roads Planning District Commission three-part study entitled *"Climate Change in Hampton Roads"*;
    - Impacts and Stakeholder Involvement (Phase I, released in February 2010);
    - Storm Surge Vulnerability and Public Outreach (Phase II, released June 2011);
    - Sea Level Rise in Hampton Roads, Virginia (Phase III, released July 2012);
- Each of the existing plan's three primary goals and related objectives; and
- Dam Safety Data Sheets for the region's High Hazard Potential Dams, as well as the list of all State-regulated dams in the region (included in **Appendix H**).

The group was provided a list of potential, broad community goal key phrases extracted from the existing plans in order to encourage brainstorming about revising the goal statements. The members also reviewed existing goal statements from the current plan and other plans pertinent to the region. The group then went to work carefully reviewing the existing mitigation plan goal statements. Participants were encouraged to critique each word in light of the goal key words identified earlier and any changes that had taken place in their communities in the previous five years. The facilitator reworked, grouped together, and presented the revised goals and objectives in real time during the meeting so that the group could arrive at a consensus on the broader mitigation goals and objectives associated with the updated mitigation plan. Detailed notes on the reasoning behind why the mitigation goals and objectives were modified is included in Section 7, which shows the changes and the revised goals and objectives.

The group discussed the current status of COVID-19 protocol and the ability to meet in person for the third workshop. Those present preferred a hybrid approach for Workshop #3 and the development of new and revised mitigation actions for 2022. The consultant proposed a virtual group workshop that would discuss the types of mitigation actions and provide examples and some suggested reading materials, followed by a series of in-person working group meetings, termed "office hours" at three locations in the study area to facilitate review, revision and development of each community's existing mitigation actions.

NOVEMBER 9, 2021: THIRD MITIGATION PLANNING COMMITTEE MEETING

The group reviewed a general list of potential mitigation actions categorized by type and the consultant provided examples, both local and national, of various successful mitigation actions. A brief discussion of the various categories followed. The consultant discussed a variety of mitigation categories for considering and evaluating possible mitigation action alternatives appropriate to each community. Suggested reading materials for the group included:

Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, FEMA 2013;
Mitigation Best Practices – FEMA web site;
Mitigation Success Stories, Association of State Floodplain Managers, 2002;
Mitigation Matters: Policy Solutions to Reduce Local Flood Risk, Pew Charitable Trusts web site;
Zoning for Coastal Flood Resiliency, New York City Planning;

Mitigation Action Portfolio, FEMA web site;
*Buoyant City: Historic District Resiliency & Adaptation Guideline*s, Miami Beach, 2020; and
Coastal Flood Resilience Design Guidelines, Boston Planning & Development Agency, 2019.

The consultant then facilitated a discussion on regional mitigation actions from the 2017 plan and made real-time edits to those actions. Action 1 was modified to remove sidescan Light Detection and Ranging (LIDAR) and replaced with the group's desire to collect lowest floor elevations by collecting existing or creating new Elevation Certificates. Action 2 was edited to reflect desire to use existing mechanisms of the HRPDC to develop additional regional mitigation strategies and host annual workshop on funding. Action 3 was edited to refocus on Hazards U.S. Multi-Hazard (Hazus) input and output data. The group decided to remove Action 4 because a Commodity Flow Study has been identified as a capability gap in regional planning and has been referred to the Local Emergency Planning Committee (LEPC) for completion. The group discussed the addition of several new regional mitigation actions regarding: NFIP repetitive flood loss data analysis at the state or regional level and preparation of repetitive flood loss area analyses; use of radon test kits to test structures; verifying status of significant hazard dams region-wide; and, strengthening/creating transportation networks for evacuation; and partnering with private companies on critical lifeline continuity.

In addition to the facilitated discussion, the consultant cross referenced the final list of proposed mitigation actions and worked with community staff to ensure that each High Hazard Potential Dam listed in Table 4.4 with a "poor" or "unsatisfactory" condition assessment is addressed in the final Mitigation Action Plan. Regional mitigation actions in Section 7 were also added to help clarify the role of the region in addressing dam safety management.

COMMUNITY-SPECIFIC WORKING GROUP MEETINGS

All communities were invited by email to schedule a one-on-one meeting with the consultant toward the end of the planning process. Most of the communities involved in the plan took advantage of these consultant-facilitated brief, in-person meetings at the community level to discuss their final Mitigation Action Plan. Participants worked carefully through a review of the list of existing mitigation actions from their existing plan, deciding which actions to modify or delete based on their progress toward completion. The group then selected and discussed priorities for several new proposed actions suggested by the consultant.

The consultant shared additional review notes on several items that varied by community, and that typically included:

comprehensive plan, resilience plan and strategic plan review notes;
floodplain management regulation review notes;
capabilities or capability gaps noted over the course of the planning process;
repetitive loss area maps (hard copies provided during the meeting);
community-specific critical facility vulnerabilities as shown in the HIRA, and as discussed in the First Planning Committee Meeting; and
other pertinent materials such as news clippings.

While previous plans have benefitted from the synergies of having all communities attend a large workshop to address the MAP revisions and share mitigation ideas, COVID 19 protocols in 2021 required a revised methodology to allow some one-on-one discussion of mitigation actions, but to limit the number of people convened at any one time. The meetings were held over the course of several days in November 2021. York County and the City of Hampton met November 16, 2021 at the City of Hampton Emergency Operations Center. The consultant met with Poquoson representatives on November 16, 2021, as well, in their City Hall Meeting Room. November 19, 2021, in the Isle of Wight Board of Supervisors Board Room, the consultant met with Southampton County, City of Franklin, City of Suffolk, and Isle of Wight County. A virtual meeting was held that same day with James City County staff.

November 22, 2021, the consultant met with City of Williamsburg officials in their Fire Department Headquarters. Finally, on November 30, 2021, the cities of Virginia Beach, Portsmouth, Newport News, Chesapeake and Norfolk sent staff for individual one-hour sessions with the consultant in the HRPDC headquarters in Chesapeake. Attendance for each community was as follows:

City of Hampton	Hui-shan Walker
	Angela King
	Tracy Hanger
	Scott Smith
	Carolyn Heaps
	Sara Snowden
	Brian Lewis
	Jonathan McBride
	Bruce Sturk
	Anna Hammond
	Phil Prisco
	Mike Hayes
	Tim Drewry
	Robin McCormick
City Newport News	George Glazner
	Heather Brown
	Kathy Angle
City of Poquoson	Michael Bryant
	Ken Somerset
	John Anderson
	Thomas Cannella
	Tonya O'Connell
	Jessica Davis
James City County	Michael Teener
	Sara Ruch
City of Williamsburg	David Eagle
	Larry Snyder, Williamsburg
	Erin Burke, Planning Department
	Kenton Towner, William & Mary
	Joanne Chapman, Colonial Williamsburg Foundation
	Sela Gordon
York County	Sean Segerblom, York County
	Kent Henkel
City of Norfolk	Daniel Hudson
	Matthew Simons
	Tristian Barnes

City of Portsmouth	Joseph Rubino
City of Virginia Beach	John Millspaugh (Arcadis) Whitney McNamara, Virginia Beach Danielle Spach
City of Suffolk	Richard Stephens, Suffolk
City of Chesapeake	Robert Gelormine Markiella Moore
Isle of Wight County	Will Drewery
Southampton County	Beth Lewis
City of Franklin	Vernie Francis, Franklin Carlee Smith Natalie Rountree

Participation in the planning process by the towns of Boykins, Branchville, Capron, Courtland, Ivor, Newsoms, Claremont and Dendron was negligible, despite multiple attempts at communication. PDC staff specifically reached out again to many of these communities in mid-February 2022 to inform them verbally about the final Public Meeting in March, and to encourage their attendance. The PDC called and emailed Boykins on February 22 and 23; they called Branchville and Capron on February 24 and left voicemails; they called Courtland and spoke with the Town Clerk on February 24. The PDC also called and emailed the Mayors of Ivor and Newsoms between February 22 and February 24, 2021. Despite these efforts, the towns did not send representatives to the meetings and, therefore, are not considered participants at the time of initial approval. Their mitigation actions from previous plans have been placed in Appendix J, Archived Mitigation Actions, should they need to reference or edit them in the future.

INVOLVING THE PUBLIC

44 CFR Requirement

Part 201.6(b)(1): The planning process shall include an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

Individual citizen involvement provides the planning committee with a greater understanding of local concerns and increases mitigation success by developing community "buy-in" from those directly affected by public policy and planning decisions. As citizens become more involved in decisions that affect their life and safety, they are more likely to gain appreciation of the natural hazards present in their community and take personal steps to reduce hazard impacts. Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business or locality safer from the effects of natural hazards.

Public input was initially sought using three primary methods: (1) open public meetings advertised locally; (2) broadly-distributed public survey; and, (3) the posting of the draft Hazard Mitigation Plan on the HRPDC web site. Public meetings were held at three stages of the planning process; early in the process to introduce the plan update process, again in the middle stage to share results of the Hazard Identification and Risk Assessment; and again, after the planning committee workshops, but prior to adoption by governing bodies.

2021/2022 Public Meetings

Three open public meetings were held virtually via Zoom to present the planning process and to review mitigation actions to be included in the Hazard Mitigation Plan.

The first public meeting was held April 20, 2021. The goal was to introduce the public to the planning process and invite their involvement. The group discussed the hazards in the 2017 plan and provided comments on hazards proposed to be included in the update. The facilitator polled the group about their concerns regarding various hazards and provided a Q&A session at the end.

Upon completion of the Hazard Identification and Risk Assessment, the Committee held another open, virtual public meeting on July 29, 2021. This meeting included review of the results of the hazard study for the region, including detailed information regarding exposure, risk assessment and social vulnerability.

Upon completion of a draft Plan, the Committee held another public meeting on the draft Hazard Mitigation Plan on March 2, 2022. The meeting provided further opportunity for the public and identified stakeholders to review and comment on the draft plan. The plan was posted on the HRPDC web site on February 7, 2022, and contact information for the HRPDC Emergency Management Division was provided if the public needed instructions for submitting comments by March 9. The meeting and review period after the March 2 meeting, provided citizens with an opportunity to review the content of the Plan's sections.

All public meetings were advertised broadly by the communities on social media, on physical bulletin boards, and via email to help ensure that local officials, residents, businesses, and other public and private interests in the region, including neighboring communities, were notified on how to be involved in the local mitigation planning process. Additionally, HRPDC and the communities advertised the meetings on their web sites. The public meeting advertisements are included in Appendix C, which also includes all committee and public meeting minutes, attendance sheets, and invitation correspondence.

The public meeting on March 2, 2022 was termed the "Feedback Forum" in an effort to solicit public comment and feedback on the draft plan. Once again, the committee relied on the efforts of multiple community Public Information Officers, web masters, and other communication specialists, including HRPDC's Administrator of the Office of Community Affairs and Civil Rights, to use a variety of sources to spread the word about the planning effort. Records of advertisements and solicitations for involvement are included in Appendix C (meeting minutes), Appendix D (public survey response summaries), and Appendix E (responses to public comments).

Additionally, the plan was reviewed and presented to each community's elected officials at a public hearing prior to adoption. Though the plan was in its final format for these meetings, this did provide additional opportunity to answer questions and present findings to the public and elected officials. The resolution of adoption by each community is included in Appendix B. Adoption dates are shown in **Table 2.3**.

TABLE 2.3: DATE OF PLAN ADOPTION BY ELECTED OFFICIALS

SUBREGION	COMMUNITY	DATE OF PLAN ADOPTION
Peninsula	City of Hampton	
	City of Newport News	
	City of Poquoson	
	City of Williamsburg	
	James City County	
	York County	
Southside	City of Norfolk	
	City of Portsmouth	
	City of Suffolk	
	City of Virginia Beach	
	City of Chesapeake	
Western Tidewater	Isle of Wight County	
	Town of Smithfield	
	Town of Windsor	
	City of Franklin	
	Southampton County	
	Surry County	

Public Survey

A public survey was distributed early in the planning process to solicit additional feedback from attendees. As indicated above, the public survey was also distributed online in spring 2021 as part of the committee's effort to improve and use public feedback. The results of a total 130 responses collected are summarized in Appendix D. Unfortunately, the response period for the survey was somewhat limited due to another public survey ongoing in the region with similar questions and content.

The majority of respondents to the survey were in Norfolk, Portsmouth, Virginia Beach and Chesapeake. Eighty-seven percent of respondents indicated that, beyond COVID-19, they had experienced or been impacted by a natural or manmade disaster. The highest threats were perceived as hurricanes/tropical storms, floods, pandemic flu/disease, and sea level rise. The majority of participants (72%) did not live in the floodplain, while 44% did have a home in the floodplain. Interestingly, 53% of respondents had flood insurance indicating that many with homes out of the floodplain still had flood insurance. Many (84%) had taken some action(s) to make their home or neighborhood more resistant to hazards; 93% indicated interest in future mitigative actions. Email and social media were viewed as the most effective way to receive information on hazard mitigation. From the respondents' perspectives, property protection

measures and structural projects were seen as the most effective mitigation actions that local governments could administer.

The information in the survey was distributed to all committee members via the HRPDC's SharePoint data sharing site set up early in the planning process. Committee members were invited via email to review the data, particularly as it related to their community, as soon as the survey closed. The contractor reviewed the responses and used them to inform the development of the Mitigation Action Plan and other components of the plan.

HRPDC Web Site

Throughout the planning process, HRPDC maintained a web site at https://www.hrpdcva.gov/departments/emergency-management/2022-hampton-roads-hazard-mitigation-plan that provided a description of the planning process and posted meeting information. The page included a copy of the draft plan prior to the final Public Meeting to provide the public an opportunity to comment. Those comments are addressed through the standard comment/response format documented in Appendix E.

Brochure

In addition to the public meetings, web site and survey, the Committee issued a brochure template that was distributed by many of the jurisdictions, primarily via social media and web postings on their respective web sites. The brochure template is shown in **Figure 2.2** below and provides background information on the planning process, the Community Rating System, and how citizens can become involved. The blank lines are intended for individual jurisdictions to input contact information for their staff point of contact.

FIGURE 2.1: HAMPTON ROADS HAZARD MITIGATION PLANNING BROCHURE

2022 Hampton Roads Hazard Mitigation Plan Update Process



Hazard Mitigation Planning

A Hazard Mitigation Plan is the result of a planning process to identify hazards and develop strategies to reduce loss of life and property. This planning process is structured around the four phases of the Disaster Mitigation Act of 2000, which the region's planning consultant has aligned with the ten steps of the Community Rating System (CRS). Having an adopted Hazard Mitigation Plan that is updated every five years helps ensure each community in the region is eligible for federal disaster funding following a disaster event.

The Community Rating System (CRS)

The CRS is a national program developed by the Federal Emergency Management Agency (FEMA) to encourage communities to reduce their risk to flood-related hazards. The CRS rewards the efforts communities take that go above and beyond the minimum requirements of the National Flood Insurance Program (NFIP) by providing discounts on flood insurance premiums.

Phase 1
1. Organize Planning Team
2. Plan for Public Involvement
3. Coordinate with Other Agencies

Phase 2
4. Identify the Hazards
5. Estimate Losses

Phase 3
6. Identify Goals & Objectives
7. Develop Potential Mitigation Actions
8. Draft the Mitigation Plan

Phase 4
9. Adopt the Plan
10. Implement and Maintain the Plan

Hazards Addressed by the Hampton Roads Hazard Mitigation Plan

The planning committee has initially identified the following hazards for inclusion in the Hampton Roads Hazard Mitigation Plan:

- Flooding
- Sea Level Rise
- Tropical Storm
- Shoreline Erosion
- Dam Failure
- Tornado
- Winter Storm
- Earthquake
- Wildfire
- Drought
- Extreme Heat
- Hazardous Materials Incident
- Communicable Disease

Citizen Involvement

Citizen participation is an important component of mitigation planning. The planning team needs your input on the types of hazards that are your priority concern, and your opinion on ways to lessen their impact.

- Visit the web site. Get more information and follow the planning process at https://www.hrpdcva.gov. The website contains announcements for upcoming meetings, minutes and presentations from past planning meetings, information on the identified hazards, draft planning documents for review, a public survey, and more.
- Take the survey. A public outreach survey is available online here. Please complete the survey as soon as possible to ensure that your opinion is captured! If you would like a hard copy, please use the email below.
- Send us information or comments. If you have information to share for inclusion in the plan, please contact _____ at _____. The draft plan will be made available for public review on the web site prior to being submitted to FEMA.

INVOLVING STAKEHOLDERS

44 CFR Requirement

Part 201.6(b)(2): The planning process shall include an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.

A range of stakeholders, including neighboring communities, agencies, businesses, academia, nonprofits, hospitals, and other interested parties were invited and encouraged to participate in the development of the Hazard Mitigation Plan. Stakeholder involvement was encouraged through notifications and invitations to agencies or individuals to participate in Planning Committee meetings, the Mitigation Strategy Workshops and document review.

In addition to the Planning Committee meetings, the committee encouraged open and widespread participation in the mitigation planning process through the design and publication of advertisements that promoted the open public meetings. These media and social media advertisements and the HRPDC web page postings provided opportunities for local officials, residents, and businesses to offer input.

During the 2021/2022 update process, additional stakeholders were contacted and invited to participate in one of three ways: 1) attend and participate in Committee meetings; 2) attend and participate in the Public Meetings; and/or 3) review draft documents and provide comments and critique.

Additional stakeholders who were invited *and did participate* at some point in the planning process but who were not included on the Steering or Working Committees in Table 2.2 include:

Neighboring communities:
- Brett Major, Gloucester County
- John Hutcheson, Fort Monroe Authority

Local and regional agencies involved in hazard mitigation activities:
- Christina Johnson, Jefferson Labs
- Lewis Bush, Sentara Leigh Hospital

Stakeholder-type organizations that are not represented on the planning committee:
- Perla Santillan, Office of the Chief Medical Examiner for Virginia
- John Cooke, Virginia Department of Health, Office of Emergency Preparedness
- Mike Monteith, Peninsula Community Foundation
- Carolyn Malloy, Virginia EMS
- Gary Lupton, Sr., Virginia 1st

Regional and metropolitan planning agencies:
- Riana Rich, HRPDC
- Danielle Spach, HRPDC (later on the Steering Committee for Virginia Beach);
- Jay Ruffa, Crater Planning District Commission (also representing neighboring communities)
- Katie Moody, PlanRVA (PDC for Richmond region, also representing neighboring communities)

Higher Education Facilities:
- Paul Long, Thomas Nelson Community College
- Jessica Whitehead, ODU ICAR
- Barry Ezell, ODU VMASC
- Pamela Mason, Virginia Institute of Marine Science, College of William & Mary
- William Berquist, College of William & Mary

Other State agencies:
- Allen Evans, Virginia Department of Military Affairs
- John Highsman, Virginia Department of Forestry

State geological agency:
- Anne Witt, Virginia Department of Energy

State emergency management agency;
- Bruce Sterling, VDEM
- Chris Bruce, VDEM

National Weather Service:
- Eric Seymour, NWS Wakefield Office

U.S. Army Corps of Engineers;
- Greg Williams
- Paul Moye

American Red Cross:
- Aubrie McClendon
- Lisa Mike

Representatives from military bases in the region:
- Rob Starr, Joint Base Langley-Eustis
- Steve Harrison, U.S. Coast Guard
- Don Clayton, U.S. Coast Guard.

Additional stakeholders who were invited *but chose not to participate* as stakeholders include:

State agency representatives:
- Virginia Department of Health

Representatives from colleges and universities in the region:
- Christopher Newport University

Representatives from utilities servicing the region:
- Dominion Energy

Social service providers in the region:
- The Planning Council

Representatives from the medical community:
- Riverside Health System.

COMMUNITY PROFILE

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2022 UPDATE

Section 3 was updated to align the format and content of the existing plans and incorporate the most recent data available for each community. Tables and figures were updated, when necessary, to incorporate data from the 2020 U.S. Census, the 2019 American Community Survey (ACS), the HRPDC and other sources. Surry County data were appended. Figure 3.1, and Figures 3.3 through 3.7 were reviewed and determined to remain relevant; thus, they remain in the plan. Towns in Southampton and Surry County that did not participate in the planning process remain represented in this and subsequent sections with the expectation that they may participate at a later date via plan amendment.

GEOGRAPHY AND THE ENVIRONMENT

Located in the southeastern quadrant of Virginia, the portion of Hampton Roads included in this study is bordered to the north by Gloucester County, to the south by Currituck and Camden Counties in North Carolina, to the east by the Atlantic Ocean and Chesapeake Bay, and to the west by the counties of Sussex and Greenville **(Figure 3.1)**. Although Gloucester County is generally considered part of the Hampton Roads region for planning purposes, the county is participating in hazard mitigation planning processes in conjunction with another, adjacent planning district.

Table 3.1 provides a summary of the geographic characteristics of each of the participating communities.

FIGURE 3.1: THE HAMPTON ROADS REGION OF VIRGINIA

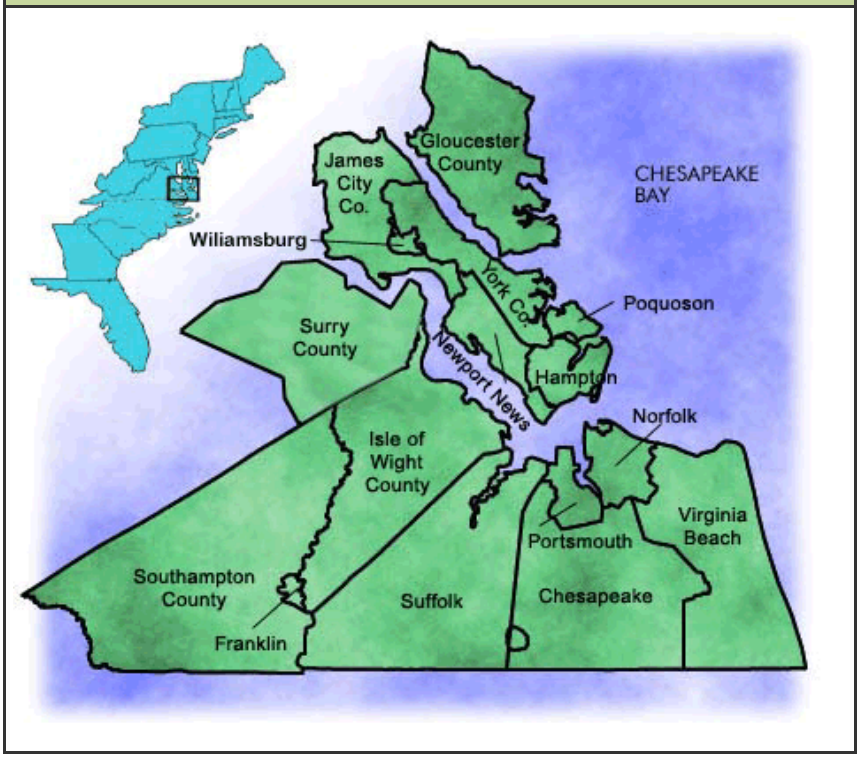


TABLE 3.1: SUMMARY OF GEOGRAPHIC CHARACTERISTICS

SUBREGION	COMMUNITY	2018 LAND AREA IN SQUARE MILES	2018 POPULATION DENSITY PER SQUARE MILE	HOUSING UNITS PER SQUARE MILE
Peninsula	Hampton	52	2,608.3	1,156
	Newport News	70	2,587.4	1,106
	Poquoson	16	770.0	298
	Williamsburg	9	1,687.0	570
	James City County	153	495.7	211
	York County	106	648.3	259
Southside	Norfolk	54	4,570.8	1,791
	Portsmouth	33	2,877.4	1,239
	Suffolk	400	231.8	89
	Virginia Beach	259	1,828.3	706
	Chesapeake	340	717.3	261
Western Tidewater	Isle of Wight County	316	118.6	49
	Smithfield	10	844.1	346
	Windsor	4	675.0	271
	Franklin	8	1,038.5	460
	Southampton	600	29.8	13

TABLE 3.1: SUMMARY OF GEOGRAPHIC CHARACTERISTICS

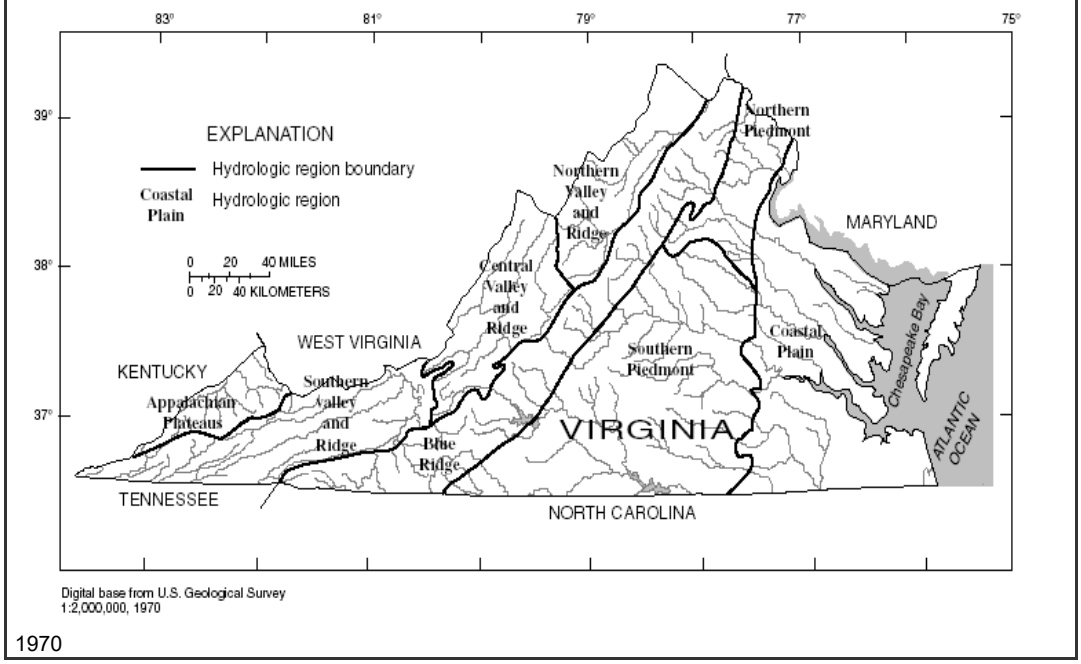
SUBREGION	COMMUNITY	2018 LAND AREA IN SQUARE MILES	2018 POPULATION DENSITY PER SQUARE MILE	HOUSING UNITS PER SQUARE MILE
	County			
	Boykins	<1	854	269
	Branchville	<1	112	57
	Capron	<1	139	69
	Courtland	<1	1,958	523
	Ivor	1	495	152
	Surry County	279	23.6	13
	Claremont	3	107.7	67
	Dendron	4	85.0	32

Source: Weldon Cooper Center (land area and density) and U.S. Census Bureau 2013-2017 American Community Survey Estimates (housing unit data)

Hampton Roads is located within the Atlantic Coastal Plain Physiographic Province, which is characterized by its low, flat relief **(Figure 3.2)**. Much of the region's elevation is nearly level, with the highest elevation point in the study area being just 177 feet above sea level. For example, the overall elevation for the City of Chesapeake averages 12.2 feet above sea level.

The Atlantic Coastal Plain is the easternmost of Virginia's physiographic zones. The zone extends from New Jersey to Florida and includes all of Virginia east of the Fall Line, which is the point at which east-flowing rivers cross from the hard, igneous, and metamorphic rocks of the Southern Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain (U.S. Geological Survey (USGS) 2001).

FIGURE 3.2: PHYSIOGRAPHIC REGIONS OF VIRGINIA

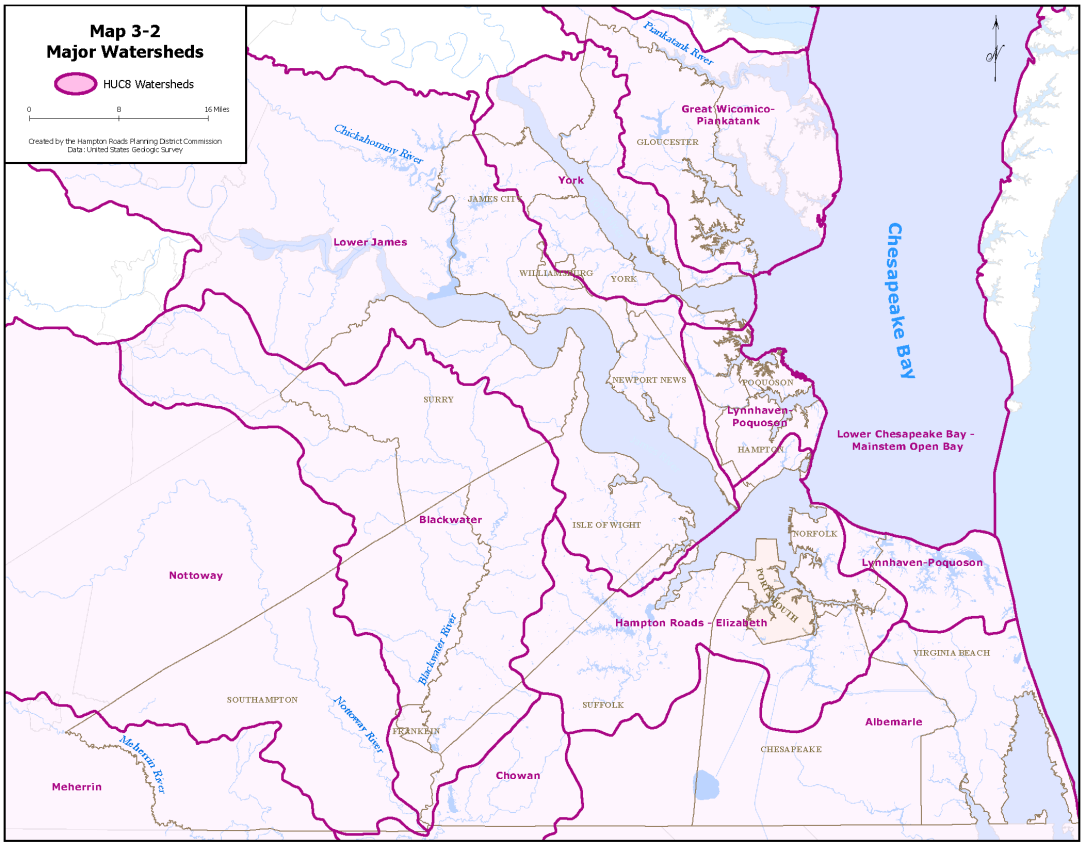


Hampton Roads contains portions of four major river basins: the James River Basin, the York River Basin, Lower Chesapeake Bay, and the Albemarle-Chowan Basin. **Figure 3.3** provides a graphical

illustration of the watersheds designated by their USGS Hydrologic Unit Code. The James River Watershed encompasses approximately 10,200 square miles, and its headwaters are located in Bath and Highland Counties. The James River, which is a part of the larger Chesapeake Bay Basin, empties into the Chesapeake Bay at Hampton Roads. The Lower James subbasin, as shown in **Figure 3.3**, has an area of 1,440 square miles, and the Hampton Roads – Elizabeth subbasin has an area of 425 square miles. The York River Basin encompasses 2,626 square miles with headwaters in Orange County, Virginia. The Lower York River subbasin shown in **Figure 3.3** has an area of just 275 square miles. Several tributaries in the study area flow directly into the Chesapeake Bay, including Poquoson River, Back River, and Lynnhaven River, but the basin also includes the small bays, river inlets, islands and shoreline of the Bay. While the entire basin includes just over 3,000 square miles of land area, just 53% of that land area is within the study area.

Land in both North Carolina and Virginia contribute runoff to the Albemarle-Chowan River Basin. The drainage basin within Virginia is 4,061 square miles, and the basin begins as far west as Charlotte County. Major tributaries include the Meherrin, Nottaway and Blackwater Rivers. In Virginia, there are four distinct sub-watersheds — the Great Dismal Swamp, North Landing River, Northwest River, and Back Bay. These waters flow into the Albemarle and Pamlico Sounds in southeastern North Carolina.

FIGURE 3.3: HYDROGRAPHIC REGIONS OF HAMPTON ROADS



2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

According to the Virginia Department of Conservation and Recreation (DCR) natural heritage inventory, there are at least seven important ecological community groups in Hampton Roads that are interrelated with the water resources of the region:

- Pine/Scrub Oak Sandhills – includes slightly elevated sand deposits along the Blackwater and Nottoway Rivers in Southampton and Isle of Wight counties and the City of Suffolk.
- Fluvial Terrace Woodlands – Nottoway River and Chickahominy River
- Bald Cypress – Tupelo Swamps – swamps dominated by old-growth bald cypress along the Blackwater River in Isle of Wight County and the Nottoway River in Southampton County.
- Coastal Plain/Piedmont Swamp Forests;
- Coastal Plain/Piedmont Floodplain Forests;
- Tidal Bald Cypress Forests and Woodlands; and,
- Tidal Freshwater and Oligohaline Aquatic Beds

The Virginia Scenic Rivers program, administered by DCR, identifies, recognizes and provides limited protection to rivers whose scenic beauty, historic importance, recreation value, and natural characteristics make them resources of particular importance. Reaches of the Blackwater, lower James, North Landing and Nottoway Rivers are all designated scenic rivers through the program. Similarly, the Nationwide Rivers Inventory is a register of river segments that possess unique, rare or exemplary features that are significant at a comparative regional or national scale. Segments of the Blackwater, Chickahominy, James, Northwest, Nottoway, Ware, Yarmouth, and York Rivers are designated on the National Rivers Inventory for various reasons. Additional information on the significance of each designated reach can be found at: https://www.nps.gov/subjects/rivers/virginia.htm.

The summer, fall, spring, and winter temperatures in the Hampton Roads region are typically mild. **Table 3.2** provides the annual meteorological averages for maximum, minimum, and mean temperatures, as well as total precipitation from three airports in the coastal part of the region. The region usually receives small amounts of snowfall annually. Additional discussion of weather extremes, including winter storms, is included in Section 4.

TABLE 3.2: ANNUAL METEOROLOGICAL AVERAGES

WEATHER STATION	TEMPERATURE (DEGREES FAHRENHEIT)			TOTAL PRECIPITATION (INCHES)
	MAXIMUM	MINIMUM	MEAN	
Joint Base Langley-Eustis (Hampton) 1918-2007	67.5	51.3	59.4	43.6
Holland (Suffolk) 1933-2008	70.2	47.4	58.8	48.4
Norfolk International Airport 1946-2008	68.5	51.4	59.9	45.3

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The following information provides a brief overview of the history, geography and unique characteristics of the jurisdictions in the study area.

City of Hampton

Hampton is the oldest continuously settled English-speaking community in the United States. The area now occupied by Hampton was first noted by English colonists before they sailed up the James River to settle in Jamestown, where they visited an Indian village called Kecoughtan.

In 1610, the construction of Fort Henry and Fort Charles at the mouth of Hampton Creek marked the beginnings of Hampton. In 1619, the settlers chose an English name for the community, Elizabeth City. The settlement was known as Hampton as early as 1680, and in 1705 Hampton was recognized as a town. The City of Hampton was first incorporated in 1849. In 1952, Hampton, the independent town of Phoebus, and Elizabeth City County, encompassing Buckroe and Fox Hill, were consolidated under one municipal government.

Benjamin Syms and Thomas Eaton founded the first free public schools in the United States in Hampton. Hampton is the site of Hampton University, established in 1868 to educate freed slaves. St. John's Episcopal parish was founded in 1610, making it the oldest in the country.

Fort Monroe was the only active moat-encircled fort in the country from 1819 until it was decommissioned in 2011. For a long period during the Civil War, the fort was the only Union outpost in the Confederacy. The famous battle between the first ironclad battleships, the Monitor and the Merrimac, was fought just offshore in Hampton Roads, near the Hampton-Newport News municipal boundary.

During the Civil War, rather than surrender to the Federal army, Hampton was burned down by its own troops. Before the fire, Hampton had 30 businesses and over 100 homes. Fewer than six buildings remained intact after the fire. In 1884, fire again besieged Hampton and almost completely destroyed the downtown business district.

Hampton is now a thriving city with numerous industries including high-tech firms, seafood processing, NASA, military, and tourism. Fort Monroe was the headquarters for the U.S. Army Training and Doctrine Command until base decommission in 2011. It has since been redeveloped as a result of the 2005 Base Realignment Closure Commission. The *Fort Monroe Reuse Plan* was signed into effect August 2008, and the city, the Fort Monroe Authority and the Federal government have worked together on implementation of the Plan. Today, Fort Monroe is a National Park with housing units, offices, and public access to the waterfront and the entire fort. The Fort Monroe Authority works to preserve the history of the Fort and maintain the buildings and grounds for continued use. Langley Air Force Base, where historic Langley field was constructed in 1917, is home of the United States' Air Force First Fighter Wing. NASA Langley Research Center, where America's first astronauts were trained, is now a major center for aviation research.

City of Newport News

Established as a town in 1880, Newport News was incorporated as a city in 1896. In the 1960s, the City of Newport News merged with Warwick County to create today's incorporated area.

The most widely accepted version of how Newport News was named relates to Captain Christopher Newport's return to the area from England in 1610. Newport met the Jamestown colonists on Mulberry Island, (located offshore on the James River) as they were preparing to return to England. The news of his arrival with three vessels, a plentiful supply of provisions, and 150 men gave heart to the dispirited colonists who agreed to go back to Jamestown. In gratitude, they named the point of landing "Newport's News." Over the years, the "s" was dropped, thus the name Newport News.

The City of Newport News played a major role in the Peninsula Campaign during the Civil War. Numerous earthen fortifications and attractions that relate to the Civil War are still visible. Additionally, the famous Battle of the Ironclads took place off the shores of Newport News in 1862. Collis P. Huntington, a Northern railroad tycoon from Connecticut, established two major industries in Newport News: the C&O Railroad and Newport News Shipbuilding. Newport News Shipbuilding and Dry Dock Company, established in 1886, built many of the United States' aircraft carriers, including the Enterprise, Kennedy, Washington, Vinson, and Roosevelt. On November 7, 2001, Newport News Shipbuilding signed a merger agreement with Northrop Grumman, and officially became Northrop Grumman Newport News.

The U.S. Army designated the City of Newport News as a Port of Embarkation immediately after America's entry into World War I. The final major military base during WWI was Camp Eustis, which later became known as Fort Eustis. Named after the founder of Fort Monroe's Artillery School of Practice and a War of 1812 veteran, Brigadier General Abraham Eustis, the camp was created in 1918 to meet the need for an artillery firing range. Today, Fort Eustis is the home of the U.S. Army Transportation Corps, and the Transportation Corps Regiment. The U.S. Army Transportation Museum is also located at Fort Eustis.

City of Poquoson

The name "Poquoson" comes from a Native American term that has been translated as either "flat land" or "great marsh." Plum Tree Island National Wildlife Refuge covers approximately 5.5 square miles and dominates the eastern portion of the City. Together with privately owned salt marsh lands, the area makes up the largest saline marsh in the lower Chesapeake Bay.

Poquoson was part of York County for over three centuries and incorporated as a town in 1952. It was later chartered as a city in 1975. It is the oldest continuously named city in Virginia. General agriculture and seafood related businesses remained the predominant activities of the City until the construction of Langley Field in 1917 prior to the United States' entry into World War I. The Field offered residents many employment opportunities either working directly for Langley Field, its many military contractors, or ancillary businesses. Since World War II, Poquoson has been a residential community for people working all over the peninsula.

City of Williamsburg

In 1699, the General Assembly of Virginia established the City of Williamsburg as the colony's capital. The new city, formerly known as Middle Plantation, was named in honor of King William III. In 1722, King George I granted a royal charter incorporating the City of Williamsburg after the fashion of the English municipal borough.

During the 1700's, Williamsburg developed into a bustling capital city and played a singularly historic role in events leading to American Independence. In 1780, the capital of Virginia moved to Richmond, and the Williamsburg area reverted to a quiet college town and rural county seat. In retrospect, Williamsburg's loss of capital city status was its salvation. Many eighteenth century buildings survived into the early twentieth century, when John D. Rockefeller Jr. supported a massive restoration effort. Now a center of tourism and history, the area is preserved and managed by the Colonial Williamsburg Foundation, a non-profit organization.

The College of William and Mary, located in Williamsburg, currently enrolls 5,800 undergraduate and almost 2,000 graduate students. Originally founded on February 8, 1693, William and Mary is the second-oldest institution of higher learning in the United States and the fourth oldest in North America. The school was one of the original Colonial colleges; the College's Wren Building is one of the oldest academic buildings in continuous use in the United States. The College educated several American leaders, including three U.S. Presidents. George Washington served as one of the College's first Chancellors. Robert M. Gates '65, L.H.D. '98, was named twenty-fourth Chancellor of William & Mary by the Board of Visitors at his investiture on February 3, 2012. He succeeded Sandra Day O'Connor, former Associate Justice of the United States Supreme Court, who was appointed in 2005. He was re-invested for a second term on February 8, 2019.

William and Mary was occupied during the Civil War and closed from 1882-1888 due to financial strains (the College had invested in Confederate bonds). In 1888, William and Mary reopened its doors and began to expand. Today, William and Mary is one of Virginia's most-cherished universities and was one of the first universities to become coeducational in 1918. William and Mary is consistently ranked among the premier public universities in America.

James City County

On May 13, 1607, 144 English explorers arrived and soon established James Towne as the administrative center or capitol. In 1634, by order of the King of England, Charles I, eight shires or counties with a total population of approximately 5,000 inhabitants were established in the colony of Virginia. James City Shire, as well as the James River and Jamestown, took their name from King James I, the father of King Charles I. During 1642 or 1643, the name of the James City Shire was changed to James City County. The original county included what is now Surry County across the James River, part of Charles City County, and some of New Kent County.

Williamsburg became an independent city from James City County in 1884; however, the city is still the county seat of James City County, and they share a school system, courts, and some constitutional officers.

James City County encompasses land important in the early history of our nation. Three jurisdictions, James City County, York County, and the City of Williamsburg, work collaboratively on policies, programs, infrastructure, and land use to preserve this historic area.

York County

York County was formed in 1634 as Charles River Shire, named for King Charles I. It was one of the eight original shires in the Colony of Virginia. The county was renamed in 1642-43 as York County. The river, county, and town are believed to have been named for York, a city in Northern England. The first courthouse and jail were located near what is now Yorktown, although the port used for shipping tobacco to Europe was variously called Port of York, Borough of York, York, or Town of York, until Yorktown was established in 1691. Never incorporated as a town, Yorktown is the county seat of York County. The only town ever incorporated within the county's boundaries was Poquoson, which was incorporated in 1952 and became an independent city in 1975.

York County is most famous as the site of the surrender of General Cornwallis to General George Washington in 1781, ending the American Revolutionary War. Yorktown also figured prominently in the Civil War, serving as a major port to supply both Union and Confederate towns, depending upon who held Yorktown at the time.

Yorktown is part of an important national resource known as the Historic Triangle of Yorktown, Jamestown, and Williamsburg, and is the eastern terminus of the Colonial Parkway.

City of Norfolk

The City of Norfolk, located on the Elizabeth River, was founded in 1682 but was not incorporated as a city until 1845. Initially comprised of only 50 acres, the city has grown to a total of 96 square miles today.

Norfolk has seven miles of Chesapeake Bay waterfront and a total of 144 miles of shoreline, including lakefront, rivers and the Bay. Naval Station Norfolk, which was established on the old Jamestown Exposition grounds in 1917, is the world’s largest naval base. The city is also home to the North American Headquarters for the North American Treaty Organization (NATO) and Old Dominion University (ODU). Norfolk is the most densely developed jurisdiction in the Southside Hampton Roads region at 4,486 people per square mile.

City of Portsmouth

The City of Portsmouth was founded as a town in 1752 on the shores of the Elizabeth River by Colonel William Crawford. In 1858, the town was separated from the county government and given status as an independent city.

Portsmouth's location as an East Coast deep-water port, and available business sites in proximity to the nation's largest shipyard, have provided a significant impetus for economic growth in the area. Today Portsmouth is in the middle of the dynamic Norfolk-Virginia Beach metropolitan area and home to almost 100,000 people. In addition to the many medical, cultural and recreational facilities within the immediate community, Portsmouth's downtown is bustling with retail, restaurant and service-related businesses. The historic waterfront neighborhood of Olde Towne lines the Elizabeth River and is easily traversed by the famous downtown seawall, and the City of Norfolk is easily accessible by a 5-minute ferry ride across the river.

City of Suffolk

In 1742, the Town of Suffolk, which was originally part of the County of Nansemond, was established. The town was burned by the British in 1779 and damaged by other fires throughout the next century but survived to eventually become incorporated as a city in 1910. In 1974, the City of Suffolk consolidated with the towns of Holland and Whaleyville, and the County of Nansemond. At that point it became the largest city (geographically) in Virginia and the 11th largest in the country, encompassing a total of nearly 430 square miles. This large area is made up of land with woods, lakes, rivers, and rolling terrain.

The City of Suffolk is located along the Nansemond River and is still largely recognized as the "Peanut Capital" of the world and as the home of "Mr. Peanut." In 1912, an Italian immigrant named Amedeo Obici moved from Pennsylvania to Suffolk and opened Planters Nut and Chocolate Company. Today, Suffolk remains a major peanut processing center and transportation hub.

City of Virginia Beach

The first settlement inside the city limits of Virginia Beach was made on Lynnhaven Bay in 1621, and the area first became incorporated as a town in 1908. In 1963, the Town of Virginia Beach merged with Princess Anne County to form the independent City of Virginia Beach.

The city consists of 51.3 square miles of inland water and 258.7 square miles of land. The topography is relatively flat with an average elevation of twelve feet above sea level. The area contains extensive brackish tidal areas, such as the Lynnhaven and Elizabeth River systems, and expansive freshwater tidal areas, such as the North Landing River and Back Bay systems.

Due to a combination of the city's geographic position on the mid-Atlantic coastline and the straddling of two ecologically significant estuaries, Chesapeake Bay and Pamlico Sound, the area serves as the southern limit of many northern plant and animal species. The Back Bay National Wildlife Refuge, established in 1938 and managed by the U.S. Fish and Wildlife Service, is an 8,000-acre freshwater refuge that borders the Atlantic Ocean on the east and Back Bay on the west. The barrier islands feature large sand dunes, maritime forests, freshwater marshes, ponds, ocean beach, and large impoundments for wintering wildfowl.

Virginia Beach is best known as a major resort destination, with miles of beaches and dozens of hotels, motels, and restaurants. The city is also home to several state parks, several protected beach areas, four military bases, a number of large corporations, and two universities. Much of the land remained undeveloped until World War II when the U.S. Navy built Oceana Naval Air Station, followed by three more military bases, including Little Creek, Fort Story, and Dam Neck. Since the end of the war, Virginia Beach has experienced continued rapid growth and is the region's most populous jurisdiction at almost 450,000 people.

City of Chesapeake

Chesapeake's history dates back much further than 1963 when Norfolk County and the City of South Norfolk merged to create Chesapeake. The first English settlement of the area began around 1620 along the banks of the Elizabeth River. Norfolk County's founding dates back to 1636.

In the early months of the Revolutionary War, in December 1775, British Royal Governor Lord Dunmore moved his forces from Norfolk to Great Bridge where his army entrenched itself to await the arrival of American forces. The two armies clashed on December 9, 1775, in the historic Battle of Great Bridge, just a few hundred yards from where the Chesapeake Municipal Center complex stands today. In a brief but decisive battle, the Americans routed Lord Dunmore's forces which fled to Norfolk and later abandoned that city.

In 1793, work began on the Dismal Swamp Canal, an idea first envisioned by George Washington in 1763, when he visited the swamp. Because the canal was dug completely by hand, progress was slow, and expenses were high. The canal opened in 1805. Now on the National Register of Historic Places, the Dismal Swamp Canal is the oldest operating artificial waterway in the country. Both the Dismal Swamp Canal and the Albemarle and Chesapeake Canal are operated by the Army Corps of Engineers and form part of the Atlantic Intracoastal Waterway. According to the City of Chesapeake 2003 Legislative Program Document, the City has more miles of deep-water canals than any other city in the country.

The first local encounter of the Civil War occurred at Sewell's Point in May 1861. Although no battles were fought in the Chesapeake area, Union troops occupied and laid waste to much of the land. When the war ended, Norfolk County took advantage of its abundant natural resources. Its coastal location, miles of riverfront and deep-water harbors and the fertile, level farmland allowed county residents to recover quickly from the wartime destruction, moving without hesitation into the 20th century.

While most of the area retained its rural atmosphere through the early 1900s, the northern section near the growing City of Norfolk began to develop as the suburb of South Norfolk. By 1900, South Norfolk had its own waterworks, public schools and a post office. Two rail lines spurred rapid growth, allowing South Norfolk to incorporate as an independent town in 1919 and a city of the first class, independent of Norfolk County, in 1950.

The area that now comprises Chesapeake grew with residential and commercial development of "community crossroads." These areas are still commonly referred to today with community names such as Pleasant Grove, Great Bridge, Oak Grove, Fentress, South Norfolk, Portlock, Deep Creek, Western Branch, Indian River and Hickory.

During the 1950s, both Norfolk County and South Norfolk fell victim to annexation suits filed by neighboring cities. Between 1950 and 1960, the county lost nearly 50,000 residents and 30 square miles of land area. Under these circumstances, both Norfolk County and South Norfolk officials found it difficult to plan for the future.

In the fall of 1961, city and county officials met to discuss the feasibility of a merger. After several weeks of negotiations, both governing bodies approved a merger agreement on December 22, 1961. On February 13, 1962, citizens of both communities turned out in near-record numbers for a special election and approved the merger. Later that year, in June, the citizens voted again and selected the name "Chesapeake" for the new city. On January 2, 1963, the Chesapeake City Council, with five members from South Norfolk and five from Norfolk County, met for the first time.

Isle of Wight County

Isle of Wight County was established as Worrosquoyacke County in 1634, one of eight counties divided from the Virginia colony. The original boundaries of the county included Lawne’s Creek to the north, the James River to the east, the head of Colonel Pitt's Creek to the south and undeveloped wooded area to the west. In 1656, Ragged Island and Nansemond County were incorporated into Isle of Wight County. A long dispute between the counties of Isle of Wight and Nansemond continued until 1674, when the General Assembly established the boundaries that exist today.

Isle of Wight County is thirty-seven miles in length and maintains an average breadth of eleven miles. The county is comprised of approximately 363 square miles, of which 80 percent is land area. The area contains relatively flat but rolling terrain with average elevation of approximately 80 feet above sea level.

The land generally dips to the northeast from a plateau west of Bethel Church, and from that same plateau, the land dips to the northwest and west. Several swamps, ravines and creeks drain to the James River, the Blackwater River and the Nansemond River.

Today, Isle of Wight's residents enjoy the rural nature of the County coupled with the quaint atmosphere of the two incorporated towns, Smithfield and Windsor. While the local economy remains agriculturally-based, the area's scenic beauty, history and proximity to other attractions in the Hampton Roads area greatly contribute to the tourist draw. In addition, the County is close enough to the transportation hubs and employment centers of the Norfolk-Virginia Beach area to attract year round residents and businesses alike.

Town of Smithfield

The Town of Smithfield was incorporated in 1752 by Arthur Smith, IV, who parceled out his family farm into 72 lots and 4 streets in order to house British merchants and ship captains. The town is located on the banks of the Pagan River, which flows into the James River. Smithfield was a river town from its very beginning, and the livelihood of its residents and continued growth over the years has been influenced by the river. The town measures approximately ten square miles.

Nurtured by trade and commerce, Smithfield soon became a town of industry with four plants devoted to the art of curing the world famous "Smithfield Ham." Located within the town is Smithfield Foods, Inc., the area's largest meat-processing industry as well as a major employer for the region.

Smithfield has many of the charms associated with Hampton Roads communities, including many historic homes representing 18th and 19th century architecture, a revitalized historic downtown, and the character of a former colonial seaport. To preserve the historical charm, the Town of Smithfield and individual property owners enacted a Historic Preservation District Ordinance in 1979. Smithfield offers residents a small-town atmosphere, a high quality school system, affordable housing, a historic downtown, and a state-of-the-art community/conference center.

Town of Windsor

The Town of Windsor is located in the heart of Isle of Wight County. The town's original name was Corrowaugh, and it was established as a post office in 1852. Five years later, the Norfolk and Petersburg Railroad obtained the post office and built a depot called Windsor Station. In 1902, a town charter was granted by the General Assembly and the town became known simply as Windsor.

In 1950, the Windsor Ruritan Club and the Town of Windsor built a "Community House" which has been a valuable asset to the community over the years. Over the next three decades, town services improved and expanded. The streets were upgraded and paved, sidewalks extended, additional streetlights installed, drainage improved, and ditches piped. The privately owned water systems in the town limits were purchased by the town, upgraded, extended and an above ground water storage tower was erected. In 1971, the Windsor Volunteer Rescue Squad was founded and continues to provide service to the town and surrounding community.

In July 2001, the Town of Windsor annexed 2.82 square miles of Isle of Wight County. As a result, the total area increased from one square mile to 3.82 square miles and population increased from approximately 900 to 2,347. Also in 2001, Isle of Wight County helped install a central sewer system in the town which opened up many areas for new homes and businesses. The Town of Windsor remains a small rural town amidst the region's larger, more populated cities which are easily accessible through two main roads bisecting the town, Route 460 and Route 258.

City of Franklin

Franklin was incorporated as a Town within Southampton County in March of 1876. The first official census of 1880 indicated that there were 447 inhabitants within its limits. By 1970, nearly 7,000 people lived in Franklin.

Franklin developed considerable steamboat commerce along the Blackwater River southward to North Carolina ports from the late 1800s and early 1900s through the 1920s. The combination of rail and water transportation led to more rapid growth in Franklin than in the other towns. The steady growth of the Camp family's lumber business after the Civil War accelerated this growth. Franklin also became a major collection point for peanuts in that period. Franklin is now the major center of commerce and industry for Southampton County.

The Blackwater River is a relatively slow moving, dark river that traverses the City and serves as a valuable resource. Residents rely on the river for recreation, using it heavily for boating and freshwater fishing.

Southampton County and towns

The earliest explorations of the area began a few years after the settlement of Jamestown. The inhabitants were then members of several small Indian tribes, mainly the Nottoways and Meherrins, with settlements along the rivers that now bear their names. In 1634, the western limit of English colonization was established at the "Blackwater Line," which extended southeast from Fort Henry (now Petersburg) through the Blackwater Swamp. Increasing pressure from colonists resulted in lifting of the line in 1705, and in following years the County lay in the path of the general southwesterly migration from the James River settlements. The soils were good for farming and there were forests for timber. More settlers were attracted, and later their slaves, as the Indians were gradually collected in reservations before they finally dispersed. There was a remnant of the Nottoway reservation still in existence in 1856 and probably for some years thereafter.

Water commerce to the south on the Blackwater and Nottoway Rivers was prominent in the early history of the County during both the Revolutionary and Civil Wars. Efforts to maintain or interrupt these routes for military supplies resulted in skirmishes on several occasions, but no major battles. South Quay on the Blackwater River was an established port from the early years of the 18th century. A most dramatic event of the County's history between the Revolutionary and Civil Wars was the slave rebellion led by Nat Turner in 1831. This bloody revolt and its aftermath resulted in the deaths of approximately 100 blacks and whites and drew national and international attention from both pro- and anti-slavery factions.

In order to establish a more convenient administrative center, the present County was split off from Isle of Wight County in 1749. The County seat was Jerusalem, renamed and incorporated as Courtland in 1888. The new County is believed to have been named for Henry Wriothesley, third Earl of Southampton, who was active in promoting colonization of Virginia under the English King James I.

The isolation of Southampton County diminished with the coming of the first railroad in 1834, as the first leg of the Portsmouth and Roanoke Railroad (now CSX) extended to the Nottoway River on its way to western Virginia and made connection with water travel to the south on the river. The Petersburg Railroad (now also CSX) had gone into operation west of the Meherrin only a year before. With the coming of the Portsmouth and Roanoke line, Southampton farmers now had access to both the Petersburg and Norfolk markets. In 1858, the Petersburg and Norfolk Railroad was completed, crossing the northeastern section of the County. Courtland eventually gained rail service with the coming of the Atlantic and Danville Railroad in 1888, about the same time the Surry, Sussex and Southampton Railway (now abandoned) provided service from the north central County to Scotland Wharf on the James River in Surry County. The Virginian Railroad (also abandoned) was built through Sebrell and Sedley in 1906. Over the years, the economic life of the County became centered on the railroad depots that were established at road crossings. Towns and villages gradually formed at these points: Newsoms, Boykins, and Branchville; Courtland, Capron, and Drewryville; and Sedley and Sebrell. Ivor to the northeast, perhaps somewhat more associated with the other towns along its railroad (Waverly, Wakefield and Zuni) also formed.

In more recent times the County's highways have assumed an increasing share of the responsibility for transporting farm products, timber, and manufactured products. In addition, improved roads and widespread automobile ownership have enabled the same kind of widely dispersed residential pattern once maintained by farming, but now maintained by community centers of trade, services, and manufacturing employment.

Surry County and Towns

When the first English settlers sailed up the James River in 1607, they first landed on the south side of the river near the present Town of Claremont in Surry County. Here they visited the Quioughcohancock Indians, allies of the Powhatan Confederacy. The English reported that they were graciously entertained during this first visit with the Native American inhabitants. These settlers went on to establish the first English settlement in the New World on Jamestown Island. The Virginia Company listed sixteen settlers on the south side of the James in May of 1625; this is the area which would later become Surry County. Surry County was formed in 1652 from a portion of James City County and was named for the English County of Surrey.

Following the American Revolutionary War, Surry County became part of the new Commonwealth of Virginia. In over 350 years of existence, the County of Surry has taken care to guard its history and its rural nature. The county is home to several picturesque small towns, historic homes and churches, and Chippokes State Park. Surry County is connected to Virginia's Historic Triangle (Jamestown, Williamsburg and Yorktown) by the Jamestown/Scotland Ferry.

Surry County is a rural county characterized by a rolling topography that gradually becomes more level in the eastern portions of the county. Seventy-five percent of the county is forested. Traditionally, forestry and agricultural land uses have supported the majority of employment but have experienced recent decline. Surry County is the location of the Surry Power Station, a nuclear power plant built in 1972 which is the County's main employer.

POPULATION AND DEMOGRAPHICS

According to the *U.S. Census Bureau 2020 Census*, the study area portion of Hampton Roads has a population of 1,693,394 people. **Table 3.3** shows total population breakdowns, including percent of children under the age of 18, percent of elderly population (age 65 and over), and percent of population living below the poverty level. Data in Table 3.3 are based on 2020 Census data and the most recent American Community Survey.

TABLE 3.3: DEMOGRAPHIC CHARACTERISTICS						
SUBREGION	COMMUNITY	TOTAL POPULATION	% UNDER 18 YEARS OLD	% 65 YEARS AND OVER	MEDIAN AGE	% PERSONS IN POVERTY
Peninsula	Hampton	134,510	21	15	35.7	15.2
	Newport News	179,225	23.1	13.3	33.4	15.1
	Poquoson	12,271	22.4	19.6	42.4	5.3
	Williamsburg	14,954	10.4	15.7	24.9	20.7
	James City County	76,523	19.7	25.8	47.0	5.8
	York County	68,280	23.5	16.6	41.3	5.1
Southside	Norfolk	242,742	19.7	10.9	31.1	18.7
	Portsmouth	94,398	23.4	14.5	36.7	16.8
	Suffolk	92,108	24.3	14.2	37.9	10.4
	Virginia Beach	449,974	22.3	13.7	36.6	7.3
	Chesapeake	244,835	24.2	13.0	37.8	8.6
Western Tidewater	Isle of Wight County	37,109	20.8	19.8	44.3	9.1
	Smithfield	8,475	23.1	18.0	40.2	17.0
	Windsor	2,746	23.6	21.5	43.6	11.0
	Franklin	7,967	25.2	19.3	39.4	14.7
	Southampton County	17,631	18.6	20.8	46.9	13.3
	Boykins	516	18.6	12.7	46.3	5.0
	Branchville	118	16.7	10.5	39.5	7.1
	Capron	141	15.8	40.5	59.7	3.8
	Courtland	1,295	23.9	19.7	43.5	17.8
	Newsoms	286	17.1	14.2	47.4	8.4
	Ivor	312	27.4	16.1	40.5	11.9
	Surry County	6,422	16.6	23.9	49.8	11.9
	Claremont	305	10.2	31.9	57.2	20.9
	Dendron	251	20.4	12.5	45.3	12.7

Source: U.S. Census Bureau, 2019 American Community Survey

Table 3.4 provides the population change experienced by communities in the region between 1980 and 2020, as well as the HRPDC population projection through 2045. Much of the projected population increase between 2020 and 2045 is fueled by population growth in rural or suburban areas, not in the more urbanized cities like Hampton, Norfolk, Newport News and Portsmouth.

TABLE 3.4: REGIONAL POPULATION CHANGE AND PROJECTED CHANGE, 1980 - 2045

SUBREGION	COMMUNITY	1980	1990	2000	2010	2020	2045
Peninsula	Hampton	122,617	133,811	138,437	137,436	134,510	139,207
	Newport News	144,903	171,439	180,150	180,719	179,225	189,962
	Poquoson	8,726	11,005	11,566	12,150	12,271	12,637
	Williamsburg	10,294	11,530	11,998	14,068	14,954	18,341
	James City County	22,339	34,859	48,102	67,009	76,523	120,741
	York County	35,463	42,422	56,297	65,464	68,280	85,930
Southside	Norfolk	266,979	261,250	234,403	242,803	242,742	263,837
	Portsmouth	104,577	103,910	100,565	95,535	94,398	97,752
	Suffolk	47,621	52,143	63,677	84,585	92,108	129,682
	Virginia Beach	262,199	393,089	425,257	437,994	449,974	518,777
	Chesapeake	114,486	151,982	199,184	222,209	244,835	317,206
Western Tidewater	Isle of Wight County	21,603	25,053	29,728	35,270	37,109	52,417
	Franklin	7,308	7,864	8,346	8,582	7,967	8,751
	Southampton County	18,731	17,550	17,482	18,570	17,631	20,218
	Surry County	6,046	6,145	6,829	7,058	6,422	7,374
REGION TOTAL		**1,193,892**	**1,424,052**	**1,532,021**	**1,629,452**	**1,678,949**	**1,982,832**

Source: Hampton Roads 2045 Socioeconomic Forecast, HRPDC, July 2020

HOUSING, INFRASTRUCTURE AND LAND USE

According to the U.S. Census Bureau, *2019 American Community Survey 5-Year Estimates*, there are 650,877 housing units in the study area portion of Hampton Roads, with more than 90-percent of the units classified as occupied. The majority of structures were built after 1970 (68%). According to the 2009-2013 American Community Survey Estimates (the most recent period available for all communities in the study area), 56% of all housing units are owner-occupied and slightly more than 40% of the housing units are mortgaged. **Table 3.5** summarizes recent data on housing characteristics. More specific information regarding the vulnerability of residential units to various hazards is provided in Section 5, *Vulnerability Assessment*.

TABLE 3.5: HOUSING CHARACTERISTICS

SUBREGION	COMMUNITY	TOTAL HOUSING UNITS	OCCUPIED UNITS	MEDIAN VALUE	AVERAGE HOUSEHOLD SIZE	% HOUSING STRUCTURES BUILT BEFORE 1970
Peninsula	Hampton	62,444	92%	$193,500	2.42	45%
	Newport News	81,901	92%	$186,600	2.45	35%
	Poquoson	4,926	94%	$307,800	2.67	28%
	Williamsburg	5,753	89%	$320,600	2.17	33%
	James City County	33,993	93%	$334,700	2.45	9%
	York County	27,827	93%	$346,200	2.7	18%
Southside	Norfolk	101,386	92%	$218,000	2.43	59%
	Portsmouth	43,164	92%	$169,600	2.47	56%
	Suffolk	38,364	93%	$263,500	2.70	26%
	Virginia Beach	190,059	94%	$296,200	2.60	21%
	Chesapeake	94,829	96%	$290,900	2.75	20%
Western Tidewater	Isle of Wight County	16,441	93%	$243,000	2.55	23%
	Franklin	3,886	88%	$178,700	2.39	48%
	Southampton County	7,724	88%	$159,700	2.53	37%
	Surry County	3,402	82%	$169,000	2.50	31%
REGION TOTAL		**650,877**	**91%**			**32%**

Source: U.S. Census Bureau, 2020 Census, 2010 Census, and 2019 American Community Survey 5-Year Estimates

The Hampton Roads region provides an integrated network of transportation facilities and infrastructure that includes many interstates (I-64, I-264, I-464, I-564, I-664) and highways (U.S. 13, 17, 58, 60, 258, 460 and State Route 164), along with hundreds of secondary roadways and bridges throughout the area. Route 168 is a four-lane highway that links I-64 to North Carolina and the Outer Banks region, a major

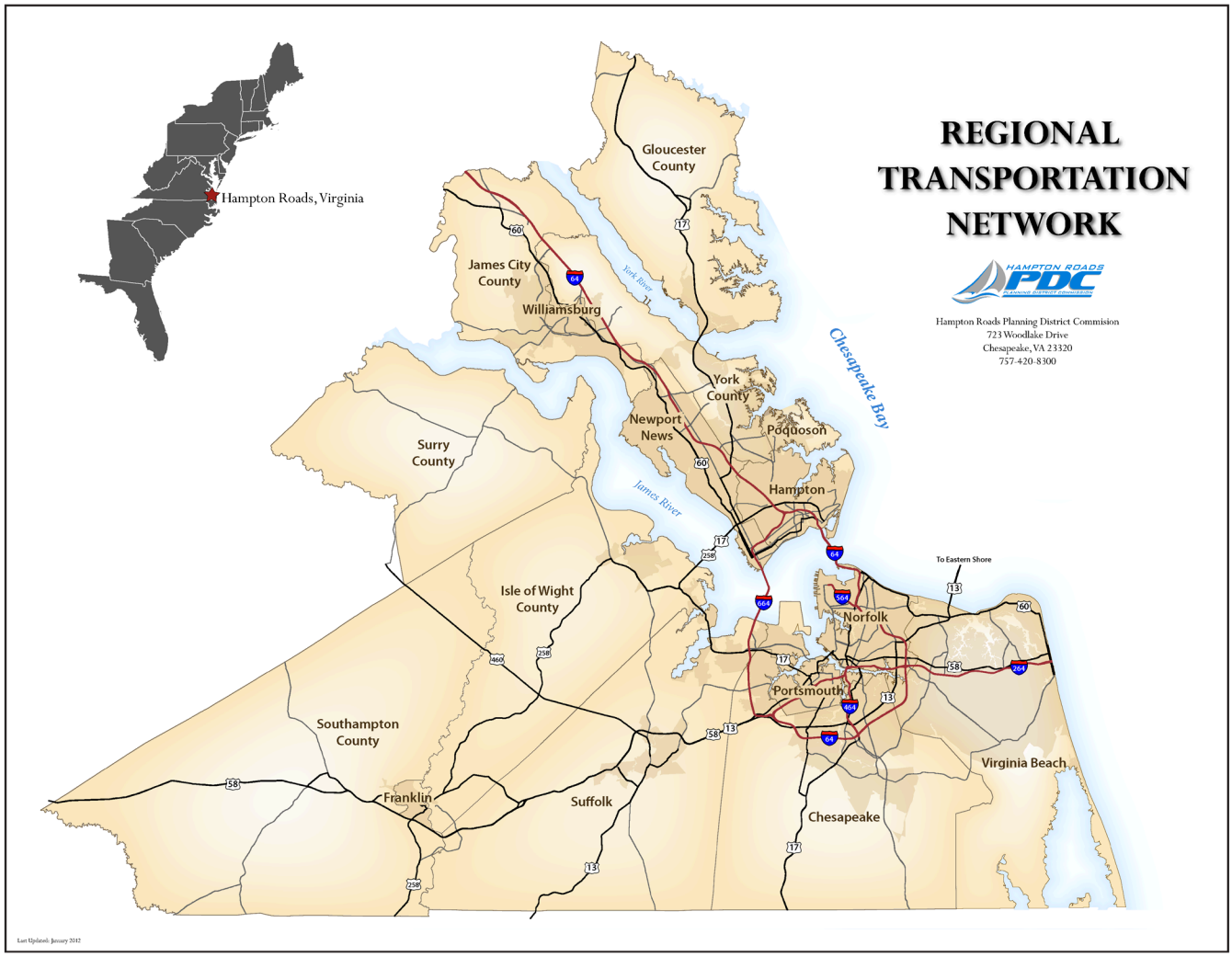
tourist destination throughout the year. US Route 58 and Interstate 64 link Hampton Roads with I-95 and I-85, which are the primary north-south interstate highways in Virginia. The Chesapeake Bay Bridge-Tunnel, which opened in 1964, connects Virginia's Eastern Shore with Virginia Beach and remains one of the world's modern engineering wonders. **Figure 3.4** illustrates the transportation network in the region. Freight rail service is provided by CSX Transportation and Norfolk Southern, Commonwealth Railroad, the Chesapeake and Albemarle Railroad, and the Norfolk/ Portsmouth Beltline. The nearest passenger rail is available through Amtrak at the Newport News station on the Peninsula and a station in downtown Norfolk.

Convenient commercial air service is available through two major airports: Southside's Norfolk International Airport which boasted over 75,000 flight operations in 2019, and the Peninsula's Newport News/Williamsburg International Airport, which services over 430,000 customers each year. The military maintains a long list of airfields in the region with national significance, including Oceana Naval Air Station in Virginia Beach, Naval Station Norfolk, the airfield at Joint Base Langley-Eustis in Hampton, and Fentress Naval Auxiliary Landing Field in Chesapeake. Several other small airports across the region service private aviation.

Water-related infrastructure is prevalent throughout the region's waterways for commercial, industrial, and recreational uses. On the Peninsula, Newport News Shipbuilding, a Division of Huntington Ingalls Industries, is located near the mouth of the James River in Newport News. Massive coal loading piers and facilities were established in the late 19th and early 20th century by the Chesapeake & Ohio (C&O), Norfolk & Western, and Virginian Railways at the end of the Peninsula in Newport News. CSX Transportation now serves the former C&O facility at Newport News. On Southside, over 95 percent of the world's shipping lines call on the Port of Virginia, linking the Commonwealth and the U.S. to more than 250 ports in over 100 countries around the world. With its six terminals across over 1800 acres, 19,885 linear feet of berth and 30 miles of on-dock rail, the Port of Virginia is determined to become the East Coast's leading gateway for global trade. Between 2015 and 2025, the port will have invested $1.5 billion in infrastructure, creating a network to handle any type of cargo, with the deepest channels on the East Coast. Two Class I railroads, CSX and Norfolk Southern, serve the Port via on-dock intermodal container transfer facilities at Virginia International Gateway and Norfolk International Terminals. The service offered by the Class I's is augmented by vital short line rail partners including the Norfolk & Portsmouth Belt Line and the Commonwealth Railway.

Also intersecting the southern part of the study area is a portion of the Atlantic Intracoastal Waterway, a series of federally-maintained inland navigation channels that extend from Norfolk, Virginia to Miami, Florida. The Intracoastal Waterway was authorized by the Rivers and Harbors Act of 1938 and was developed and is still maintained by the U.S. Army Corps of Engineers.

FIGURE 3.4: REGIONAL TRANSPORTATION NETWORK



2012

Source: Hampton Roads Planning District Commission

According to the HRPDC, *Hampton Roads Benchmarking Study,* 2015, the transportation network in Hampton Roads has garnered considerable attention as aging infrastructure and traffic congestion are closely tied to the economy and quality of life within the region. The recent downturn in the economy has affected many aspects of the region's transportation system, with growth in roadway travel coming to a halt and a decrease in air travel from Hampton Roads airports. In spite of relatively lower amounts of travel per capita in Hampton Roads than in competitor regions, congestion is a significant issue, particularly at the bridges and tunnels. Only Washington, DC, Baltimore, and Atlanta had a higher indexed measurement of the extra amount of time trips take during congested peak travel periods in 2011.

As a result of the congestion occurring at the Hampton Roads Bridge Tunnel, an expansion project is underway to increase capacity, ease major congestion and enhance travel time reliability. The Hampton Roads Bridge-Tunnel Expansion is the largest highway construction project in Virginia's history. This transformative undertaking, scheduled for completion in November 2025, will widen the current four-lane segments along nearly ten miles of the I-64 corridor in Norfolk and Hampton, with new twin tunnels

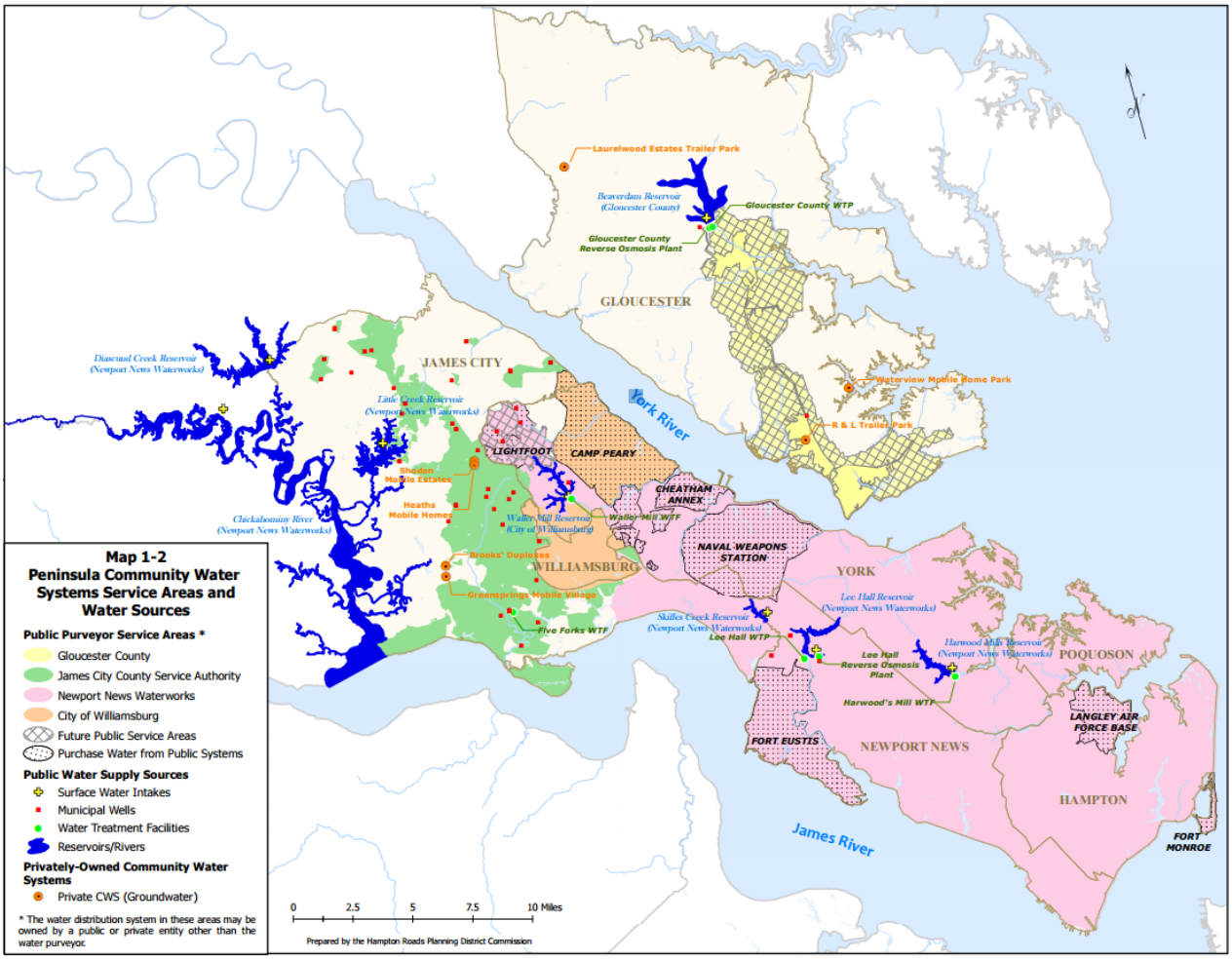
across the harbor. Including the construction contract and owner's costs, the project's total budget is over $3.8 billion, making it one of the largest infrastructure projects in the country.

Public transportation continues to play a small role in the region when compared to some other areas of similar size due in part to low population density and the geography of interspersed water bodies. Norfolk has completed building the region's first light rail line, running 7.4 miles from Eastern Virginia Medical Center to Newtown Road. Light rail has the capability to impact future land use decisions and encourage increased density in development.

The communities of Hampton Roads maintain a significant number of critical facilities and infrastructure that include hospitals, schools, police stations, fire stations, energy facilities, water and wastewater facilities and hazardous material facilities (further discussed in Section 5: *Vulnerability Assessment*). The large military presence provides its own significant facilities and infrastructure base, though these are located on federal land and outside the planning area. Electrical service is supplied throughout the region by Dominion Virginia Power and Franklin Municipal Power & Light (City of Franklin and surrounding areas), and natural gas is provided by Columbia Gas and Virginia Natural Gas. Verizon, Verizon Wireless, FIOS and Cox Communications are primary service provider for cable television, phone and internet service. Surry Power Station is a nuclear power plan located in Surry County, on the south bank of the James River, across from historic Jamestown. The facility provides 14-percent of Virginia's electricity.

In order to examine the existing sources of water in Hampton Roads, the region is divided into three sub-regions. The first sub-region is the Peninsula sub-region, and it is composed of the cities of Hampton, Newport News, Poquoson, and Williamsburg and the counties of Gloucester, James City, and York. There are 26 community water systems that provide water to this sub-region as seen in **Figure 3.5**. According to the Hampton Roads District Planning Commission, these community water systems serviced about 512,000 people in 2011. The water used in the Peninsula sub-region comes from groundwater, reservoirs and the Chickahominy River and serves both urban and rural areas. The majority of the water used comes from surface water in five reservoirs located throughout the sub-region.

FIGURE 3.5: PENINSULA SUB-REGION WATER SOURCES

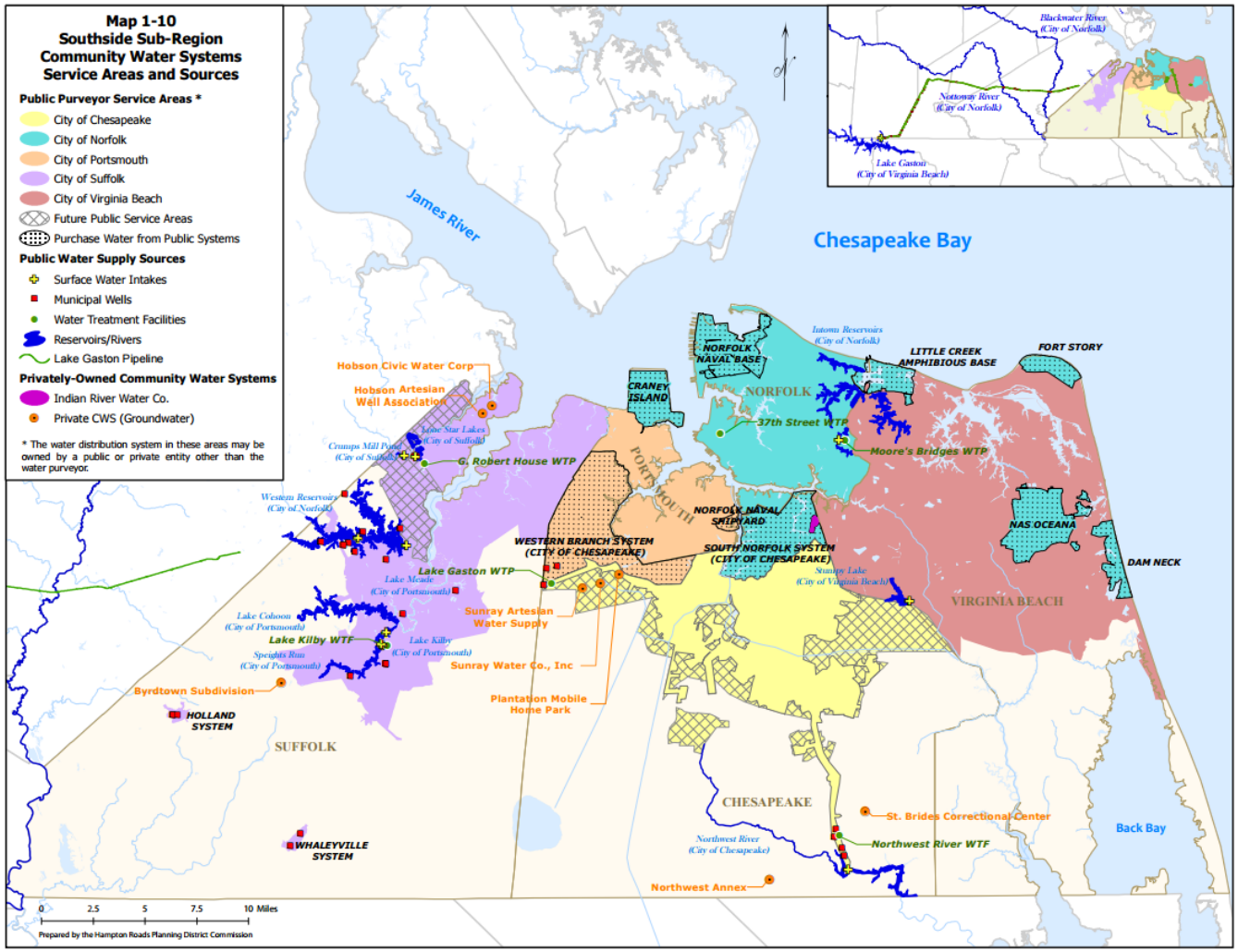


2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The Southside sub-region includes the cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach. Approximately 975,000 people were served by 15 publicly-owned community water systems in 2011. Water sources for the Southside sub-region include aquifers, reservoirs, Lake Gaston, and the Northwest, Blackwater, and Nottoway Rivers and can be seen in **Figure 3.6**. Both urban and rural areas are serviced by the community water systems in the Southside sub-region.

FIGURE 3.6: SOUTHSIDE SUB-REGION WATER SOURCES

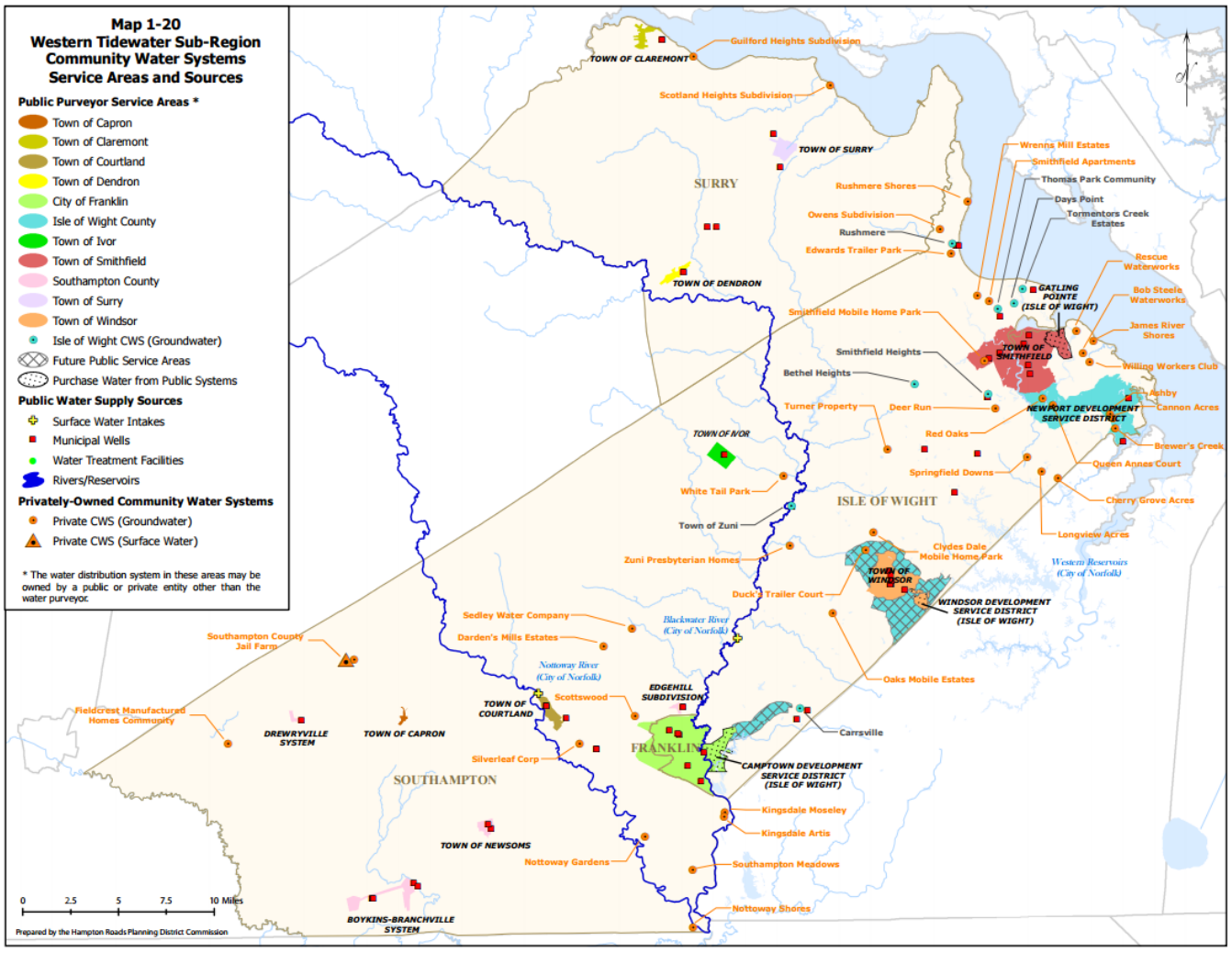


2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The third sub-region in Hampton Roads is the Western Tidewater sub-region. It includes the city of Franklin and the Counties of Isle of Wight, Southampton, and Surry. Since it is a mostly rural sub-region, all but one of the 24 community water systems use groundwater to service 28,000 people. The water sources for the Western Tidewater sub-region can be seen in **Figure 3.7**.

FIGURE 3.7: WESTERN TIDEWATER SUB-REGION WATER SOURCES



2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

EMPLOYMENT AND INDUSTRY

Nearly two million people live in or within an hour's drive of the Hampton Roads region, and because of the presence of several military bases, a large proportion of the total population is employed in military- and service-related industries. The military bases not only contribute billions of dollars annually to the regional economy, but also supply a skilled labor force. Over 15,000 trained and disciplined personnel leave the military installations each year, and many of these skilled professionals decide to stay in the area and look for local private sector employment. In addition, there are approximately 40,000 military spouses available to work. The region's tourism industry creates over 10,000 seasonal jobs during summer months. This group provides an additional source of workers to companies with personnel needs that peak at other times of the year. Lastly, over 86,000 students attend eight universities and four community colleges in the area. Most of these students are permanent residents available for part-time or full-time employment while in school and upon graduation.

Table 3.6 shows basic employment data for the study area.

TABLE 3.6: REGIONAL EMPLOYMENT

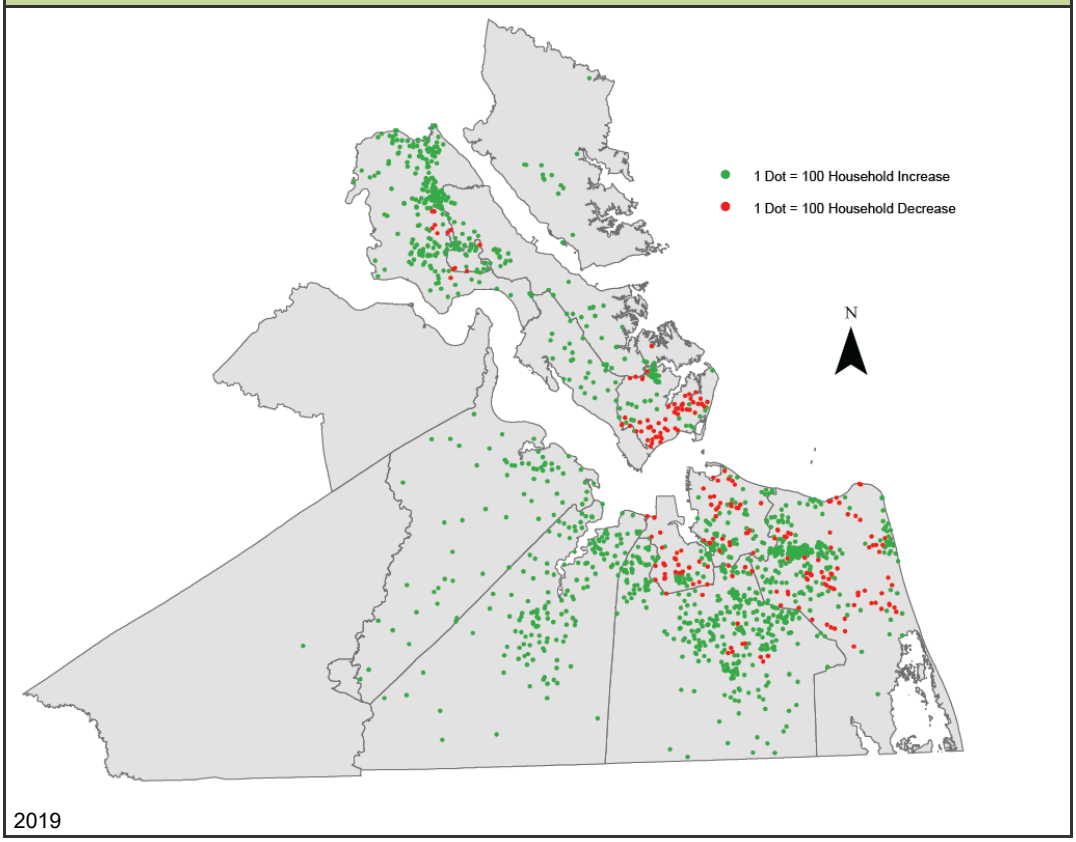
SUB-REGION	COMMUNITY	LABOR FORCE (2020 annual average)	UNEMPLOYMENT RATE (2020 annual average)
Peninsula	Hampton	64,604	8.5
	Newport News	89,715	8.7
	Poquoson	6,249	4.2
	Williamsburg	6,705	8.2
	James City County	36,558	6.1
	York County	32,390	5.6
Southside	Norfolk	111,825	8.7
	Portsmouth	44,701	9.6
	Suffolk	44,546	6.5
	Virginia Beach	230,322	6.2
	Chesapeake	122,036	6.1
Western Tidewater	Isle of Wight County	19,092	5.1
	Franklin	3,640	8.5
	Southampton County	9,063	5.0
	Surry County	3,603	5.7
	VIRGINIA	**4,244,200(September 2021)**	**3.8% (September 2021)**

Source: U.S. Bureau of Labor Statistics, April 16, 2021, except as noted

DEVELOPMENT TRENDS

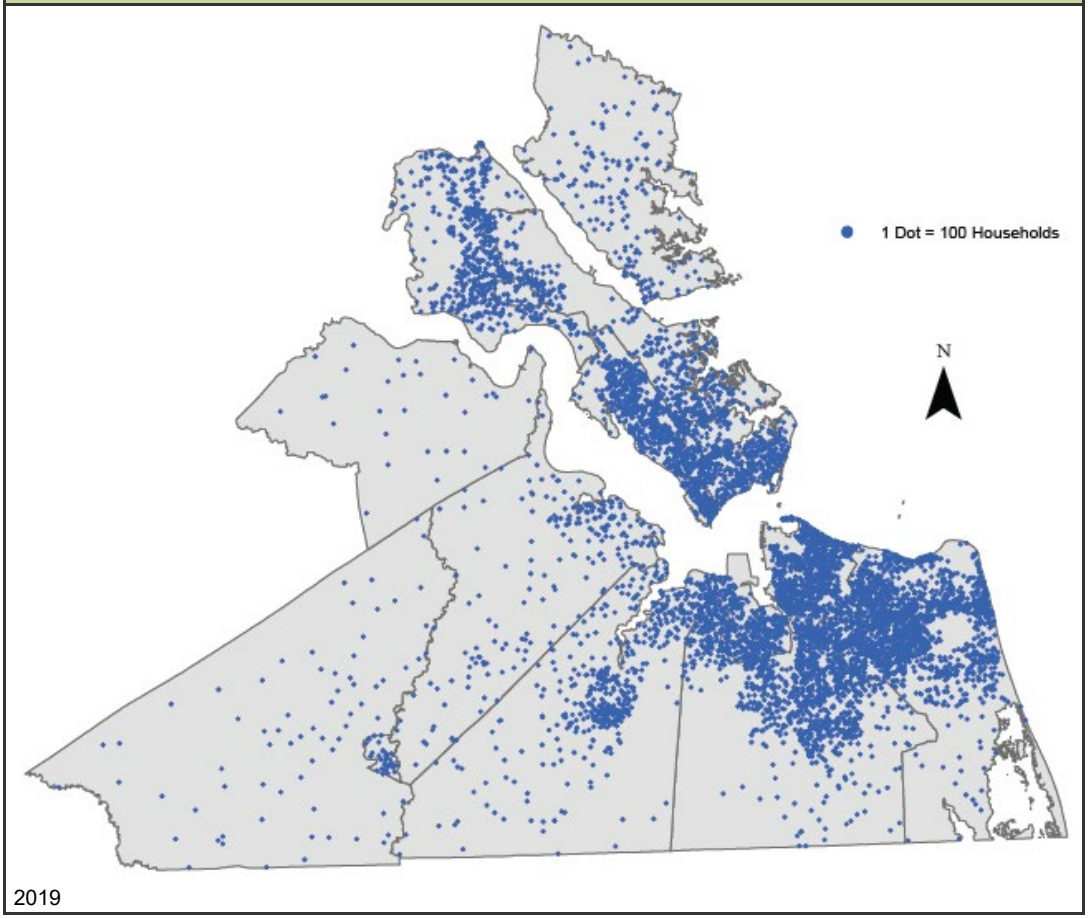
The Hampton Roads 2045 Socioeconomic Forecast prepared by the Hampton Roads Transportation Planning Organization in February 2019 provides the maps shown in **Figures 3.8 and 3.9** to help visualize where demand for employment will impact the number of households in the region. These growth patterns show expected change from 2015 through 2045 and provide a regional summary intended for the purpose of transportation planning; however, the data points shown are also relevant to hazard mitigation planning in that they provide a relative indicator of future housing needs in the region. Where and how those houses will be built influences the region's vulnerability to a range of hazards.

FIGURE 3.8: CHANGE IN HOUSEHOLDS, 2015 TO 2045



Source: Hampton Roads Transportation Planning Organization, Hampton Roads 2045 Socioeconomic Forecast and Transportation Analysis Zones (TAZ) Allocation, February 2019.

FIGURE 3.9: 2045 FORECASTED HOUSEHOLDS



Source: Hampton Roads Transportation Planning Organization, Hampton Roads 2045 Socioeconomic Forecast and TAZ Allocation, February 2019.

The Hampton Roads area expects to add 124,356 net new jobs by 2033. These net new jobs would increase employment by 16.4% with jobs being added to professional and business services, health services, construction and administrative, and waste service sectors. In order to attract workers to these jobs and remain a competitive region that people want to live in, it is imperative that there is adequate housing and transportation and a skilled workforce to do the jobs.

The number of houses needed will vary by jurisdiction. It is estimated that 86,098 net new housing units must be built by 2033. In order to be able to house all of the workers of Hampton Roads, 4,305 net new units must be built each year. Assuming people live near where their jobs are and do not commute, Virginia Beach and Chesapeake will see the most job growth in the region, resulting in more housing units being built. **Table 3.7** illustrates where the housing units need to be built based on how many net new jobs will be in the jurisdiction and whether workers will commute to work or live close to their jobs. The "Remainder of Region" includes Suffolk, Franklin, Gloucester, Isle of Wight, Southampton, Surry, and York County. Gloucester County figures could not be separated out of these published data.

TABLE 3.7: PROJECTED HOUSING DEMAND FOR NEW NET WORKERS 2013-2033

SUBREGION	COMMUNITY	NET NEW JOBS	BY WORK LOCATION	BY CURRENT COMMUTING PATTERNS		
				NON-COMMUTERS	COMMUTERS	TOTAL BY COMMUTING PATTERN
Peninsula	Hampton	2,698	1,800	838	2,693	2,556
	Newport News	5,930	3,911	1,897	3,418	5,316
	James City County and Williamsburg	23,707	17,222	6,860	645	7,506
Southside	Norfolk	13,061	8,947	3,719	3,418	5,316
	Portsmouth	1,675	1,196	414	2,142	2,556
	Virginia Beach	24,661	16,659	11,987	7,974	19,962
	Chesapeake	20,868	13,578	6,634	5,864	12,498
Remainder of Region*		31,756	22,785	12,312	7,976	20,285

** Includes Gloucester County.*
Source: Sturtevant, Lisa. Housing the Future Workforce in the Hampton Roads Region, May 2014. Prepared for Housing Virginia and shared on Hampton Roads Planning District Commission web site.

Due to changes in the demographic of the average net new worker, the type of housing that will need to be built will be different than it has been in the past. The new workers who will move to Hampton Roads will be young people working for lower wages. They will require more single family houses and rental units with moderately priced rent. According to a survey done by the American Community Survey, the percentage of multi-family housing units will increase by 5.2% to 39.7% in the coming years. The percentage of rental units will also increase to 46.5%, compared to 36.4% in previous years. **Table 3.8** illustrates how many housing units will need to be built in each community and the number of units that will be owned compared to those that will be rented. The "Remainder of Region" data include the City of Franklin, and the counties of Gloucester, Isle of Wight, Southampton, Surry, and York.

TABLE 3.8: ADDITIONAL HOUSING UNITS NEEDED BY 2033

SUBREGION	COMMUNITY	TOTAL UNITS NEEDED	SINGLE FAMILY		TOWNHOUSE/MULTI-FAMILY	
			OWNER	RENTER	OWNER	RENTER
Peninsula	Hampton	1,800	1,019	118	240	423
	Newport News	3,911	1,311	495	323	1,782
	James City County and Williamsburg	17,222	8,420	2,938	1,002	4,863
Southside	Norfolk	8,947	3,400	927	930	3,690
	Portsmouth	1,196	401	233	31	531
	Virginia Beach	16,659	6,124	1,920	1,618	6,997
	Chesapeake	13,578	7,684	1,961	916	3,017
	Suffolk	13,730	6,743	2,286	881	3,820
Remainder of Region*		9,055	4,445	1,513	549	2,545
Hampton Roads Region		86,098	39,547	12,391	6,491	27,668

* Includes Gloucester County.

Source: Sturtevant, Lisa. Housing the Future Workforce in the Hampton Roads Region, May 2014. Prepared for Housing Virginia and shared on Hampton Roads Planning District Commission web site.

Virginia law requires that all communities have a comprehensive land use plan and that it be updated every five years. Each county or city government in the study area has adopted a comprehensive plan that provides additional detail on the development trends for that community. Additionally, zoning maps and ordinances within each community further dictate allowable uses and show where future development is guided, or where higher density housing is allowable. Additional information and figures in the Section 5 *Vulnerability Assessment* show recent community development patterns in more detail.

HAZARD IDENTIFICATION AND ANALYSIS

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2022 UPDATE

The hazards significantly affecting the region, as determined by the planning group during the process outlined in Section 2, were updated with current hazard history information from several sources, including the National Centers for Environmental Information (NCEI), National Oceanic and Atmospheric Administration (NOAA) Hurricane Tracks, National Weather Service (NWS), and the *2018 Commonwealth of Virginia Hazard Mitigation Plan*. Flooding Due to Impountment Failure/High Hazard Dam, Pandemic Flu or Communicable Disease, and Radon Exposure were added and described.

INTRODUCTION

This section of the Plan describes the hazards that threaten the Hampton Roads region and provides general background information, local data (e.g., the location and spatial extent), and historical occurrences for each hazard. This section also presents best available data regarding notable historical damages within the region. The hazards discussed in this section are as follows:

- FLOODING
- FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM
- SEA LEVEL RISE AND LAND SUBSIDENCE
- TROPICAL/COASTAL STORM

- LANDSLIDE/COASTAL EROSION
- TORNADO
- WINTER STORM
- EARTHQUAKE
- WILDFIRE
- DROUGHT
- EXTREME HEAT
- HAZARDOUS MATERIALS INCIDENT
- PANDEMIC FLU OR COMMUNICABLE DISEASE
- RADON EXPOSURE

44 CFR Requirement

Part 201.6(c)(2)(i): The risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Some of these hazards are interrelated (e.g., tropical/coastal storm events can cause flooding and tornado activity, and flooding can be associated with winter storms and erosion); thus, hazard discussions overlap where necessary throughout the risk assessment.

To a large extent, historical records are used to identify the level of risk within the planning area—with the assumption that the data sources cited are reliable and accurate. Maps are provided to illustrate the location and spatial extent for those hazards within the region that have a recognizable geographic boundary (i.e., hazards that are known to occur in particular areas of the region such as the 100-year floodplain). For those hazards with potential risk not confined to a particular geographic area (such as winter storms and tornadoes), historical event locations and/or general information on the applicable intensity of these events across the entire planning area is provided.

For most hazards analyzed in this section, some level of property damage was associated with any or all of the hazard events cataloged. However, for some historic events reports of property damage were not available. Therefore, totals of past property damages derived from historical records are best estimates and should not be used as a stand-alone indicator of hazard risk.

The terms “likely”, “highly likely” and “unlikely” are used to describe the probability of future occurrence for each hazard. Hazards termed “likely” to occur again in the future are expected to occur but may not have occurred with such high frequency in the past that future events are a certainty. Hazards termed “highly likely” have a history of occurrence or have characteristics that make a future event almost guaranteed. “Unlikely to occur” indicates that committee members, based on review of past events, have the impression that any future occurrence will be a rare and unique event.

The *Vulnerability Assessment*, Section 5 of this plan, expands upon the foundation provided here and assesses the vulnerability of the region to these natural hazards.

SUMMARY OF PRESIDENTIAL DISASTER DECLARATIONS

A presidential disaster declaration is issued when a disaster event is determined to be beyond the response capabilities of state and local governments. Since 1953, the first year presidential disaster declarations

were issued in the United States, the region has been named in sixteen such declarations (**Table 4.1**). Under a presidential disaster declaration, the state and affected local governments are eligible to apply for federal funding to pay 75% of the approved costs for debris removal, emergency services related to the storm, and the repair or replacement of damaged public facilities. The types of natural hazards that led to these disaster declarations in Hampton Roads include ice storms, winter storms, hurricanes and tropical storms, the Hurricane Katrina evacuation in 2005 and pandemic. The most recent declarations were for Hurricanes Matthew (2016) and Florence (2018), Tropical Storm Michael (2018), and the Covid-19 Pandemic in 2020.

TABLE 4.1: PRESIDENTIAL DISASTER DECLARATIONS ISSUED FOR HAMPTON ROADS

YEAR	DATE OF DECLARATION	DISASTER NUMBER	DISASTER TYPE	DESIGNATED AREAS
1972	September 8	339	Tropical Storm Agnes	Chesapeake, Hampton, Isle of Wight Co, James City Co, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, Williamsburg, York Co
1996	February 16	1086	Blizzard of 1996	All study area communities
1996	October 23	1135	Hurricane Fran	Hampton, Isle of Wight Co, James City Co, Newport News, Poquoson, Suffolk, Williamsburg, York Co
1998	October 9	1242	Hurricane Bonnie	Chesapeake, Norfolk, Portsmouth, Suffolk, Virginia Beach
1999	September 6	1290	Tropical Storm Dennis and Tornadoes	Hampton
1999	September 24	1293	Hurricane Floyd	All study area communities
2000	February 28	1318	Severe Winter Storms	Franklin, Isle of Wight Co, James City Co, Newport News, Southampton Co, Suffolk, Williamsburg, York Co
2003	September 18	1491	Hurricane Isabel	All study area communities
2005	September 12	3240	Hurricane Katrina Evacuation	All study area communities
2006	September 22	1661	Tropical Depression Ernesto	Isle of Wight Co, James City Co, Newport News, Poquoson, York Co
2009	December 9	1862	Tropical Depression Ida and a Nor'easter	Chesapeake, Hampton, Isle of Wight Co, Newport News, Norfolk, Poquoson, Portsmouth, Virginia Beach
2011	August 26	4024	Hurricane Irene	All study area communities
2016	November 2	4291	Hurricane Matthew	Chesapeake, Franklin, Isle of Wight County, Norfolk, Portsmouth, Southampton County, Suffolk, Virginia Beach
2018	December 18	4411	Tropical Storm Michael	James City County
2018	October 15	4401	Hurricane Florence	Newport News, Hampton, Williamsburg, Isle of Wight County
2020	April 2	4512	Covid-19 Pandemic	All study area communities

Source: FEMA, 2021

NATIONAL CENTER FOR ENVIRONMENTAL INFORMATION STORM EVENT DATABASE

Much of the data in the remaining tables of this section were taken from the NOAA NCEI database. NCEI receives storm data from the NWS which, in turn, receives their information from a variety of sources, including: city, county, state, and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clippings, the insurance industry, and the general public. Information on hazard events not recorded in this database is provided in narrative format for each hazard subsection to supplement the NCEI data and to provide a more accurate depiction of historic hazard events in the region. While far from perfect, the NCEI data represents the best weather history data available that covers the entire region, and provides damages.

FLOODING

BACKGROUND

Nationwide, the primary types of flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs when manmade development obstructs the natural flow of water or when impervious surfaces significantly decrease the ability of natural groundcover to absorb and retain surface water runoff.



Photo courtesy of the City of Chesapeake.

Hampton Roads is subject to a variety of flood sources. The three major sources are: coastal flooding and storm surge associated with large amounts of tidally-influenced water being pushed inland from Hampton Roads and nontidal, riverine flooding as a result of excess precipitation in the watershed. Precipitation flooding occurs when rain intensity exceeds capacity of storm drain systems due to blockages or naturally low-lying areas. Tidal floods are influenced by tidal variations and are directly related to land elevation and proximity to the coastline. This type of flooding occurs in the study area with increasing regularity and is exacerbated by wind speed and direction, sea level rise and occurrence in conjunction with other types of flooding.

Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their strong winds and heavy surf. Nor'easters are named for the winds that blow in from the northeast and drive storms up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful.

Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding. There are two main components to a nor'easter: (1) a Gulf Stream low-pressure system (counter-clockwise winds) generated off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic, and pulled up the East Coast by strong northeasterly winds at the leading edge of the storm; and (2) an Arctic high-pressure system (clockwise winds) which meets the low-pressure system with cold, arctic air blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation and have the potential for creating dangerously high winds and heavy seas. As the low-pressure system deepens, the intensity of the winds and waves increase and can cause serious damage to coastal areas as the storm moves northeast.

The presence of the Gulf Stream off the eastern seaboard in the winter season acts to dramatically enhance the surface horizontal temperature gradients within the coastal zone. This is particularly true off the Virginia coastline where, on average, the Gulf Stream is closest to land north of 32 degrees latitude. During winter offshore cold periods, these horizontal temperature gradients can result in rapid and intense destabilization of the atmosphere directly above and shoreward of the Gulf Stream. This air mass modification or conditioning period often precedes wintertime coastal extra-tropical cyclone development. The temperature structure of the continental air mass and the position of the temperature gradient along the Gulf Stream drive this cyclone development. As a low pressure deepens, winds and waves can increase and cause serious damage to coastal areas as the storm generally moves to the northeast.

The coastal communities of Virginia are most vulnerable to the impacts of nor'easters. Since the storms typically make landfall with less warning than hurricanes (due to their rapid formation along the coast), residents and business owners may be caught unprepared for the impacts. Fortunately, nor'easters typically occur during the tourist off-season when fewer non-residents are visiting the coast. As with hurricanes, structural vulnerability to nor'easters is proportional to the strength of the structure, with mobile homes being particularly vulnerable.

Additional causes of flooding, especially in the western Tidewater portion of the study area, may include features, such as roadways and pipelines, that act as choke points in the river, blocking debris and restricting the flow of water during heavy flooding events; development of the watershed resulting in the loss of riparian zone and vegetation coverage; land management, including forestry and farming practices; and deficiencies in manmade drainage systems.

The periodic inundation of floodplains adjacent to rivers, streams, and shorelines is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. FEMA has studied and mapped both the 100-year floodplain (with a 1% chance of being equaled or exceeded in any given year), and the 500-year floodplain (with a 0.2% chance of being equaled or exceeded in any given year) for the study area.

LOCATION AND SPATIAL EXTENT

Flooding can occur along all waterways in the region. Localized riverine flooding can occur in areas of Hampton Roads not adjacent to a major body of water. Large sections of the region are low and subject to tidal flooding during hurricanes and severe nor'easters. Flood duration is typically shorter for hurricanes and tropical storms than for nor'easters because the storms tend to move faster and affect only 1 to 2 tidal cycles. The main impacts from flooding include:

- Inundation of low-lying residential neighborhoods and subsequent damage to structures, contents, garages, and landscaping; over time, mold and mildew from flooding can damage building components and mold spores can cause adverse health effects, including allergic reactions;
- Impassable road crossings and consequential risk for people and cars attempting to traverse flooded crossings;
- Damage to public and private infrastructure, possibly including but not limited to water and sewer lines, bridge embankments, and both small and large drainageways;
- Wave action responsible for shoreline damage, and damage to boats and facilities, including ships, ports and shipyards;
- Inundation of critical facilities, possibly including some fire stations, police facilities, public shelters, emergency operations centers (EOC), and several publicly-owned buildings. Public shelter availability is limited by the expected severity of flooding. (See **Table 5.2** for number of critical facilities in flood hazard areas.)
- Recovery time needed to bring critical infrastructure, schools and employers back online. Of particular concern in the region are transportation routes, including school buses, housing for displaced residents and debris management.

Communities in the study area have outlined detailed plans for activating their EOC, protecting critical facilities and taking specific drainage system actions when faced with an impending flood. Since power outages and threats to the water supply can result from both the wind and flood hazard (which often occur simultaneously in the region), residents are advised of appropriate precautions and specific low-lying areas are evacuated to protect the safety of residents, tourists and responders, and to minimize loss of life.

When severe floods occur, the regional economy is severely impacted by the inability of flooded homeowners to get back to work quickly, the slow rebound of closed or debris-strewn transportation routes, the closing of schools and businesses, and the general state of emergency. Power outages and boil-water advisories are common and can affect many thousands of residents and businesses in the region for several days or even weeks if the damage is severe. Severely flooded homes and even whole

neighborhoods result in displaced residents, including schoolchildren. Loss of life due to people traversing flooded roads, remaining in or becoming trapped in flooded structures, and curiosity-seekers watching storm surge is possible. Flooded businesses that decide to close, move or cease operations in the region have an impact on land values and the labor force, as does flood damage to the facilities of large port-related employers in the region such as shipyards and marinas. Time spent repairing flood damage versus productive value-added labor is costly to employers.

Over time, the pressure on communities and elected officials to fix flooding problems has increased in the region. Longer-term impacts to the real estate market from flooding and flood insurance costs are impacting property sales, especially for older homes in the densely-populated floodplains of Hampton, Newport News, Poquoson, Norfolk, Portsmouth and Virginia Beach. The large number of structures vulnerable to flood damage (see Section 5 for more details) and the cost of measures needed to mitigate such a large-scale problem is daunting for emergency managers, floodplain managers, planners and building professionals throughout the region.

Areas identified as vulnerable to flooding are depicted on FEMA's Flood Insurance Rate Maps (FIRMs), which were developed through the National Flood Insurance Program (NFIP), show the existing potential flood hazard areas throughout the region based on the estimated 100-year floodplain (**Figure 4.1**). The 100-year floodplain represents the area susceptible to the 1% annual flood. The 100-year flood, or base flood, has at least a 26% chance of occurring over the life of a typical 30-year mortgage. FIRM data is available through several sources for more detailed viewing at the parcel level:

- Paper FIRMs are available for viewing in each jurisdiction in the study area that participates in the NFIP;
- The FEMA Map Service Center at https://msc.fema.gov/portal/ is the official public source for flood hazard information produced in support of the NFIP;
- The Virginia Flood Risk Information System (VFRIS) is a collaboration between the Virginia Department of Conservation and Recreation (DCR) and the Virginia Institute of Marine Science (VIMS). The tool has flood depths, changes since the last FIRM, limit of moderate wave action (LiMWA), parcel boundaries, and the ability to download flood insurance studies and flood risk reports - http://cmap2.vims.edu/VaFloodRisk/vfris2.html
- Most localities in the study area have property information viewer tools with flood data layers, and several have included additional sea level rise inundation viewers. The following may be helpful:

  Hampton - https://webgis2.hampton.gov/sites/ParcelViewer/Account/LogOn
  Newport News - http://gis2.nngov.com/gis/
  Poquoson - https://parcelviewer.geodecisions.com/Poquoson/Account/Logon
  Williamsburg - https://williamsburg.maps.arcgis.com/apps/webappviewer/index.html?id=a5996d069d934d58bbcf1918129858f8 (does not have flood layer)
  James City County - http://property.jamescitycountyva.gov/JamesCity/Account/Logon
  York County - http://maps.yorkcounty.gov/York/Account/Logon
  Norfolk STORM Map – real-time event mapping - https://orf.maps.arcgis.com/apps/webappviewer/index.html?id=eb7164021ada45fea397d66fa84f4441
  Interactive Norfolk – various GIS layers, including flood zones - https://orf.maps.arcgis.com/apps/webappviewer/index.html?id=eb7164021ada45fea397d66fa84f4441
  TITAN (Tidal inundation Tracking Application for Norfolk) – https://orf.maps.arcgis.com/apps/dashboards/1fd204f3515e40428e77eea7c659a0e1
  Portsmouth - https://www.portsmouthva.gov/328/Flood-Maps
  Suffolk - http://apps.suffolkva.us/realest/
  Virginia Beach - https://gisapps.vbgov.com/map/

Chesapeake - https://www.cityofchesapeake.net/government/city-departments/departments/Real-Estate-Assessor/app.htm
Isle of Wight County, Smithfield, Windsor - http://iowgis.maps.arcgis.com/apps/webappviewer/index.html?id=4889333b70534c018c2c723b4d953f51
Southampton County, Franklin, towns - http://www.southampton.interactivegis.com/index.php#
Surry County - https://parcelviewer.geodecisions.com/surry/Account/Logon

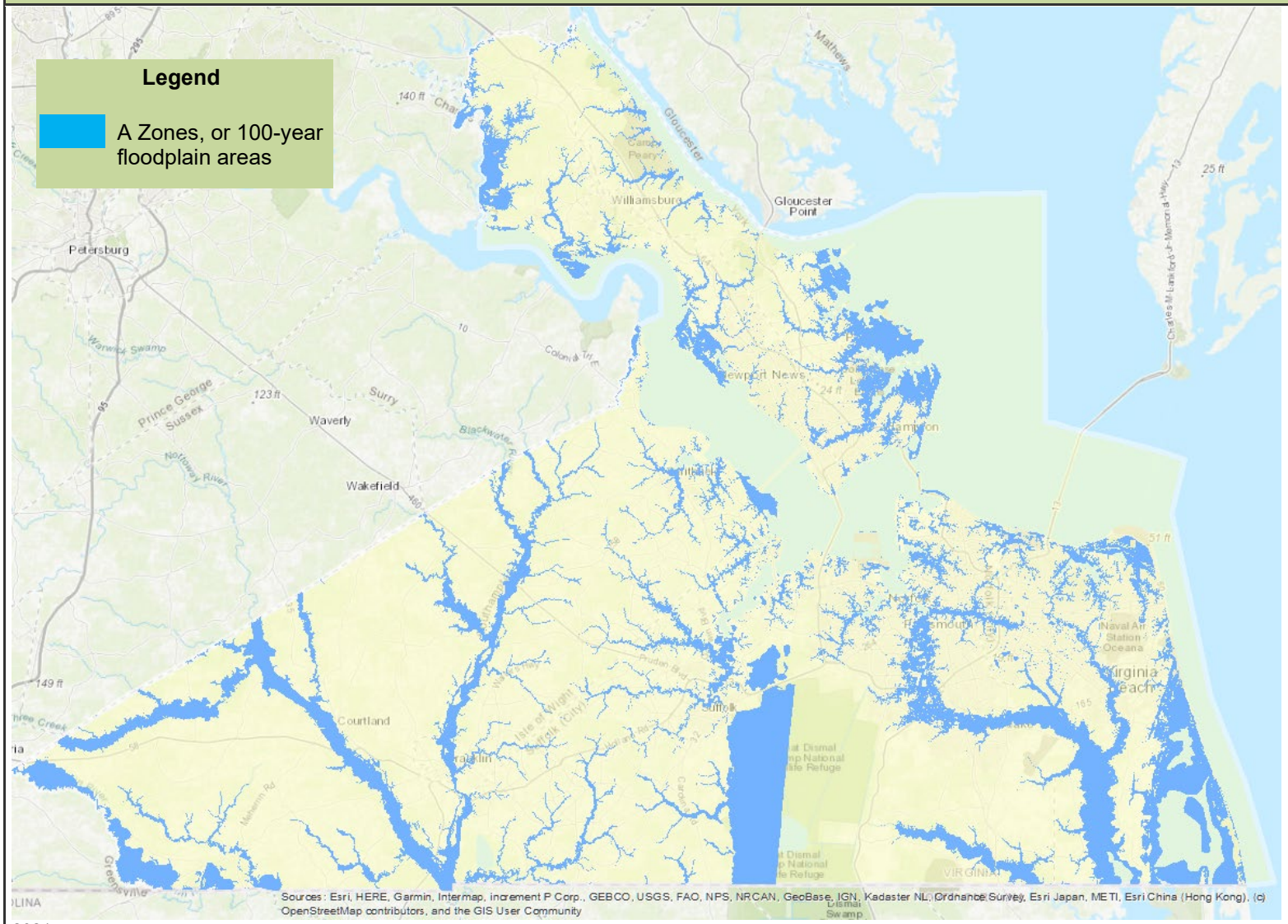
Figure 4.2 shows the 500-year flood hazard area with a 0.2-percent annual chance of flooding) and floodways, which are the channels of rivers or other watercourses and the adjacent land areas that must be reserved in order to discharge the base flood. Floodways are typically reserved for the fastest and strongest flows during the base flood.

Figure 4.3 shows the LiMWA, which delineates the Coastal A Zone, and the Coastal V Zone, or coastal high hazard area, an area of special flood hazard which is subject to high velocity waters from tidal surge or hurricane wave wash.

Figure 4.4a shows the most recent storm surge hazard areas that can be expected as the result of Category 1, 2, 3, and 4 hurricanes, based on the Sea, Lake and Overland Surge from Hurricanes (SLOSH) model. SLOSH is a computerized model run by the NWS to estimate storm surge heights resulting from hypothetical hurricanes by taking into account the maximum of various category hurricanes as determined by pressure, size, forward speed, and sustained winds. The regional analysis represents the composite maximum water inundation levels for a series of parallel tracks making landfall at various points along the coast. The SLOSH model, therefore, is best used for defining the “worst case scenario” of potential maximum surge for particular locations as opposed to the regional impact of one singular storm surge event.

Figure 4.4b shows the Virginia Hurricane Evacuation Routes for Hampton Roads. Termed the “Know Your Zone” initiative, this map and the effort to get the information engrained into residents’ minds prior to impending hurricane-related flooding or high winds, emphasizes the importance of warning and evacuating residents and visitors well before weather conditions deteriorate. When a storm is approaching, emergency managers will determine which zones are most at risk considering the intensity, path, speed, tides and other meteorological factors. Emergency managers at the state and local level will work with local media and use social media and other tools to notify residents of impacted zones and what they should do to stay safe. Depending on the emergency, being safe might mean staying at home, a short trip to higher ground, or traveling to a different region of the state. Given the geography of the region and the reliance of the transportation system on tunnels and bridges, early evacuation is a crucial element in public safety.

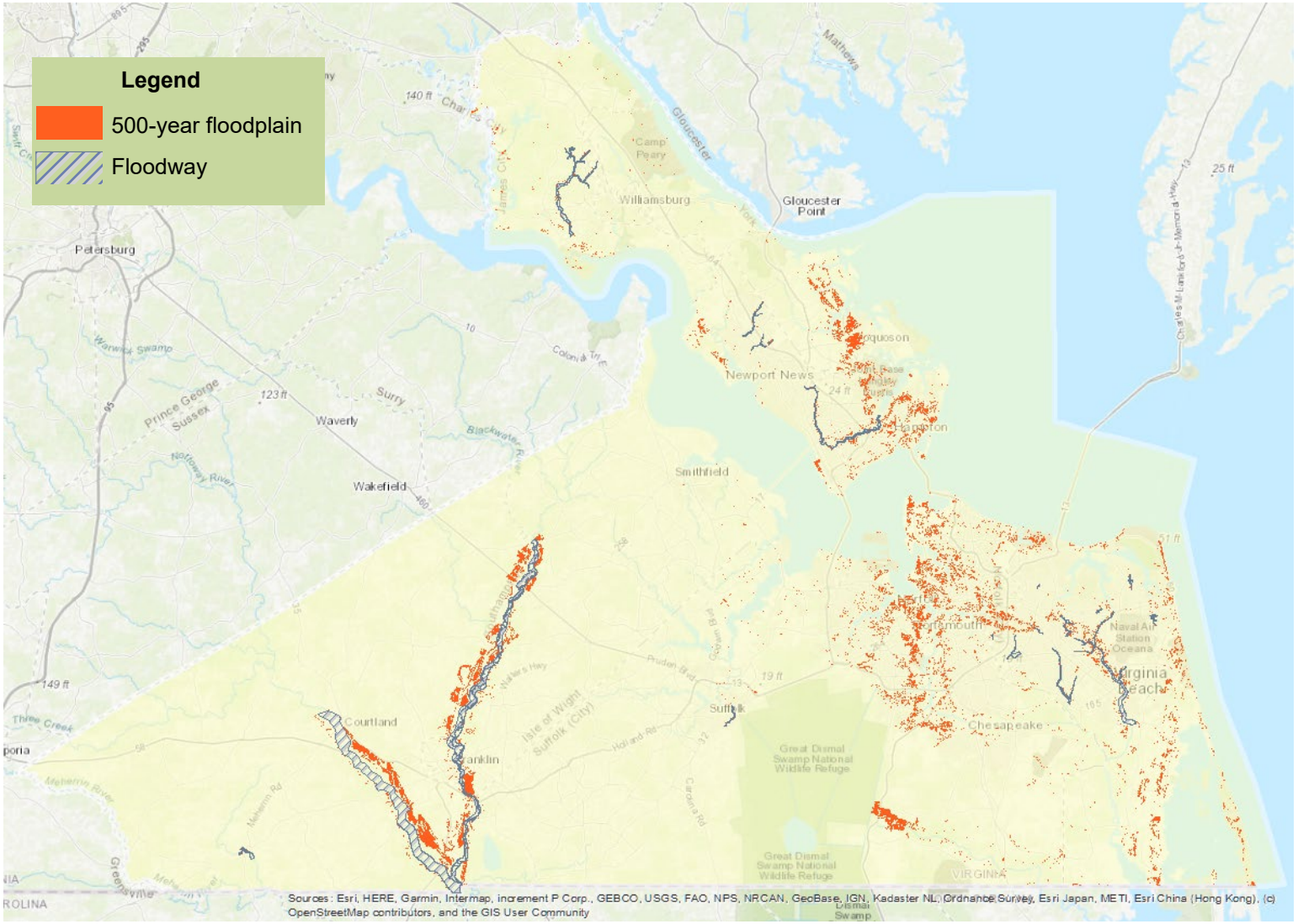
FIGURE 4.1: 100-YEAR FLOOD HAZARD AREAS



2021

Source: Federal Emergency Management Agency, 2021

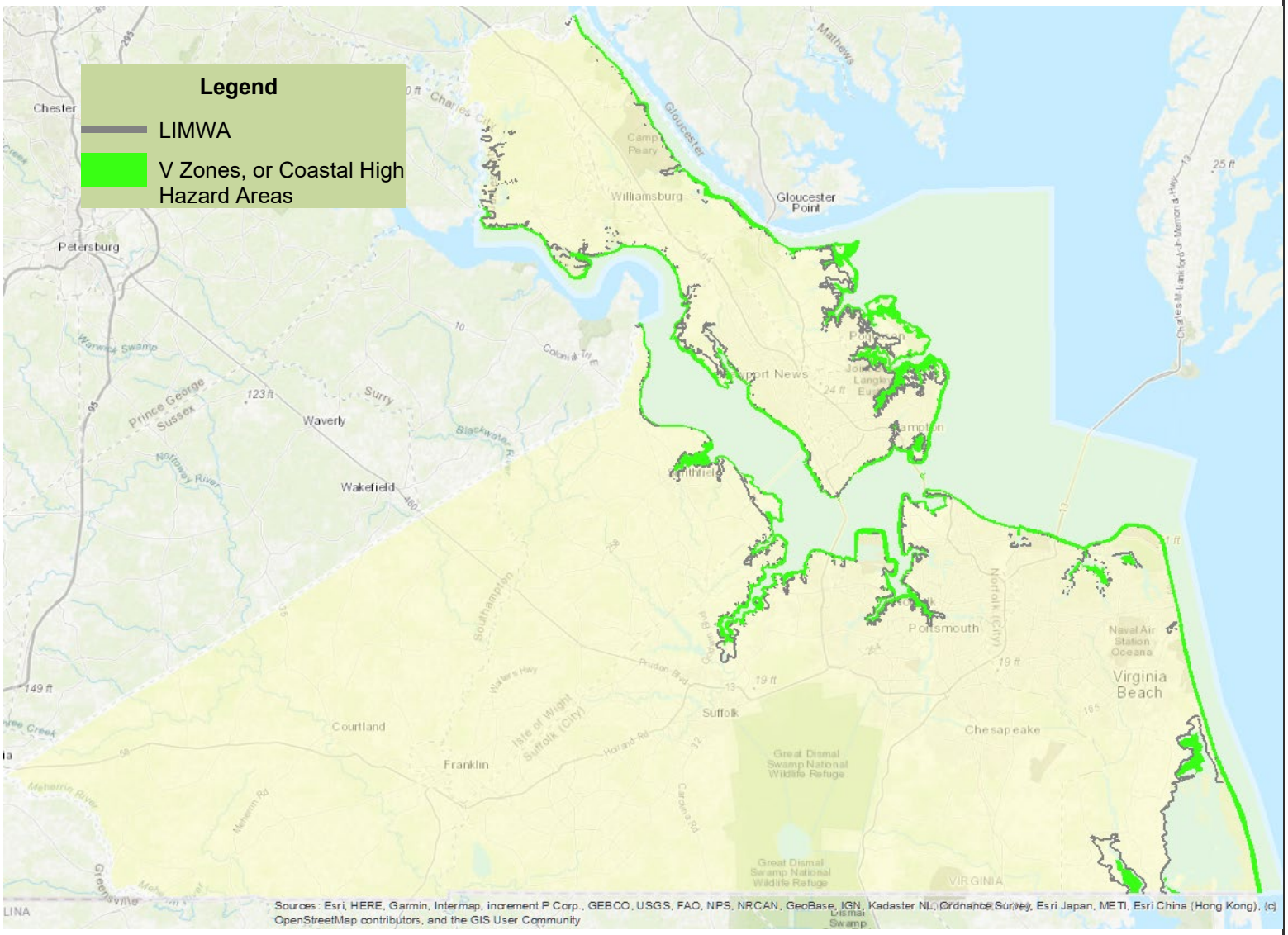
FIGURE 4.2: 500-YEAR FLOOD HAZARD AREAS AND FLOODWAYS



2021

Source: Federal Emergency Management Agency, 2021

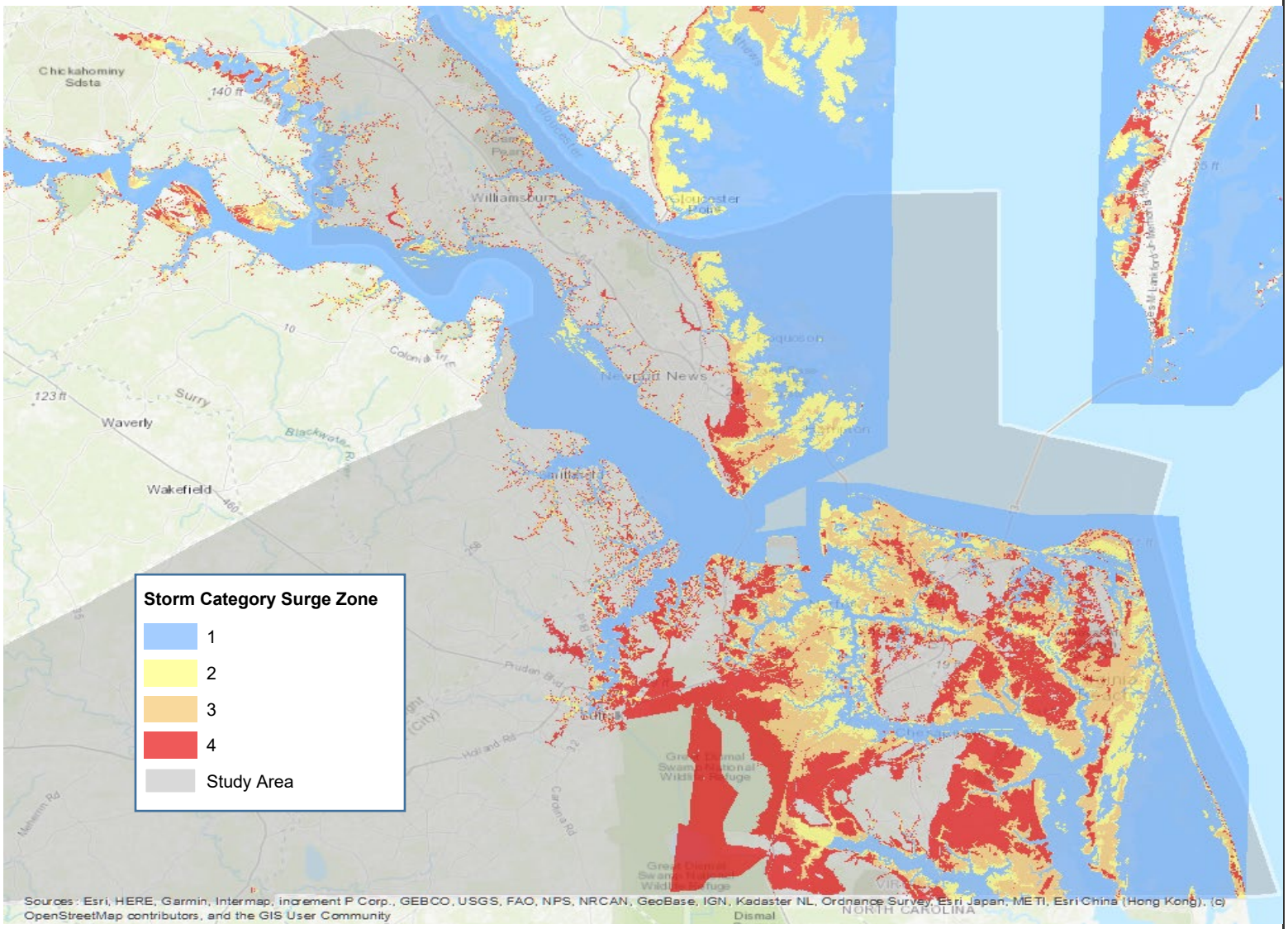
FIGURE 4.3: COASTAL HIGH HAZARD AREAS (V ZONES) AND LIMITS OF MODERATE WAVE ACTION (LIMWA)



2021

Source: Federal Emergency Management Agency, 2021

FIGURE 4.4A: HAMPTON ROADS STORM SURGE ZONES



2021

Source: U.S. Army Corps of Engineers, Norfolk District, 2021.

FIGURE 4.4B: VIRGINIA HURRICANE EVACUATION ROUTES

State Hurricane Evacuation Routes

Hurricane Evacuation Zones

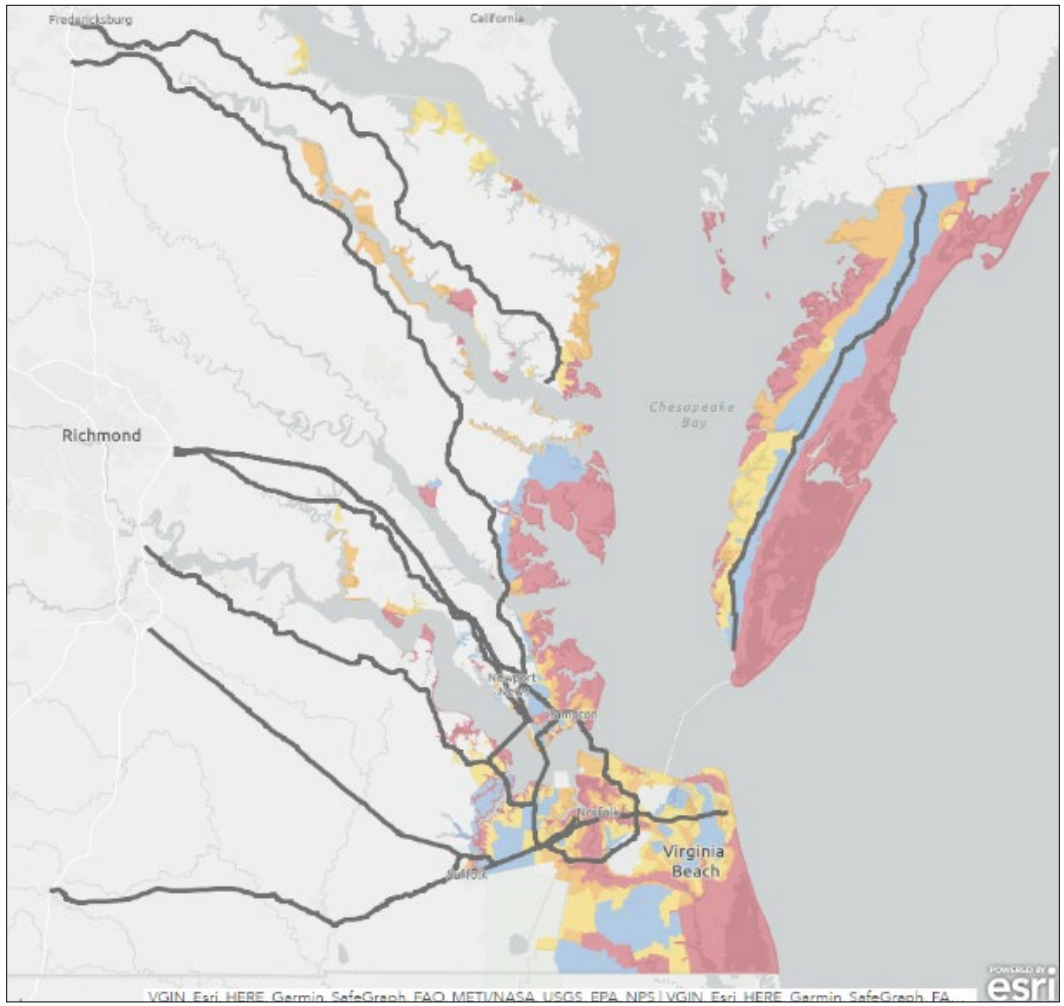
Hurricane Evacuation Zone

A

B

C

D



2022

Source: Virginia Department of Emergency Management, 2022.

In addition to floodplains, tidal and non-tidal wetlands within all of Hampton Roads' watersheds help store floodwaters, reduce erosion and filter pollutants. Wetlands are the transition area between aquatic and terrestrial habitats. A primarily low, marshy area, a wetland is saturated or even submerged all or part of the year, with soils that support unique plant and animal life. Wetlands work as a natural measure to help slow down the rising water from storms that may cause flooding, which is accomplished by acting as a giant sponge, absorbing and holding water during storms. Fast moving water is slowed by vegetation and temporarily stored in wetlands. Wetlands also filter pollutants carried by stormwater, which can be trapped by wetland vegetation. These excess nutrients are then used by the plants to promote growth.

Wetlands are resting, nesting, breeding, and spawning areas for many species of fish, shellfish, as well as other plant and animal life. More than one half of all threatened and endangered species depend on wetlands at one point of their life cycle. Hampton Roads, though located entirely within the Coastal Plain, spans a diverse range of habitats, including sandy ocean beaches, salt marshes of the Chesapeake Bay, wind tidal fresh marshes, dry sandhills, seasonally wet ponds and blackwater swamps. These habitats support many rare and significant plant communities and rare species, including:

Mabee's Salamander	*Ambystoma mabeei*	State threatened
Tiger Salamander	*Ambystoma tigrinum*	State endangered
Piping Plover	*Charadrius melodus*	State & Federal threatened
Wilson's Plover	*Charadrius wilsonia*	State endangered
Red-cockaded Woodpecker	*Dryobates borealis*	State & Federal endangered
Peregrine Falcon	*Falco peregrinus*	State threatened
Gull-billed Tern	*Gelochelidon nilotica*	State threatened
Black Rail	*Laterallus jamaicensis*	State endangered & Federal threatened
Yellow Lance	*Elliptio lanceolata*	State & Federal threatened
Atlantic Pigtoe	*Fusconaia masoni*	State & Federal threatened
Northeastern Beach Tiger Beetle	*Cicindela dorsalis dorsalis*	State & Federal threatened
Atlantic Sturgeon	*Acipenser oxyrinchus*	State & Federal endangered
Roanoke Logperch	*Percina rex*	State & Federal endangered
Eastern Big-eared Bat	*Corynorhinus rafinesquii macrotis*	State endangered
Little Brown Myotis	*Myotis lucifugus*	State endangered
Northern long-eared Myotis	*Myotis septentrionalis*	State & Federal threatened
Tricolored bat (=Eastern pipistrelle)	*Perimyotis subflavus*	State endangered
Loggerhead (Sea Turtle)	*Caretta caretta*	State & Federal threatened
Canebrake Rattlesnake	*Crotalus horridus [Coastal Plain population]*	State endangered
Chicken Turtle	*Deirochelys reticularia*	State endangered
Eastern Glass Lizard	*Ophisaurus ventralis*	State threatened
Sensitive Joint-vetch	*Aeschynomene virginica*	State & Federal threatened
Harper's fimbry	*Fimbristylis perpusilla*	State endangered
Small Whorled Pogonia	*Isotria medeoloides*	State endangered & Federal threatened
New Jersey Rush	*Juncus caesariensis*	State threatened
Narrow-leaved Spatterdock	*Nuphar sagittifolia*	State threatened
Reclining Bulrush	*Scirpus flaccidifolius*	State threatened

Source: Virginia Department of Conservation and Recreation, Natural Heritage Program, April 2022

Coastal wetlands absorb the erosive energy of waves, thus reducing further erosion. The vegetation provides a buffer to the shoreline from the wave action while the root systems provide support to help hold the soil together. Once plant material is removed or destroyed, the erosion potential increases dramatically. When any type of wetlands are filled in or drained, the areas designed by nature to control floodwaters from damaging storms, extreme high tides, and extreme precipitation are lost.

Existing natural area preserves in the region include: Antioch Pines; Blackwater Ecological Preserve; Blackwater Sandhills; Cypress Bridge; False Cape; Grafton Ponds; North Landing River; Northwest River; and, South Quay Sandhills. There are approximately 236,660 acres of conserved lands in the region, with the largest concentrations in Chesapeake, Suffolk, Virginia Beach, and York County. Conservation targets of special significance in the Hampton Roads region include:

- Pine barren communities;
- Seasonal depression ponds and other significant wetlands;
- Large blocks of old-growth cypress-tupelo swamps;
- Habitat for rare reptiles and amphibians;
- Lands along the Northwest and North Landing rivers; and
- Forestland along the Blackwater, Meherrin and Nottoway rivers.

SIGNIFICANT HISTORICAL EVENTS

Many flood events that have occurred in the region have been the result of coastal storms, tropical storms or hurricanes. Other localized flooding occurs when heavy rains fall during high tide causing waters that would normally drain quickly to back up because of the tides. Based on historical and anecdotal evidence, it is clear that there is a relatively high frequency of flooding in the region. Some of the notable flood events to impact Hampton Roads are discussed below.

The "**Dreadful Hurricane of 1667"** occurred on September 6th. This system is considered one of the most severe hurricanes to ever strike Virginia. On September 1st, this same storm was reported in the Lesser Antilles. The hurricane devastated St. Christopher as no other storm had done before. The "great storm" went on to strike the northern Outer Banks of North Carolina and southeastern Virginia. The wind turned from the northeast to due south and finally to the west, which suggested a track similar to the August 1933 hurricane. This 1667 hurricane lasted about 24 hours and was accompanied by very violent winds and tides. Approximately 10,000 houses were blown over. Area crops (including corn and tobacco) were beat into the ground. Many cattle drowned in area rivers and bays by the twelve foot storm surge and many people had to fleet the region. The foundations of the fort at Point Comfort were swept into the river. A graveyard of the First Lynnhaven parish church tumbled into the waters. Twelve days of rain followed this storm across Virginia. This system is blamed for the widening of the Lynnhaven River. Ships in regional rivers sustained great damage.

The Storm of 1749 is one of the most notable storms to occur in the region. It was responsible for the formation of Willoughby Spit, a formation of land approximately two miles long and a quarter mile wide. This storm created a 15-foot storm surge that flooded much of the region.

On **March 1-3, 1927** a nor'easter hit the region with high winds gusting to 62 mph at Cape Henry and 52 mph at Norfolk. Heavy snow fell across North Carolina into Virginia and travel was delayed for two to three days. In Virginia Beach, high tide and heavy surf on March 2 inflicted considerable damage. The beaches in some places were washed back 50 feet and denuded of the overlying sand, exposing the clay beneath.

The Chesapeake-Potomac hurricane struck the region on **August 23, 1933** and created a high tide in Norfolk of 9.69 feet above Mean Lower Low Water (MLLW), a record for the area. Eighteen people were killed by this storm that also flooded downtown Norfolk and destroyed homes at Ocean View. Winds were recorded at 70 mph in Norfolk, 82 mph at Cape Henry, and 88 mph at the Naval Air Station in Norfolk.

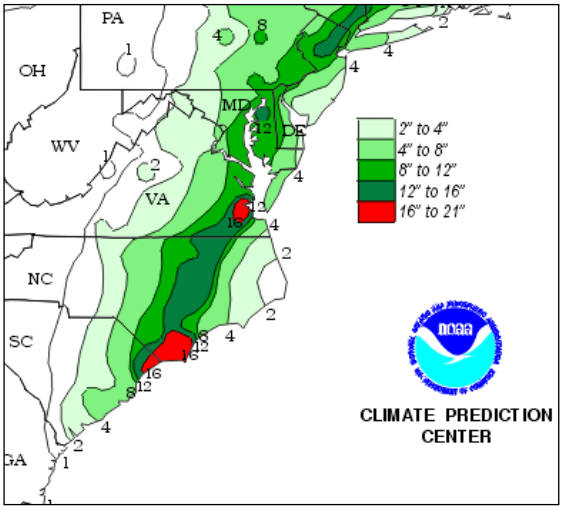
Flooding of **August 13-18, 1940**, was the result of four significant rainfall events within a three-week period. During this historical flood for the region, the Blackwater River crested at 21.9 feet, approximately 10 feet above flood stage for the City of Franklin. One of the primary causes of this flood event was an unnamed tropical cyclone that meandered across the southeast United States for four days before dissipating on August 15. Rains began in earnest in Virginia on August 13 as the storm entered the state from the west. Deluges flooded locations statewide with 4.76 inches of rainfall being measured in Hampton Roads. The Meherrin River at nearby Emporia reached a flood of record stage on August 17 when the river crested at 31.5 feet, 8.5 feet above flood stage. A total of 16 deaths in Virginia and neighboring states are directly attributed to this flood event.

On **April 11, 1956**, a severe nor'easter gave gale winds (greater than 40 mph) and unusually high tides to the Tidewater Virginia area. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide, which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were large. Two ships were driven aground. Waterfront fires were fanned by the high winds. The flooded streets made access to firefighters very difficult, which added to the losses.

The Ash Wednesday storm of 1962 produced very severe flooding throughout the Hampton Roads region partly because it occurred during "Spring Tide" (sun and moon phase to produce a higher than normal tide). The storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and waves which battered the coast for several days. The storm's

center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and seven feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and sea wall. Houses on the bay side also saw extensive tidal flooding and wave damage. The beaches and shorefront had severe erosion. Locals indicated that the damage from this storm was worse in Virginia Beach than that caused by the 1933 Hurricane. The islands of Chincoteague and Assateague on the Eastern Shore were completely submerged. Receding water exposed hundreds of thousands of dead chickens drowned by the flooding. The Virginia Department of Health (VDH) indicated that it was an extreme health hazard and asked all women, children, and elderly to evacuate. A million dollars in damage was done to NASA's Wallops Island launch facility and an estimated $4 million in wind and flood damages occurred in the City of Hampton. Winds were recorded at speeds up to 70 mph causing 40-foot waves at sea. This storm also produced Virginia's greatest 24-hour snowfall with 33 inches and the greatest single storm snowfall with 42 inches (these were recorded in the mountainous western region of the Commonwealth).

In September of 1999, **Hurricane Floyd** was responsible for wind and flood damage in the Hampton Roads region. Several trees were uprooted as wind speeds were recorded between 50 and 80 mph across the region. This event brought over 10 inches of rain to Chesapeake, and approximately 13 inches to the Southampton County/City of Franklin area, and occurred just two weeks after Tropical Storm Dennis had saturated the area with 6.2 inches of rain. Hurricane Floyd caused the Great Dismal Swamp to overflow its banks creating flooding along the Northwest River. In Suffolk, during Hurricane Floyd in 1999, Speight's Run spillway was compromised rendering Turlington Road impassable. Other dams in Suffolk were overtopped by what was reported as 8 feet of water. In western Tidewater, primary routes out-of-service due to flooding included U.S. Highway 58 near Franklin and Interstate 95 south of Petersburg to Emporia. Riverine flooding was extensive and prolonged throughout the Chowan River Basin with the Blackwater, Meherrin and Nottoway Rivers all exceeding flood stage. Water levels within the City of Franklin were estimated to be more than four feet above the previous flood of record, which occurred in August 1940, making it the new flood of record. Gage height indicated that the water reached a height of 26.27 feet on September 18, 1999. By early morning on September 16, the Blackwater River had made its way to Main Street bringing four to five feet of water to even the higher elevations of Downtown Franklin, and floodwaters continued to rise at a rate of approximately six inches per hour. Approximately 100 homes and 182 businesses were totally destroyed as a result of the flooding. Floodwaters did not begin to recede until September 21, and home and business owners were not able return to their properties and begin to evaluate their losses until September 28. The flooding was a 500-year flood of record for parts of the basin. Also, there were enormous agricultural/crop losses due to the flooding.



Rainfall totals from Hurricane Floyd.
Source: NOAA Climate Prediction Center, 1999

On **October 17, 1999**, a flash flood, which resulted from very heavy rainfall associated with Hurricane Irene, ranged from five to nine inches in the City of Franklin and Southampton County. The precipitation resulted in numerous flooded roads and road closures due to high water. Specific problem areas in Franklin included: a ditch along Armory Drive near the Wal-Mart Shopping Plaza where fast-moving water and drainage issues caused some road erosion; and flooding near the library caused problems along Second Avenue.

In September of 2003, **Hurricane Isabel** caused widespread flooding, comparable to that caused by the 1933 hurricane and the Ash Wednesday Storm of 1962. Hurricane Isabel proved to be the costliest disaster in Virginia's history. The storm produced a high storm surge (four to five feet in Southside Hampton Roads)

which inundated the tidal portions of the region's creeks and rivers. Damage from flooding was extensive to structures and infrastructure in the planning area. The NFIP processed more than 24,000 Isabel claims in six states and the District of Columbia, totaling nearly $405 million. As a result of polluted runoff, VDH forbade gathering shellfish in the Virginia portion of the Chesapeake Bay, and rivers flowing into the bay. On September 18, 2003, Hurricane Isabel made landfall off the coast of northeast North Carolina. The hurricane, which had originally been a Category 5 storm, reached Chesapeake as a weak Category 1 storm. The magnitude of Hurricane Isabel's impact on the region was historic with rain, storm surge, and wind severely affecting many areas. Rainfall from Hurricane Isabel averaged four to seven inches over large portions of eastern North Carolina, east-central Virginia, and Maryland.

Although no damage was reported in the NCEI records, several streets in Franklin flooded as a result of precipitation associated with **Tropical Storm Ernesto** during the first four days of **September, 2006**. Ernesto strengthened throughout the day on Thursday, August 31 with maximum sustained winds reaching 70 mph. The Tropical Storm made landfall in Brunswick County, North Carolina near Long Beach at 1130 PM on Thursday, August 31. Ernesto moved north across the Coastal Plain of North Carolina on Friday, September 1, reaching southeastern Virginia as a Tropical Depression during the late afternoon on Friday. The system became extratropical late Friday evening as it moved across eastern Virginia. The Blackwater River crested at 15.61 feet according to stream gage data.

Between **October 7 and 10, 2006**, a strong low pressure system off the North Carolina coast coupled with an upper level cutoff low to dump intense rainfall across portions of southeastern Virginia and western Tidewater. Rainfall amounts in excess of 10 inches resulted in numerous road closures and moderate to major river flooding from late Friday, October 6th through Saturday, October 7th. In Franklin, the Blackwater River flooded much of downtown Franklin. Numerous businesses and residences sustained water damage, with estimates of property damage totaling approximately $4 million and crop damage estimated at $700,000. The Blackwater River crested October 10, 2006, at 22.77 feet.



Downtown Franklin during the October, 2006 flood. Source: City of Franklin photo

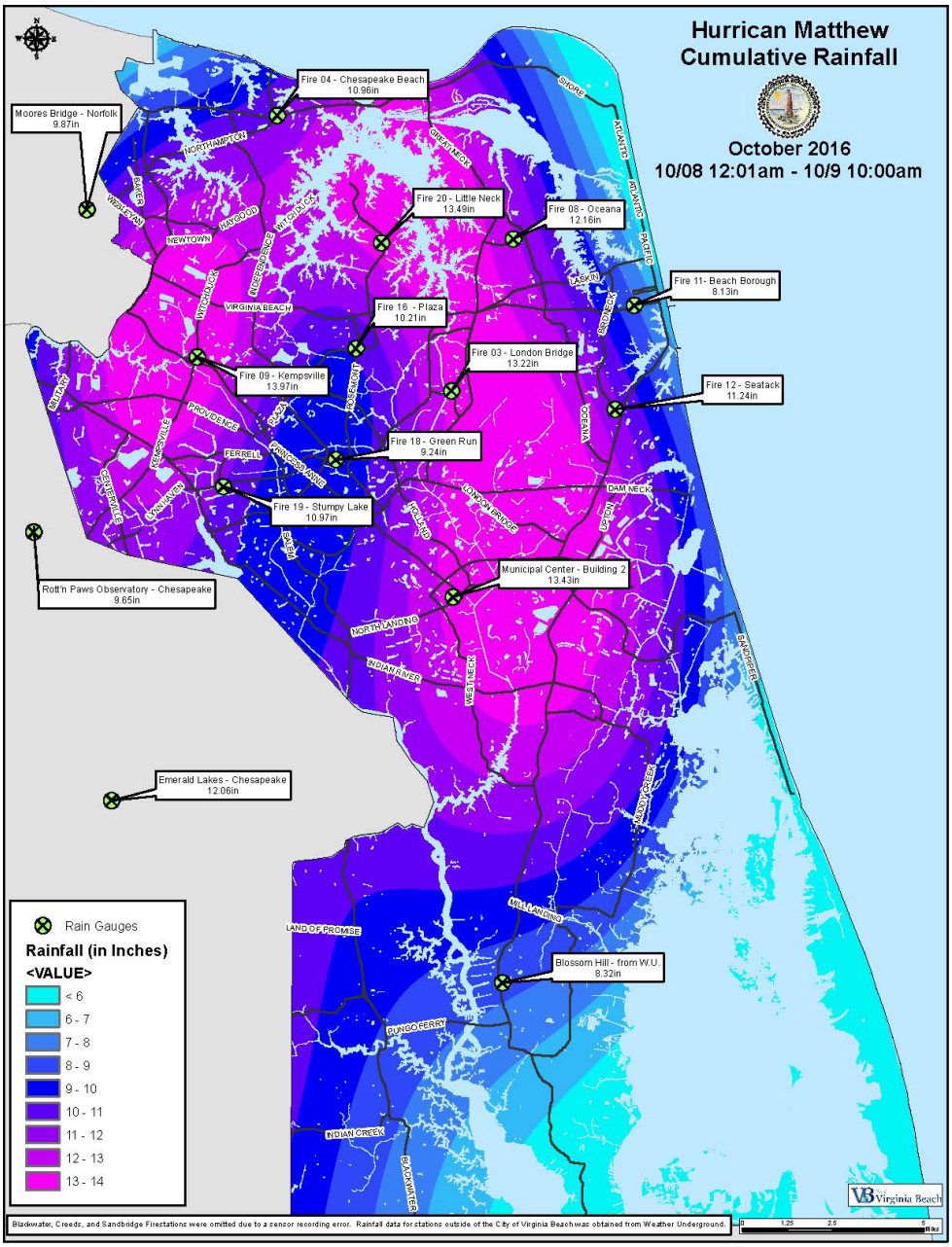
The November **2009 Mid-Atlantic nor'easter** (or "Nor'Ida") was a powerful storm that caused widespread flooding throughout the region. Persistent onshore flows brought elevated water levels for four days. At Sewells Point, a max storm tide of 7.74 feet MLLW was recorded on November 13th, the third highest recorded tide of all time at that location. Widespread coastal damage and major flooding occurred as a result of seven inches of rainfall and large wind-driven waves impacting beaches. Damage in Virginia exceeded $38.8 million, of which 64% was in Norfolk alone. According to the NWS, 7.4 inches of rain fell in Norfolk between November 11 and 13. Hurricane-force winds also affected the region, with a peak gust of 75 mph recorded at Oceana.

In August 2011, **Hurricane Irene** moved northward over the Outer Banks of North Carolina and just off the Virginia coast, producing heavy rains which caused widespread flooding across most of south central and southeast Virginia Saturday morning, August 27th into early Sunday morning, August 28th. Storm total rainfall generally ranged from six to as much as 12 inches. Heavy rains associated with Hurricane Irene produced widespread lowland flooding across much of Southside Hampton Roads, including roadways which were washed out or closed. Great Bridge reported 10.75 inches of rain. Deep Creek reported 9.72 inches of rain. Very heavy rainfall ranged from five to nine inches in the City of Franklin and Southampton County. The precipitation resulted in numerous flooded roads and road closures due to high water. Fort Monroe estimated wind and water caused an estimated $2.2 million in damage to properties leased by the Fort Monroe Authority.

At the end of October 2012, **Tropical Cyclone Sandy** moved northward well off the Mid Atlantic Coast producing heavy rain which caused flooding across much of eastern and southeast Virginia. Storm total rainfall ranged from four inches to as much as 10 inches across the area. Numerous roads were closed due to flooding. Storm total rainfall ranged from three to six inches across Chesapeake. Although the storm did not cause the destruction locally that it did in the northeast, it remains a significant rain and coastal flood event for parts of the Hampton Roads region.

In early October 2016, the combination of the tropical moisture from **Hurricane Matthew**, combined with a cold front moving across the middle Atlantic, allowed for heavy rain to fall from North Carolina through Southeast Virginia. Some locations across the Tidewater region of Virginia received more than 10 inches of rain for the storm total. This created considerable flooding across the region with many roads becoming impassible and some even washed out. According to the National Weather Service, Deep Creek in Chesapeake recorded 10.01 inches on October 9; areas in Norfolk and Portsmouth recorded just shy of 10 inches by late on October 8, or the morning of October 9. Rainfall totals on the Peninsula ranged from 5 to 9 inches. **Figure 4.5** shows the cumulative rainfall totals for Virginia Beach. The rainfall and resultant flooding resulted in 5,576 Virginia homeowners and renters applying to FEMA for disaster assistance. As of January 2017, more than $7.4 million in individual housing assistance grants and nearly $1.6 million in other needs assistance had been approved for residents of the 7 designated cities: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, Suffolk and Virginia Beach. In addition to the FEMA grants, and SBA loans, the NFIP paid out $46.8 million to 2,263 claimants to settle Flood Insurance Claims. The *Virginia Pilot* reported that Matthew damaged roughly 2,000 structures at a cost of about $30 million. In Virginia Beach in particular, the extraordinarily heavy rainfall overwhelmed the existing drainage system and left infrastructure incapable of performing to design expectations. The storm has marked a turning point for City leaders as they prioritize flood mitigation projects in coming years.

FIGURE 4.5: HURRICANE MATTHEW CUMULATIVE RAINFALL, VIRGINIA BEACH 2016



Source: City of Virginia Beach

Table 4.2 provides information on significant flood events documented by the NCEI between 1995 and December 2020 for the study area, representing the most recent data available. These events resulted in two reported deaths and one reported injury, and $189,684,000 million in property damages reported to the NCEI. Additional unreported property damages are likely. Additional data on repetitive flood losses is provided in Chapter 5. Bolded events in **Table 4.2** are described in additional detail above.

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
SURRY COUNTY	1/19/1996	Flood	0/0	-	1 to 2 feet of water on Rte. 10 between Surry and Bacon Castle Rd.
SOUTHAMPTON	6/11/1996	Flash Flood	0/0	-	Heavy rain in 3 hours caused road closures in the Sebrell area.
NORFOLK	6/18/1996	Flood	0/0	-	Heavy rain in 2 hours caused road closures in the Ocean View and Willoughby Spit sections of Norfolk.
VIRGINIA BEACH	6/18/1996	Flood	0/0	$10,000	Heavy rain in a few hours caused road closures in Lynnhaven and Oceanfront sections of Northern Virginia Beach.
VIRGINIA BEACH	6/20/1996	Flood	0/0	-	Heavy rain in 1 hour caused road closures in the Alanton and Oceana sections of Virginia Beach.
NORFOLK and VIRGINIA BEACH	7/18/1996	Flash Flood	0/0	-	Heavy rain in 6 hours caused road closures with people trapped in cars along the 300-400 block of East Little Creek Road and along Campostella Road. Flooding was also reported in the Kempsville area along Indian River Road and Princess Anne Road. High water was reported in the Oceanfront area along Atlantic Avenue.
CHESAPEAKE	7/18/1996	Flash Flood	0/0	-	Heavy rain in a few hours resulted in water along Bainbridge Boulevard and Freeman Avenue and a split of Interstate 64 and 264.
VIRGINIA BEACH	7/18/1996	Flash Flood	0/0	-	Heavy rain in a few hours resulted in flooding in the Kempsville area along Indian River Road and Princess Anne Road and the Oceanfront area along Atlantic Avenue.
NORFOLK	7/31/1996	Flood	0/0	-	Streets were flooded due to two storms in an afternoon.
NEWPORT NEWS, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND VIRGINIA BEACH	4/23/1997	Coastal Flood	0/0	-	Moderate coastal flooding caused tides to peak at 5.8ft above the Mean Lower Low Water especially in Willoughby Spit, Ghent, and downtown sections of Norfolk, the Old-Town section of Portsmouth, the Buckroe Beach and Grandview sections of Hampton, and the Sandbridge section of Virginia Beach. Minor coastal flooding was reported in Newport News and York county.
NORFOLK AND VIRGINIA BEACH	6/3/1997	Coastal Flood	0/0	-	Minor to moderate flooding resulted in loss of part of the boardwalk and a couple lifeguard stands in Virginia Beach and several streets flooded in downtown Portsmouth and downtown Norfolk.
VIRGINIA BEACH, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND NEWPORT NEWS	10/19/1997	Coastal Flood	0/0	-	Minor to moderate flooding resulted in streets being closed and water in a few houses in Norfolk, downtown Portsmouth, Sandbridge and Sandfiddler areas of Virginia Beach. Minor flooding was reported in Newport News and York County.
VIRGINIA BEACH, NEWPORT NEWS, NORFOLK, AND YORK	1/27/1998	Coastal Flood	0/0	$1,500,000	A Nor'easter caused high tides and moderate coastal flooding combined with gale and storm force winds. A couple houses were damaged and power outages were scattered across the Hampton Roads area.
NORFOLK, HAMPTON, PORTSMOUTH, VIRGINIA BEACH, NEWPORT NEWS, AND YORK/POQUOSON	2/4/1998	Coastal Flood	0/0	$75,000,000	A Nor'easter caused gale & storm force winds & high tides that resulted in moderate to severe coastal flooding with damage to buildings, road closures, & scattered power outages especially in Norfolk, Virginia

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					Beach, and Hampton. Willoughby & Ocean View had the most damage.
NORFOLK, CHESAPEAKE, VIRGINIA BEACH, SUFFOLK, and PORTSMOUTH	7/24/1999	Flash Flood	0/0	-	Roads were flooded including Hampton Boulevard. Parts on Interstate 264, Ballahack Road, and Military Highway in Chesapeake were flooded. Many other roads were flooded and impassable.
VIRGINIA BEACH, NORFOLK, CHESAPEAKE, AND PORTSMOUTH	8/14/1999	Flash Flood	0/0	-	Primary roads and underpasses were flooded including Route 13 in Chesapeake.
VIRGINIA BEACH, NORFOLK, CHESAPEAKE, SUFFOLK, AND PORTSMOUTH	9/7/1999	Flash Flood	0/0	-	A line of thunderstorms caused flooding on roads.
SUFFOLK	9/7/1999	Flash Flood	0/0	-	Road (1500 block Camp Pond Road) flooded out.
CHESAPEAKE, ISLE OF WIGHT, SUFFOLK, NORFOLK, FRANKLIN, SOUTHAMPTON, PORTSMOUTH, NEWPORT NEWS, HAMPTON, YORK, JAMES CITY, POQUOSON, SURRY COUNTY AND WILLIAMSBURG	**9/15/1999**	**Flash Flood**	**0/0**	**$35,000**	**Hurricane Floyd caused heavy rain and widespread flooding and flash flooding across eastern Virginia. 12 to 18 inches of rain fell in the Tidewater region. Numerous roads were washed out and several rivers exceeded flood stage including the Chowan River Basin and the Blackwater, Meherrin, and Nottoway Rivers. There were enormous agricultural losses due to flooding.**
SUFFOLK, SOUTHHAMPTON, ISLE OF WIGHT, FRANKLIN, NORFOLK, VIRGINIA BEACH, CHESAPEAKE, PORTSMOUTH, NEWPORT NEWS, POQUOSON, YORK, AND HAMPTON	**10/17/1999**	**Flash Flood**	**0/0**	**-**	**Heavy rainfall associated with Hurricane Irene caused flooded roads and road closures.**
JAMES CITY	7/19/2000	Flash Flood	0/0	-	Heavy rain caused flooding and standing water across the intersection of Routes 30 and 60 near Toano.
HAMPTON, NEWPORT NEWS	7/24/2000	Flash Flood	0/0	$350,000	Heavy rain caused 35 residences to be evacuated due to high water on Scoggin Circle and Grimes Road in the Buckroe Beach section of Hampton. Widespread flooding of main and secondary roads was reported in Newport News.
SOUTHAMPTON, POQUOSON, YORK AND SURRY COUNTY	7/24/2000	Flash Flood	0/0	-	Flooding on secondary roads and several roads washed out. Three interstate off-ramps were closed due to flooding in York.
NORFOLK	7/26/2000	Flash Flood	0/0	-	Heavy rain flooded roadways and caused closure of underpasses on Tidewater Drive in downtown Norfolk. Flooding also occurred at Chesapeake Boulevard and Chesapeake Street in the East Ocean View section of Norfolk.
SUFFOLK	7/30/2000	Flash Flood	0/0	-	Heavy rain caused flooding of Kings Fork Road in the western part of the city.
SOUTHAMPTON CO AND SURRY CO	8/3/2000 – 8/4/2000	Flash Flood	0/0	$2,000	Heavy rain caused flooding on Route 58 near Drewryville and two minor accidents

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					on Route 308 were due to high water. Heavy rain caused flooding on Route 31 between Dendron and Scotland. Flooding also occurred on Route 10 in Surry.
PORTSMOUTH, AND NORFOLK	8/11/2000	Flash Flood	0/0	-	Flooding caused the closure of Interstate 264 at Frederick Boulevard. The intersections of Granby Street and Brambleton Avenue, Princess Anne Road and Monticello Avenue, and City Hall Avenue and Granby Street were all closed due to high standing water in Norfolk. Also, underpasses on Campostella Avenue, Tidewater Drive and Colley Avenue were closed due to accumulated water.
VIRGINIA BEACH	8/14/2000	Flash Flood	0/0	-	Widespread flooding caused the closure of several roads in the vicinity of Princess Anne Plaza. Sections of Rosemont Road were closed due to flooding.
SOUTHAMPTON COUNTY AND SURRY COUNTY	9/1/2000	Flash Flood	0/0	-	Several roads flooded. Route 10 under water near the Surry/Prince George county line.
NORFOLK	9/5/2000	Flash Flood	0/0	-	Heavy rain caused the side of an underpass wall to slide into the road at Granby Street and Interstate 64 resulting in road closure.
SOUTHAMPTON / FRANKLIN	9/5/2000	Flood	0/0	$3,000	The Nottoway and Blackwater Rivers flooded and caused some road closures including: Route 653 from Route 719 to Cary's Bridge, Route 619 at the intersection of Route 629, Route 614 from Route 622 to the Isle of Wight county line, and Route 651 (Indian Town Road) from Route 35 at Hancock Peanut to Route 652.
SUFFOLK AND ISLE OF WIGHT	6/16/2001	Flash Flood	0/0	-	Flooding caused one road closure near Whaleyville. Knoxville Road, Rose Drive, and numerous other secondary roads were impassable around Windsor.
NORFOLK	7/23/2001	Flash Flood	0/0	-	One car was submerged at the underpass on Colley Avenue and 21st Street and roads were covered with water.
SOUTHAMPTON	8/18/2001	Flash Flood	0/0	-	Flooding resulted in impassable roads and high water on Route 35.
HAMPTON AND NEWPORT NEWS	6/14/2002	Flash Flood	0/0	-	Streets were flooded and water was shooting out of a manhole cover.
VIRGINIA BEACH, NORFOLK, HAMPTON, AND NEWPORT NEWS	8/28/2002	Flash Flood	0/0	-	Heavy rains caused roads closures along Rosemont at the Virginia Beach Boulevard and around Kings Grant area. A car stalled in deep water. Union street and areas near City Hall and Granby were flooded in Norfolk. A section of West Mercury Boulevard and Powhatan Parkway in Hampton were closed due to high water. Roads were closed at the intersection of 27th and Buxton streets and flood barricades were in place at the City Line Apartment Complex in Newport News.
VIRGINIA BEACH AND NORFOLK	10/11/2002	Flash Flood	0/0	-	Atlantic Avenue was closed in Virginia Beach between 42nd and 65th streets due to flooding. The intersection of Tidewater Drive and Virginia Beach Boulevard in Norfolk were flooded.

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
NEWPORT NEWS, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND VIRGINIA BEACH	4/10/2003	Storm Surge/tide	0/0	-	Flooding occurred at high tide resulting in water in some streets portions of the Middle Peninsula and Hampton Roads.
NEWPORT NEWS AND YORK	7/19/2003	Flash Flood	0/0	-	Heavy rain caused street flooding near Leesville Mill Subdivision. Route 17 was reported closed at intersection with Route 173 due to street flooding.
NEWPORT NEWS	8/5/2003	Flash Flood	0/0	-	6 families had to be evacuated due to flash flooding.
POQUOSON	8/17/2003	Flash Flood	0/0	-	High water occurred on Poquoson and Huggins roads, and also in Hunts Neck are and in yards.
SUFFOLK, HAMPTON, NEWPORT NEWS, NORFOLK, AND PORTSMOUTH	**9/3/2003**	**Flash Flood**	**0/0**	**-**	**Streets were flooded in northern Suffolk. Many roads closed due to high water, including 27th and Buxton Streets in Newport News and the 8000 block of Hampton Boulevard in Norfolk.**
NEWPORT NEWS AND YORK	5/19/2004	Flash Flood	0/0	-	High water on Warwick Boulevard between 36th and 50th Street and at Center and Jefferson Avenue, and underpasses along Main Street and Center Avenue. Dare Road reported closed due to high water in York.
NEWPORT NEWS	5/22/2004	Flash Flood	0/0	-	High water at Flint Drive and Tillerson Drive.
PORTSMOUTH	6/10/2004	Flash Flood	0/0	-	High water at Airline Boulevard and I-264 and at intersection of Oregon and Dakota Roads.
CHESAPEAKE	7/4/2004	Flash Flood	0/0	-	A section of Route 17 in the Great Dismal Swamp Area was washed out due to rain.
NORFOLK, ISLE OF WIGHT CO, SURRY CO	7/25/2004	Flash Flood	0/0	-	Streets were flooded in downtown Norfolk including Waterside Drive. Lawnes Creek Bridge on Route 10 near Rushmere and several other roads were reported closed due to flooding in Isle of Wight. Route 617 closed due to flooding in Surry County.
SURRY COUNTY	7/29/2004	Flash Flood	0/0	-	Road closed on Route 611 near the intersection of Highway 40 due to flooding.
NORFOLK AND PORTSMOUTH	8/2/2004	Flash Flood	0/0	-	Some streets were flooded including the intersection of Park Avenue and Virginia Beach Boulevard and at the intersection of Robinhood Road and I-64 Underpass. Duke and Randolph Streets reported closed due to high water. Flooding on I-264 and Portsmouth Boulevard in Portsmouth.
CHESAPEAKE	7/13/2005	Flash Flood	0/0	-	One half mile of Murray Drive near Fentress in the Green Haven subdivision was underwater.
SUFFOLK, CHESAPEAKE, PORTSMOUTH, AND NORFOLK	8/9/2005	Flash Flood	0/0	-	College Drive and Camelia Drive flooded in Suffolk. Parts of Taylor Road were flooded in Chesapeake. Numerous roads were closed including Hampton Boulevard with vehicles flooded in Norfolk. Effingham and London Boulevard and the entrance to Route 264 at Frederick Boulevard were flooded in Portsmouth.
NORFOLK / HAMPTON / PORTSMOUTH…, NORFOLK, SUFFOLK, PORTSMOUTH, CHESAPEAKE, HAMPTON, NEWPORT	10/8/2005	Flood	0/0	-	Street flooding reported at Hampton Boulevard and Terminal Boulevard, Granby Street and Tidewater Drive, 900 Block of East Oceanview Avenue, Virginia Beach Boulevard and Brambleton, Princess Anne and Monticello Avenue. Areas of flooding

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
NEWS, AND POQUOSON					were reported along sections of Route 58, on College Drive in the College Square Section, and on Kilby Shores Drive in Suffolk. The 56th block of Cranny Brook Road, Bunch Boulevard at Dwight Avenue, Powhatan and Vahallia, Scott Drive at Westhaven, 264 West bound off ramp, and Gateway Drive were closed due to flooding in Portsmouth. Bruce Road was closed near Tyre Neck Road in Western Branch part of Chesapeake. Grimes Road and Lee Street were under water in Hampton. Buxton Avenue was closed at 25th Street in Newport News. North Lawson Road was flooded in Poquoson.
CHESAPEAKE, NORFOLK, PORTSMOUTH, SUFFOLK, AND VIRGINIA BEACH	6/14/2006	Flash Flood	0/0	-	Heavy rain from the remnants of Tropical Storm Alberto caused flash flooding and road closures and the closure of Bainbridge Boulevard near the Triple Decker Bridge in Chesapeake. Brambleton Avenue near Route 264 overpass was closed and flooding occurred at Texas Avenue in the Norvell Heights area in Norfolk. The 2000 block of Frederick Boulevard was closed due to flash flooding in Portsmouth. The 2500 block of Pruden Boulevard was closed due to flash flooding in Suffolk. Atlantic Avenue between 49th and 71st streets was closed in Virginia Beach due to flash flooding.
YORK, HAMPTON, ISLE OF WIGHT, AND NEWPORT NEWS	6/23/2006	Flood	0/0	-	High water on several roads including Main Street in Isle of Wight.
SUFFOLK, NORFOLK, VIRGINIA BEACH, CHESAPEAKE, SOUTHAMPTON, FRANKLIN, YORK, PORTSMOUTH, HAMPTON, JAMES CITY CO, SURRY CO AND NEWPORT NEWS	**9/1/2006**	**Flash Flood**	**0/0**	**-**	**Numerous streets flooded with a couple feet of water including Route 600 between Routes 614 to 623 in Southampton, Route 264 ramp to Frederick Boulevard in Portsmouth, London Bridge Road and Corporate Landing Street in Virginia Beach, Route 64 at Mercury Boulevard in Hampton, Route 664 at 35th street to Jefferson Avenue in Newport News, and Route 632 in James City. Route 630 in Surry County closed.**
YORK / POQUOSON	**9/1/2006**	**Coastal Flood**	**0/0**	**$1,900,000**	**Tides of 4 to 5 feet above normal caused significant property damage across portions of the Virginia Peninsula and Middle Peninsula near the Chesapeake Bay and adjacent tributaries.**
NORFOLK AND YORK	**10/6/2006**	**Coastal Flood**	**0/0**	**$200,000**	**Strong onshore winds caused moderate coastal flooding during high tide and caused road closures and power outages in western portions of the southern Chesapeake Bay.**
SOUTHAMPTON, ISLE OF WIGHT, FRANKLIN, SURRY COUNTY AND JAMES CITY	**10/7/2006**	**Flash Flood**	**0/0**	**$8,800,000**	**Intense rainfall caused river flooding, road closures, and power outages in western portions of the southern Chesapeake Bay. HWY 460 was closed from Ivor to the Sussex county line. HWY 258 and parts of HWY 460 near Windsor in Isle of Wight. The Blackwater River flooded much of downtown Franklin where numerous businesses**

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					and residences sustained water damage. Crop damage and road closures in Surry County.
NORFOLK, YORK, CHESAPEAKE, SUFFOLK, AND VIRGINIA BEACH	11/22/2006	Coastal Flood	0/0	$225,000	Strong onshore winds caused moderate coastal flooding during high tide and caused road closures across portions of eastern and southeast Virginia including the intersection of Tidewater Drive and Brambleton Avenue and the intersection of Virginia Beach Boulevard and Tidewater Drive. The 700 block of North Main Street and East Constance Road in the 100 block between North Main and Katherine Street were closed due to high water in Suffolk.
NORFOLK AND VIRGINIA BEACH	6/26/2007	Flash Flood	0/0	-	Heavy rain caused flash flooding on roads and in underpasses including Tidewater Drive underpasses. Flooding was reported on Virginia Beach Blvd and Kempsville Road in Virginia Beach.
PORTSMOUTH AND NORFOLK	4/21/2008	Flash Flood	0/0	-	Heavy rains caused flash flooding and road closures across portions of southeast Virginia.
SUFFOLK	5/5/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Suffolk. High water was reported at the 3800 Block of Whaleyville Boulevard in Whaleyville.
SOUTHAMPTON	8/5/2009	Flash Flood	0/0	-	Isolated thunderstorms produced heavy rains which caused flash flooding across portions of Southampton county and a section of State Highway 186 was flooded and partially closed.
PORTSMOUTH, CHESAPEAKE, AND NORFOLK	8/12/2009	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding and road closures across portions of southeast Virginia. Gracie Road and State Highway 407 were flooded in Chesapeake. Westbound Route 264 at the downtown tunnel was closed from Norfolk to Portsmouth. Road was flooded at South Brambleton Road and Kimball Terrace near the Exit 11A interchange of Interstate 264 in Norfolk.
HAMPTON	8/13/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Hampton.
NEWPORT NEWS	8/14/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Newport News.
NORFOLK	8/22/2009	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding and road closures in numerous locations downtown, including the Ghent area and in the vicinity of Old Dominion University.
CHESAPEAKE, ISLE OF WIGHT, NEWPORT NEWS, NORFOLK, VIRGINIA BEACH, YORK, SURRY COUNTY AND SUFFOLK	**11/12/2009**	**Coastal Flood**	**0/0**	**$39,250,000**	**A Nor'easter produced moderate to severe coastal flooding across much of eastern and southeastern Virginia causing flooding of streets, homes, and businesses. Tidal flooding took out the clubhouse north of the Godwin Bridge, and destroyed a number of piers in Suffolk. The flooding was extensive, well above what was experienced in Isabel, in the Long Creek, Lynnhaven**

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					Colony and Bay Island areas of Virginia Beach. In Surry County, several streets, homes and businesses were flooded in low lying areas of the county close or directly exposed to the James River. Many decks and piers were damaged or destroyed.
CHESAPEAKE, NORFOLK, VIRGINIA BEACH, AND YORK	12/19/2009	Coastal Flood	0/0	$40,000	A coastal low pressure area produced moderate to severe coastal flooding across much of eastern and southeast Virginia and several streets, homes and businesses were flooded in low lying areas
VIRGINIA BEACH, PORTSMOUTH, AND HAMPTON	7/29/2010	Flash Flood	0/0	-	Scattered thunderstorms produced flash flooding across portions of southeast Virginia and numerous roads were flooded in north Virginia Beach, the City of Hampton, and the City of Portsmouth.
PORTSMOUTH, HAMPTON, YORK, NORFOLK, AND CHESAPEAKE,	9/30/2010	Flash Flood	0/0	-	Thunderstorms produced flash flooding and caused road closures including Portsmouth Boulevard, County Street, Effingham Street, and the Interstate 264 Exit at Effingham.
VIRGINIA BEACH, CHESAPEAKE, FRANKLIN, ISLE OF WIGHT, NORFOLK, PORTSMOUTH, SOUTHAMPTON, SUFFOLK, YORK, HAMPTON, JAMES CITY, NEWPORT NEWS, SURRY COUNTY AND JAMES CITY COUNTY	**8/27/2011**	**Flood**	**0/0**	**-**	**Hurricane Irene produced heavy rains which caused widespread flooding and either closed or washed out roadways. Rainfall ranged from four to twelve inches across the region.**
SURRY COUNTY	9/7/2011	Flash Flood	0/0	-	The combination of the remnants from Tropical Storm Lee and a frontal boundary draped over the region caused heavy rain which produced flash flooding. Blackwater swamp rose and flooded a road. Portions of Carsley Road were impassable due to high water.
SOUTHAMPTON	9/9/2011	Flood	1/1	-	The driver of a vehicle drowned after his vehicle went into a swamp in Southampton county. The passenger was able to escape from the vehicle.
VIRGINIA BEACH	9/28/2011	Flash Flood	0/0	-	Scattered thunderstorms caused heavy rain which produced flash flooding and flooded Jeanna Street and Shore Drive.
ISLE OF WIGHT, NEWPORT NEWS, AND YORK	5/15/2012	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain and flash flooding resulting in flooding on several roads and high water west of Carrollton in Isle of Wight. In Newport News, flooding was reported on Interstate 64 at Jefferson Avenue. Several accidents were reported near the Patrick Henry Mall. The underpasses at Main Street and Center Avenue were flooded several feet. Winterhaven Drive had several cars floating. There was significant flooding off of Harpersville Road. There was flooding at the Virginia Living Museum. Three feet of water was reported on a road in the Coventry Subdivision in York.
NEWPORT NEWS AND HAMPTON	8/25/2012	Flash Flood	0/0	$2,000,000	Scattered thunderstorms produced heavy rain which caused flash flooding which

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					resulted in flooding on Warwick Boulevard, Main Street, Deep Creek Road and cars were submerged on Warwick Boulevard just west of Mercury Boulevard in Newport News. An apartment building was flooded in Hampton.
HAMPTON	8/28/2012	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding. Fox Hill Road was almost impassable at Mercury Boulevard due to flooding. Other roads were closed or impassible and an apartment complex was evacuated.
SOUTHAMPTON	8/28/2012	Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flooding and road closures mainly western sections along and south of Route 58.
ISLE OF WIGHT, VIRGINIA BEACH, YORK, SUFFOLK, NEWPORT NEWS, CHESAPEAKE, NORFOLK, SURRY COUNTY AND JAMES CITY COUNTY	**10/28/2012**	**Coastal Flood**	**0/0**	**$2,144,000**	**Tropical Cyclone Sandy produced very strong winds which caused moderate to severe coastal flooding especially on the James River, York River, Chesapeake Bay, and at Sewells Point. Some streets were flooded in Chesapeake. Water levels reached 2.5 to 3.5 feet above normal along the James River up into Surry County.**
NEWPORT NEWS, JAMES CITY, ISLE OF WIGHT, HAMPTON, CHESAPEAKE, WILLIAMSBURG, PORTSMOUTH, SUFFOLK, YORK, VIRGINIA BEACH, AND NORFOLK	**10/29/2012**	**Flood**	**0/0**	**-**	**Tropical Cyclone Sandy produced very strong winds which caused flooding and closed numerous roads.**
YORK	7/21/2013	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding. Flooding was reported along Farm Road just off of Route 17. Oriana Road (Route 620) was flooded just north of Newport News Airport. Two to three inches of water was over roadway along Route 17 just south of the Coleman Bridge.
NORFOLK, PORTSMOUTH, AND CHESAPEAKE	5/16/2014	Flood	0/0	-	Heavy rain caused flooding during high tide. Numerous roads were closed due to high water. The first floor of some apartments and a couple of cars were under water in Ghent. Norfolk Public Schools experienced flooding inside some of their buildings.
VIRGINIA BEACH	7/9/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused minor flooding on Sandbridge Road.
NORFOLK, ISLE OF WIGHT, AND PORTSMOUTH	7/10/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused some minor flooding on Windsor Boulevard in Windsor and Elm Street in Portsmouth.
VIRGINIA BEACH	7/15/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused some minor flooding at the intersection of Baxter Road and Princess Anne Road and on Mill Dam Road near First Colonial Road.
SUFFOLK	7/24/2014	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding on Clay Street with water flowing into homes in

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Suffolk. A car was partially submerged in high water in the Pleasant Hill area.
ISLE OF WIGHT, NEWPORT NEWS, PORTSMOUTH, NORFOLK, CHESAPEAKE, AND HAMPTON	9/8/2014	Flood	0/0	-	Showers and scattered thunderstorms produced locally heavy rainfall and resulted in flooding across portions of southeast Virginia. Several roads were flooded or impassable over northeast Isle of Wight county. Several roads were flooded in southern portions of Newport News, including 26th Street near Interstate 664, and Warwick Boulevard and 35th Street. Also, several streets were flooded around Mercury Boulevard. An apartment complex was evacuated in Hampton. Heavy rain closed several roads and underpasses across the region.
SURRY COUNTY	7/11/2015	Flood	0/0	-	Scattered thunderstorms produced heavy rain. There were multiple reports of water over the road along Route 10 in Surry.
VIRGINIA BEACH, NORFOLK, HAMPTON, POQUOSON, YORK, CHESAPEAKE, ISLE OF WIGHT, NEWPORT NEWS, JAMES CITY, SURRY AND SUFFOLK	10/2/2015	Coastal Flood	0/0	1,000,000	A tidal departure of 3 to 4 feet resulted in moderate flooding along the Atlantic coast and Chesapeake Bay. A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay.
VIRGINIA BEACH	1/23/2016	Coastal Flood	0/0	-	A tidal departure of 2.5 to 3.5 feet resulted in moderate coastal flooding along the Atlantic Ocean and Chesapeake Bay. The peak water level at the Chesapeake Bay Bridge Tunnel was 5.72 feet at 606 am on January 23.
CHESAPEAKE	7/1/2016	Flash Flood	0/0	-	Scattered showers and thunderstorms in advance of a cold front produced heavy rain and caused flash flooding across portions of eastern and southeast Virginia. Rainfall totals ranged from five to as much as eleven inches in areas where flash flooding occurred.
CHESAPEAKE, NORFOLK, PORTSMOUTH	7/19/2016	Flood, Flash Flood	0/0	-	Scattered thunderstorms in advance of a cold front produced heavy rain and caused flash flooding across portions of southeast Virginia. Flooding on Bainbridge Blvd at Rte 13; water covering Olney Rd with vehicles stuck in water; streets flooded on Old Town Portsmouth with vehicles trapped.
VIRGINIA BEACH, NORFOLK	7/31/2016	Flash Flood	0/0	-	Heavy rain from thunderstorms caused flash flooding, with rainfalls ranging between 2 and 7 inches. 2800 block of Shore Drive closed, roads closed near Fairfield Shopping Center, Little Creek/Ft Story, and streetlights out in Ocean View.
PORTSMOUTH, SUFFOLK, CHESAPEAKE, NORFOLK, VIRGINIA BEACH, ISLE OF WIGHT, SOUTHAMPTON, FRANKLIN	9/21/2016	Flood	0/0	$1,085,000	The combination of a stalled frontal boundary and the remnant low pressure area that was Tropical Storm Julia, produced heavy rain which caused flooding across much of southeast Virginia from Wednesday morning, September 21st into early Thursday morning, September 22nd. Numerous roads washed out or closed.

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
ISLE OF WIGHT, FRANKLIN, SUFFOLK SOUTHAMPTON, NORFOLK, PORTSMOUTH, CHESAPEAKE, YORK, NORFOLK, NEWPORT NEWS, HAMPTON, JAMES CITY, VIRGINIA BEACH, POQUOSON, SURRY	**10/8/2016**	**Flood, Flash Flood, Coastal Flood**	**1/0**	**$56,140,000**	**The combination of a cold front moving through the mid-Atlantic and Post Tropical Cyclone Matthew tracking northeast just off the coast, produced heavy rain which caused flash flooding. Strong northeast or north winds over southeast Virginia causes coastal flooding over the study area. Heavy rain caused an extended period of significant flooding. Numerous roads were impassable or closed for several days, and many homes and businesses were impacted. Numerous roads were impassable or closed, and some small creeks or streams were out of their banks due to heavy rain causing flash flooding. Coastal storm tides of 2 to 3.5 feet above astronomical tide levels were common, with only minor beach erosion reported. The maximum storm tide reached 5.86 feet MLLW at Sewalls Point, which resulted in moderate coastal flooding.**
CHESAPEAKE	3/31/2017	Flash Flood	0/0	-	Knee high water was reported at Sparrow Intermediate School.
VIRGINIA BEACH	7/24/2018	Flood	0/0	-	Numerous roads were flooded and closed for several days across much of central and eastern portions of Virginia Beach due to heavy rain.
VIRGINIA BEACH	8/6/2018	Flood	0/0	-	High water was reported on Interstate 64 at Mile marker 291. Vehicle accident was reported due to the high water.
NORFOLK	8/11/2018	Flash Flood	0/0	-	Neighborhood roadways were flooded. Rainfall total of 2.19 inches was measured in 45 minutes. Colley Avenue was closed due to flooding at the underpass. One vehicle was caught in the flood waters.
CHESAPEAKE, VIRGINIA BEACH	8/20/2018	Flood	0/0	-	Thunderstorms caused heavy rain that flooded roads.
HAMPTON	9/9/2018	Flood	0/0	-	Road was closed due to flooding at Coliseum Drive and Merchant Lane. Radar estimates indicated that two to four inches of rain had fallen in the area.
JAMES CITY COUNTY, YORK COUNTY	10/12/2018	Flash Flood	0/0	-	Showers and scattered thunderstorms associated with Tropical Cyclone Michael produced heavy rain which caused flash flooding across portions of central and south central Virginia and the Middle Peninsula. Several roads remained impassable or closed across much of the county due to lingering flooding. Route 737 was flooded at Otey Drive.
CHESAPEAKE, NORFOLK	6/7/2019	Flash Flood	0/0	-	Slow moving thunderstorms produced intense rainfall of 4 to 6 inches resulting in flash flooding on June 7th. Flooding was reported at Triple Decker Bridge underpass at Bainbridge Boulevard and Highway 113 in South Norfolk. Monticello Drive and 16th Street were closed due to flooding.
NORFOLK, CHESAPEAKE	8/7/2019	Flash Flood	0/0	-	Thunderstorms produced heavy rain which caused flash flooding. Reported along Chesapeake Boulevard, Johnstons Road, and Auburn Drive, at the intersection of 26th and 27th Streets, Granby Street and

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Colonial Avenue, and outside of WTKR studio. Also, portions of Boush Street were impassible. Oxford Street and Newport Avenue and streets in Ocean View were impassible due to high water.
VIRGINIA BEACH	8/22/2019	Flood	0/0	-	Minor street and roadway flooding was reported.
NORFOLK, VIRGINIA BEACH, YORK COUNTY, SURRY COUNTY	9/6/2019	Coastal Flood	0/0	-	Very strong northeast to north winds associated with Hurricane Dorian produced tidal anomalies between 2.5 and 3.5 feet over the southern Chesapeake Bay. This caused moderate coastal flooding over portions of the study area. Sewells Point reached 5.87 feet MLLW at 342 pm on September 6. Some streets were flooded and closed, and vehicles were stranded in the Ghent area.
YORK COUNTY, JAMES CITY COUNTY, SURRY COUNTY	10/11/2019	Coastal Flood	0/0	-	Persistent north or northeast winds, along with high waves, produced tidal anomalies between 2.0 and 3.0 feet over the York and James Rivers. This caused moderate coastal flooding. Yorktown USCG Station reached 5.24 feet MLLW.
VIRGINIA BEACH, NORFOLK	11/17/2019	Coastal Flood	0/0	-	Very strong northeast to north winds produced tidal anomalies between 2.0 and 3.0 feet over the southern Chesapeake Bay. This caused minor to moderate coastal flooding over portions of Virginia Beach and Norfolk. Chesapeake Bay Bridge Tunnel reached 5.88 feet MLLW. Some streets were flooded.
JAMES CITY COUNTY	5/19/2020	Coastal Flood	0/0	-	Minor to moderate tidal flooding occurred over portions of James City county along the James River. Jamestown reached 4.72 feet MLLW.
YORK COUNTY, JAMES CITY COUNTY	5/29/2020	Flash Flood	0/0	-	Right lane of Interstate 64 East at Mile Marker 240 was closed due to high water. Portions of Merrimac Trail were impassible due to high water.
PORTSMOUTH, CHESAPEAKE	6/20/2020	Flash Flood	0/0	-	In Portsmouth, total rainfall of 3.38 inches was reported, with 3.00 inches of rain reported in one hour. Several roads were flooded.
VIRGINIA BEACH	7/1/2020	Flash Flood	0/0	-	Interstate 264 East and West bound lanes were flooded. Two lanes were closed due to high water. Total rainfall between 3.37 inches and 4.05 inches was reported across the area.
VIRGINIA BEACH	8/4/2020	Coastal Flood	0/0	-	Strong south to southeast winds associated with Tropical Storm Isaias resulted in moderate (perhaps some locally major) tidal flooding over portions of Virginia Beach adjacent to Back Bay.
VIRGINIA BEACH, CHESAPEAKE	8/6/2020	Flash Flood	0/0	-	Flash flooding was reported in the Dam Neck area of Virginia Beach. Numerous cars were flooded. Rainfall total of 5.50 inches was reported. Some water was reported in garages and starting to enter homes.
CHESAPEAKE, VIRGINIA BEACH, NORFOLK	8/11/2020	Flash Flood	0/0	-	Water over the roadway reported near Chesapeake Square Mall, and along Great Neck Rd. Several streets were flooded in the city of Norfolk with water almost up to

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					car windows near Redgate Avenue in Ghent.
JAMES CITY COUNTY, YORK COUNTY, NEWPORT NEWS, SURRY COUNTY, SOUTHAMPTON COUNTY, ISLE OF WIGHT COUNTY	8/15/2020	Flash Flood	0/0	-	All north and south lanes were closed on Route 614 near John Tyler Memorial Highway due to flooding, Dare Rd had lane closures, multiple roads in Newport News and York County impassible, portions of Rte 10, Rte 616, roads in Colony Pines neighborhood closed, and flooding the Rushmere area.
ISLE OF WIGHT COUNTY, SURRY COUNTY, SOUTHAMPTON COUNTY, YORK COUNTY	9/9/2020	Flash Flood	0/0	-	Windsor Elementary School partially flooded (no damages reported), Post Office in Isle of Wight Co flooded, multiple roads closed, washed out or impassable; water rescues performed and cars stranded in Smithfield/Isle of Wight County.
JAMES CITY COUNTY, VIRGINIA BEACH, ISLE OF WIGHT COUNTY, PORTSMOUTH	9/18/2020	Flash Flood	0/0	-	Post Tropical Cyclone Sally tracking northeast across the Southeast United States and off the Mid Atlantic Coast produced heavy rain which caused flash flooding across portions of southeast Virginia. Multiple road closures, including Centerville Road, Brick Bat Road, Nike Park Rd, and roads in Virginia Beach. One person rescued from car in Lansdowne, Virginia Beach.
ISLE OF WIGHT COUNTY, HAMPTON, NORFOLK, CHESAPEAKE, YORK COUNTY, SURRY COUNTY, SOUTHAMPTON COUNTY, NEWPORT NEWS, WILLIAMSBURG, JAMES CITY COUNTY, VIRGINIA BEACH, SUFFOLK, PORTSMOUTH, FRANKLIN	11/12/2020	Flood, Flash Flood	0/0	-	Deep tropical moisture streaming northward into the mid-Atlantic region combined with the approach of a cold front and low pressure, produced heavy rain which caused flash flooding across portions of central and southeast Virginia. Numerous roads were impassible or closed due to continued flooding from heavy rainfall throughout the study area, including standing water on portions of interstate highways.
YORK COUNTY	12/24/2020	Flash Flood	0/0	-	Intersection of Airport Road and Mooretown Road was closed due to high water over the roadway.
TOTAL			**2/1**	**$189,684,000**	

Source: NCEI (1995 to January, 2021 data)

PROBABILITY OF FUTURE OCCURRENCES

Flooding remains a highly likely occurrence throughout the identified flood hazard and storm surge areas of the Hampton Roads region. Smaller floods caused by heavy rains and inadequate drainage capacity will be frequent, but not as costly as the large-scale floods caused by hurricanes and coastal storms, which may occur at less frequent intervals.

FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM

Flooding in the region is also possible as the result of a dam that malfunctions or is overtopped. There are approximately 80,000 dams in the United States today, the majority of which are privately owned. Other owners include state and local authorities, public utilities and federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods.



Lake Burnt Mills in Suffolk.
Photo source: City of Suffolk

Though dams have many benefits, they also can pose a risk to communities if not designed, operated and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. The failure of dams has the potential to place large numbers of people and great amounts of property in harm's way.

Flooding due to impoundment failure refers to a collapse, overtopping, breaching, or other failure that causes an uncontrolled release of water or sludge from an impoundment, resulting in downstream flooding. Dam or levee failures can occur with little warning. Intense storms may produce a flood in a few hours or even minutes from upstream locations. Flash floods can occur within six hours of the beginning of heavy rainfall, and impoundment failure may occur within hours of the first signs of breaching. Other failures and breeches can take much longer to occur, from days to weeks, because of debris jams or the accumulation of melting snow.

Failure of dams may result in catastrophic localized damages. Vulnerability to dam failure is dependent on dam operations planning and the nature of downstream development. Depending on the elevation and storage volume of the impoundment, the impact of flooding due to dam failure may include loss of human life, economic losses such as property damage and infrastructure disruption, and environmental impacts such as destruction of habitat. Flooding following a dam failure may occur due to any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity;
- Internal erosion caused by embankment or foundation leakage or piping, or earth movement resulting from an earthquake;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, or other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- High winds, which can cause significant wave action and result in substantial erosion; or
- Intentional criminal acts.

Dams are classified by DCR, with a hazard potential depending on the downstream losses estimated in event of failure. Hazard potential is not related to the structural integrity of a dam but strictly to the potential for adverse downstream effects if the dam were to fail. State regulatory requirements administered by DCR, such as the frequency of dam inspection, the standards for spillway design, and the extent of emergency operations plans, are dependent upon the dam classification. **Table 4.3** provides additional information on these classes and the possible effects on downstream areas if failure were to occur.

TABLE 4.3: VIRGINIA DAM CLASSIFICATION SYSTEM

HAZARD POTENTIAL	DESCRIPTION	INSPECTION
High (Class I)	Failure will cause probable loss of life or serious economic damage (to buildings, facilities, major roadways, etc.)	Annual, with inspection by a professional engineer every 2 years.
Significant (Class II)	Failure may cause loss of human life or appreciable economic damage (to buildings, secondary roadways, etc.)	Annual, with inspection by a professional engineer every 3 years.
Low (Class III)	Failure would result in no expected loss of human life, and cause no more than minimal economic damage	Annual, with inspection by a professional engineer every 6 years.

Source: 2018 Commonwealth of Virginia Hazard Mitigation Plan

The owner of each regulated high, significant, or low hazard dam is required to apply to DCR for an Operation and Maintenance Certificate. The application must include an assessment of the dam by a licensed professional, an Emergency Action Plan, and the appropriate fee(s), submitted separately. An executed copy of the Emergency Action Plan or Emergency Preparedness Plan must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management. The Virginia Soil and Water Conservation Board, a division of DCR, issues Regular Operation and Maintenance Certificates to the dam owner for a period of six years. If a dam has a deficiency but does not pose imminent danger, the board may issue a Conditional Operation and Maintenance Certificate, during which time the dam owner is to correct the deficiency. After a dam is certified by the board, annual inspections are required either by a professional engineer or the dam owner, and the Annual Inspection Report is submitted to the regional dam safety engineer.

Dam risk can be classified as incremental, non-breach or residual risk. Incremental risk is the risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or misoperation, where the consequences considered are over and above those that would occur without dam breach. The consequences typically are due to downstream inundation, but loss of the pool can result in significant consequences in the pool area upstream of the dam. Non-breach risk is the risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios. Residual risk is the risk that remains after all mitigation actions and risk reduction actions have been completed. With respect to dams, FEMA defines residual risk as "risk remaining at any time" (FEMA, 2015, p A-2). It is the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue.[1]

At this time, limited information is available to conduct an analysis of incremental, non-breach and residual risk relative to the high hazard potential dams in the region. Please refer to Section 3.11: Flooding Due to Impoundment Failure of the *2018 Commonwealth of Virginia Hazard Mitigation Plan*, as amended, for

[1] FEMA, Rehabilitation of High Hazard Potential Dams Grant Program Guidance, June 2020

additional information regarding the statewide approach to dam risk. That section of the state's plan is hereby incorporated by reference.

The Commonwealth of Virginia relies upon FEMA's definition of risk: "Risk is the product of the likelihood of a structure being loaded, adverse structural performance, and the magnitude of the resulting consequences." Risk data are compiled in the state's Dam Safety Inventory System (DSIS) for each high hazard dam. DCR, VDEM and local emergency and planning staff are given copies of emergency action plans and plans include detailed information on risk to the following:

- Dwellings
- Schools
- Hospitals
- Businesses
- Railroads:
- Utilities:
- Parks:
- Golf Course
- Public Trails
- Emergency Infrastructure.

The summary impacts shown in **Table 4.4** are drawn from the information in DSIS and the EAPs for the high hazard potential dams, These data represent how Virginia summarizes significant economic, environmental and social impacts from a dam incident. Factors considered in risk assessment include the population at risk, land use, inspection condition assessment and any missing studies such as stability analyses under normal and extreme loading conditions (seismic and hydrologic), and any measures underway that affect the operational status, such as drawdowns or temporary pumps and siphons, when dams are compromised.

LOCATION AND SPATIAL EXTENT

Owners of impounding structures are required to have dam break inundation zone maps that meet the standards of the Virginia Impounding Structure Regulations. The properties that are identified within the dam break zone are recorded in the dam safety emergency action plan for that impoundment. DCR is pursuing efforts to make this information available in a digital form, but it is not currently available for all dams. The *2018 Commonwealth of Virginia Hazard Mitigation Plan* indicates that such data would greatly improve ability to identify impact and vulnerability due to dam inundation.

Table 4.4 lists the high hazard dams in the study area from DCR's database and includes key details regarding each dam's basic characteristics, Emergency Action Plan status and a summary of expected impacts resulting from dam failure. Three dams with a "poor" condition rating (Harwood's Mill Dam, Little Creek Dam in James City County, and Godwin's Millpond Dam in Suffolk) are considered to have a greater risk of flooding and are a potential target for mitigation action.

TABLE 4.4: HIGH HAZARD DAMS IN THE HAMPTON ROADS REGION

COMMUNITY	NAME OF DAM	DAM TYPE	YEAR BUILT	PRIMARY PURPOSE	TOP HEIGHT (FEET)	TOP CAPACITY (ACRE FEET)	EMERGENCY ACTION PLAN STATUS (LAST APPROVAL DATE)	SUMMARY IMPACTS	MOST RECENT CONDITION ASSESSMENT
York County	Harwood's Mill Dam	Earth	1919	Water Supply	27	5,845	Active (08/18/2016)	172 homes, 21 roadways	Poor
York County	Waller Mill Dam	Earth	1965	Recreation & Water Supply	40	7,274	Expired (8/25/2005)	3 homes, 1 business, 3 roadways, 1 downstream dam	Fair
James City County	Little Creek Dam	Earth	1980	Water Supply	67	32,143	Active (4/26/2016)	2 homes, 2 roadways	Poor
James City County	Diascund Creek Dam	Earth	1961	Water Supply	35	29,093	Active (08/18/2016)	208 homes, 25 roadways	Fair
Williamsburg	Lake Matoaka Dam	Earth	1694	Recreation	24	587	Expired (04/30/2008)	7 homes, 2 businesses, 4 utilities, 1 roadway	Fair
Norfolk	Lake Whitehurst	Gravity	1900	Water Supply	26	4,200	Expired (5/31/2011)	none listed	Fair
Virginia Beach	Lake Smith Dam	Earth	1885	Water Supply	15.35	1,385	Expired (5/31/2012)	352 homes, 2 roadways, 1 downstream dam	Fair
Virginia Beach	Little Creek Reservoir	Earth	1899	Water Supply	7.6	1,819	Expired (5/31/2011)	none listed	Fair
Chesapeake	Chesapeake Energy Center Bottom Ash Dam	Earth	1955	Coal Ash Storage	20	56	Active (11/14/2018)	none listed	Satisfactory
Suffolk	C-Pond Dam	Earth	1962	Other	52	29,800	Active (04/24/2020)	287 homes, 4 roadways, 1 downstream dam	Satisfactory
Suffolk	Godwin's Millpond Dam	Earth	1960	Water Supply	14	214	Expired (03/14/2013)	1 home, 3 businesses, 1 road	Poor
Suffolk	Lake Burnt Mills	Earth	1942	Water Supply	46.5	18,500	Active (09/16/2019)	310 homes, 8 roadways, 1 downstream dam	Fair
Suffolk	Lake Cohoon	Earth	1919	Water Supply	28.8	9,300	Active (07/13/2015)	39 homes, 1 business, 1 railroad, 5 roadways, 1 downstream dam	Satisfactory
Suffolk	Lake Kilby	Earth	1892	Water Supply	18.6	3,400	Active (07/13/2015)	1 downstream dam	Satisfactory
Suffolk	Lake Meade Dam	Gravity	1958	Water Supply	25	9,281	Active (08/10/2020)	86 homes, 29 businesses, 5 railroads, 2 parks, 17 roadways	Satisfactory
Suffolk	Speight's Run Dam	Earth	1957	Water Supply	25.7	4,000	Active (07/13/2015)	2 downstream dams	Satisfactory
Suffolk	Western Branch	Earth	1963	Recreation & Water Supply	41	35,300	Active (09/16/2019)	310 homes, 8 roadways	Satisfactory
Isle of Wight County	ASB Pond	Earth	1901	Other	16.7	1,103	Active (4/24/2020)	52 homes, 7 roads, 1 downstream dam	Fair

TABLE 4.4: HIGH HAZARD DAMS IN THE HAMPTON ROADS REGION

COMMUNITY	NAME OF DAM	DAM TYPE	YEAR BUILT	PRIMARY PURPOSE	TOP HEIGHT (FEET)	TOP CAPACITY (ACRE FEET)	EMERGENCY ACTION PLAN STATUS (LAST APPROVAL DATE)	SUMMARY IMPACTS	MOST RECENT CONDITION ASSESSMENT
Isle of Wight County	B-1 Pond Dam	Earth	1950	Other	13	668	Expired (12/17/2013)	54 homes, 6 roadways	Satisfactory
Isle of Wight County	B-2 Pond Dam	Earth	1901	Other	15.3	1,668	Expired (12/17/2013)	54 homes, 6 roadways	Satisfactory
Newport News	Lee Hall Reservoir Dam	Gravity	1893	Water Supply	23.7	4,640	Active (1/31/2019)	861 homes, 1 business, 3 schools, 2 parks, 28 roadways	Satisfactory

Source: Virginia Department of Conservation and Recreation, Dam Safety Inventory System, May 2021

Appendix H contains a list of all dams in the study area from the DCR database, as well as the DCR Dam Safety Data Sheet for each high hazard dam, ordered alphabetically by dam name. Each data sheet includes general characteristics, watershed information, technical basics, hydrology/hydraulics data, inspection dates and condition, EAP quick reference data, potential impacts and a detailed map of each impoundment. Section 3.11 of the *2018 Commonwealth of Virginia Hazard Mitigation Plan* is also hereby adopted by reference, specifically the information regarding dams in the region.

SEA LEVEL RISE AND LAND SUBSIDENCE

BACKGROUND

Global sea level is determined by the volume and mass of water in the world's oceans. Sea level rise occurs when the oceans warm or ice melts, bringing more water into the oceans. Sea level rise caused by warming water or thermal expansion is referred to as steric sea level rise, while sea level rise caused by melting snow and ice is called eustatic sea level rise. The combination of steric and eustatic sea level rise is referred to as absolute sea level rise. Absolute sea level rise does not include local land movements. Additionally, while it is often represented as a global average, absolute sea level rise varies from place to place as a result of differences in wind patterns, ocean currents, and gravitational forces.

The primary consequences of continuing sea level rise are interrelated and include:

Increased Coastal Erosion – Sea level rise influences the on-going processes that drive erosion, in turn making coastal areas ever more vulnerable to both chronic erosion and episodic storm events (Maryland Commission on Climate Change, 2008). Secondary effects of increased erosion include increased water depths and increased sediment loads which can drown seagrass and reduce habitat and food sources for fish and crabs. Increased wave action contributes to the increased erosion as the wave energy attacks intertidal and upland resources.

Inundation of Normally Dry Lands – The loss of coastal upland and tidal wetlands through gradual submergence or inundation is likely over time. Wetlands can provide protection from erosion, subdue storm surges, and provide a nursery and spawning habitat for fish and crabs. Without impediments, such as hardened shorelines, and with a slow enough rate of sea level rise, wetlands can normally migrate upland. However, if barriers are present and sea level rise outpaces upland migration, wetlands can drown in place (*Virginia Governor's Commission on Climate Change*, 2008). Many communities in the region have noted an influx of requests in recent years for bulkhead repair as a result of more frequent inundation behind failing bulkheads. Tidal wetlands are slowly migrating landward. The loss of wetlands means increased coastal and shoreline erosion, reduced storm surge protection, and reduction in nursery and spawning habitat for fish and crabs.

Coastal Flooding – An increase in duration, quantity, and severity of coastal storms results in increased flood damages to infrastructure. Increased sea level and/or land subsidence increases the base storm tide, which is the storm surge plus astronomical tide (Boon, Wang, and Shen, undated). Ultimately, sea level rise increases the destructive power of every storm surge. Minor storms that may not have caused damage in the past will begin to affect infrastructure in the future (Boon, et al, undated). Higher wave energy from higher storm tides will translate each storm's destructive forces landward. The damage caused by major storms becomes increasingly costly. Sea level rise will threaten the longevity and effectiveness of stormwater drainage systems and other infrastructure, especially during significant rain events that occur during high tides such as that which may be caused by a nor'easter.

Saltwater Intrusion – As sea level rises, the groundwater table may also rise, and saltwater may intrude into freshwater aquifers. This impact may have secondary impacts related to drinking water and agriculture, even for home gardeners.

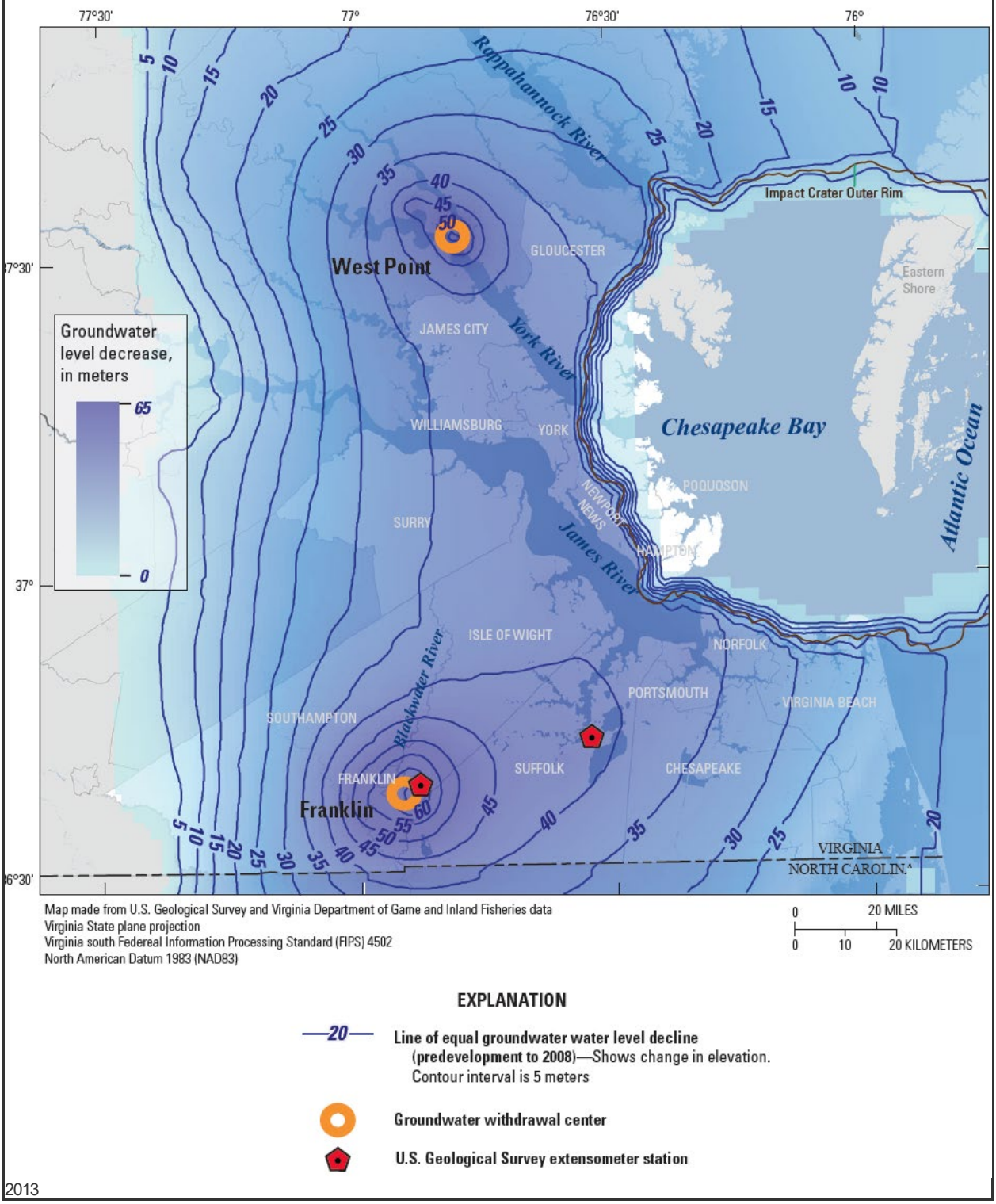
LOCATION AND SPATIAL EXTENT

According to the Old Dominion University Center for Sea Level Rise, sea level rise has a very localized spatial extent related to past development activities. Historically, many of the region's large and small waterways were filled, creating developable land upon which infrastructure, residences and businesses were constructed. Subsequently, as sea level has risen, these areas have been the first to experience the effects. Water begins to retrace ancient flow paths, flooding neighborhood streets and stormwater outfalls. The outfalls are then less capable of handling rainfall runoff because the pipes must also accommodate rising sea water. This phenomenon exacerbates and prolongs flood events.

Several factors are influencing the rates of sea level rise relative to land in the Hampton Roads region, including an increased volume of water in the oceans from melting ice. Some scientists believe that thermal expansion of a gradually warming ocean increases ocean volume. The rate of sea level rise is relative to the land adjacent to the sea; land subsidence is the downward movement of the earth's crust. The Hampton Roads region is experiencing both regional subsidence (along the east coast of the United States) and local subsidence, exacerbating the effects of storms. Subsidence alone can damage wetland and coastal marsh ecosystems and damage infrastructure, but when combined with sea level rise, the effects can be even more devastating.

Local subsidence is believed to be the result of settlement or compaction of subsurface layers resulting from groundwater withdrawals and glacial isostatic rebound (USGS, *Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region*, 2013). Groundwater withdrawals in the region, primarily seen near the pumping centers of Franklin and West Point, decrease pressure and therefore water levels in the aquifer system. As a result, the aquifer system compacts and the land surface subsides. Borehole extensometers, like the one in Franklin, Virginia measure compaction or expansion of aquifer thickness. Scientists also use surface monitoring data such as that from tidal stations, geodetic surveying and remote sensing in an effort to determine how much land subsidence can be attributed to aquifer compaction. **Figure 4.6** illustrates the spatial extent of changes in groundwater level in the Hampton Roads region that are thought to contribute to land subsidence.

FIGURE 4.6: GROUNDWATER LEVEL DECREASES FROM 1900 TO 2008

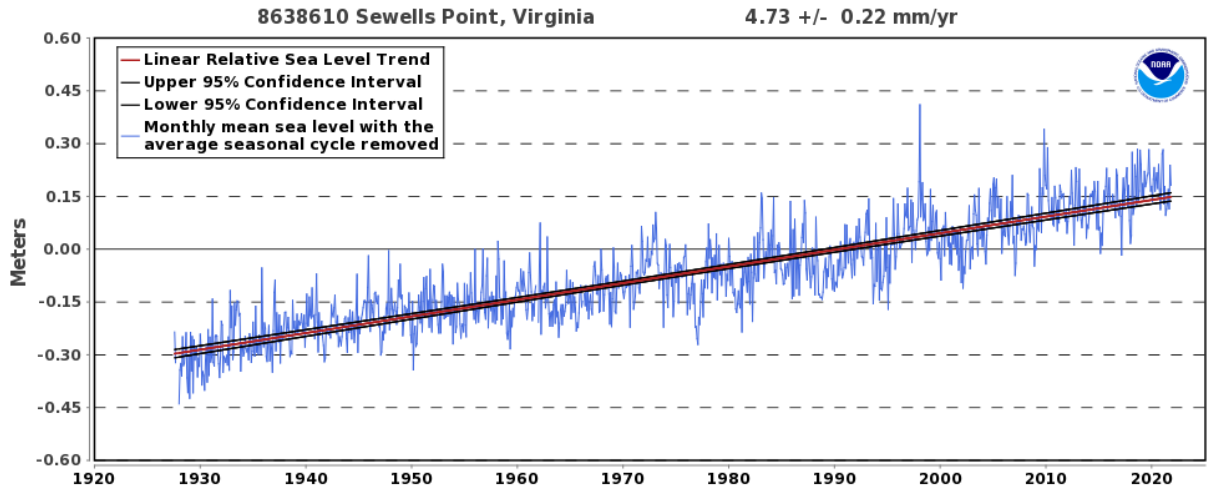


Source: USGS, Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region, 2013

NOAA has compiled data from regional tide gauges to document the rates of sea level rise. There are four local stations with data pertinent to the region, and the rates of sea level rise range from 1.23 feet to 1.98 feet per 100 years.

At Sewell's Point, Naval Station Norfolk, the local NOAA tide station with the longest period of record, the mean sea level trend is 4.73 millimeters/year with a 95% confidence interval of +/- 0.22 mm per year, based on monthly mean sea level data from 1927 to 2020 (**Figure 4.7**). This rate is equivalent to a change of 1.55 feet in 100 years. The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95 percent confidence interval.

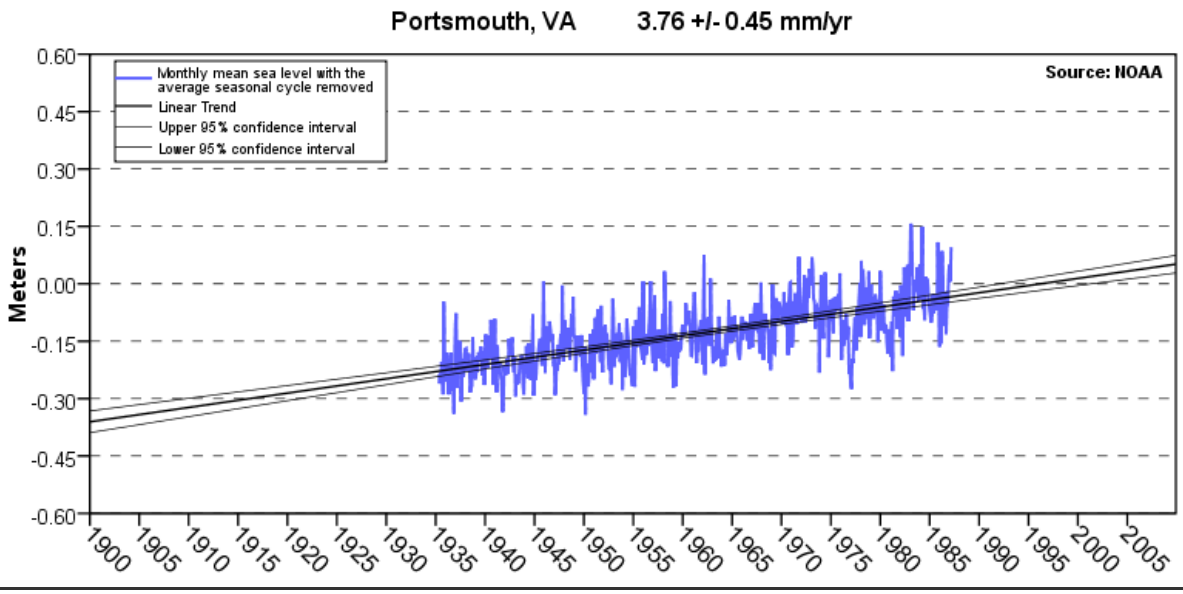
FIGURE 4.7: MEAN SEA LEVEL TREND, SEWELLS POINT, VIRGINIA



Source: NOAA, 2021

At Downtown Portsmouth, the mean sea level trend is 3.76 millimeters/year with a 95% confidence interval of +/- 0.45 mm/year based on monthly mean sea level data from 1935 to 1987 (**Figure 4.8**). This rate is equivalent to a change of 1.23 feet in 100 years.

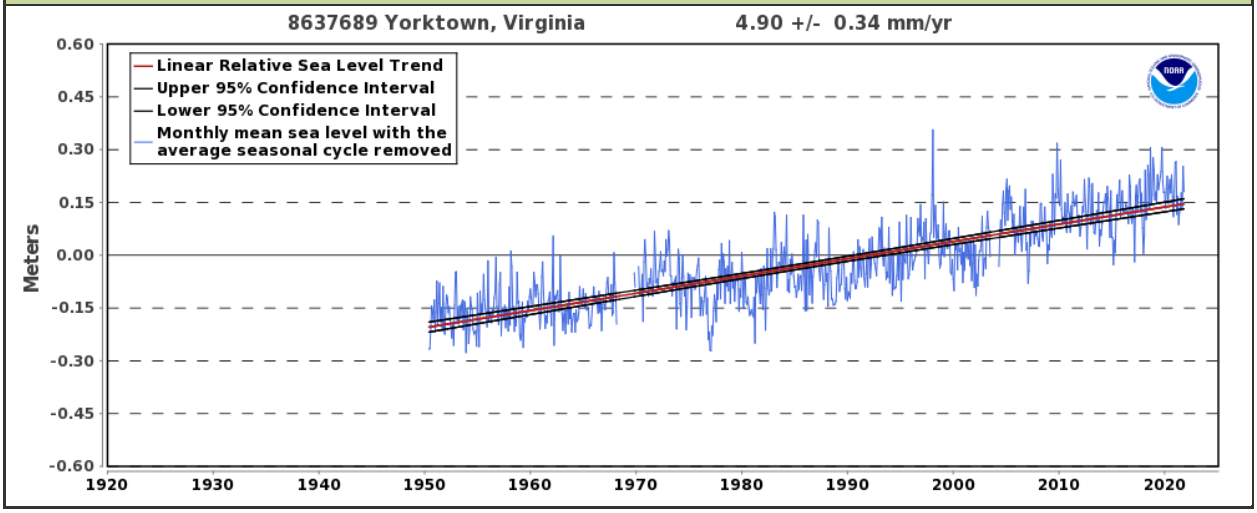
FIGURE 4.8: MEAN SEA LEVEL TREND, PORTSMOUTH, VIRGINIA



Source: NOAA, 2021

At Yorktown, Virginia, as shown in **Figure 4.9**, the mean sea level trend is 4.90 millimeters/year with a 95-percent confidence interval of +/- 0.34 mm/yr based on monthly mean sea level data from 1950 to 2020, which is equivalent to an increase of 1.61 feet in 100 years.

FIGURE 4.9: MEAN SEA LEVEL TREND, YORKTOWN, VIRGINIA



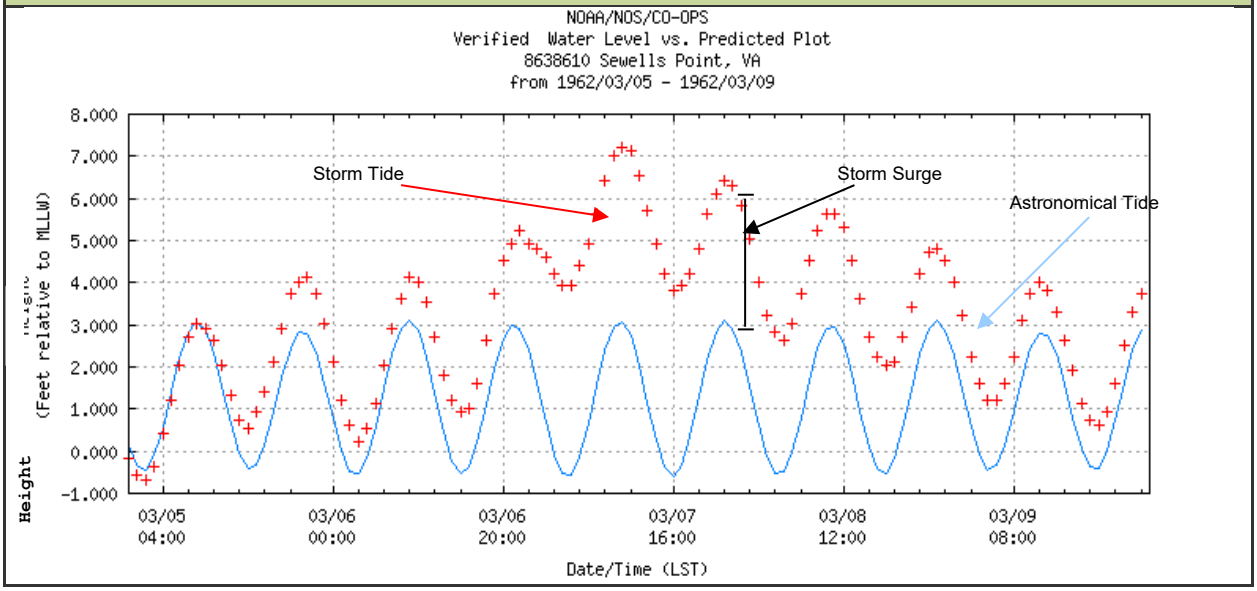
Source: NOAA, 2021

SIGNIFICANT HISTORICAL EVENTS

Unlike wildfires, earthquakes or coastal storms, the impacts of sea level rise are not felt or recorded in a matter of hours or days, but instead are slowly observed, recorded, and experienced over decades and centuries. However, scientists at VIMS have gathered data from several historical storms and made careful comparisons in an effort to highlight the historical impact of sea level rise locally.

The **Ash Wednesday Storm of 1962** produced a peak storm tide of approximately 7.2 feet MLLW at Sewell's Point (see **Figure 4.10**). If that same storm were to occur at mean high tide in 2030, using the sea level rise rates calculated above for Sewell's Point, the astronomical tide would be approximately one foot higher. Since the storm tide is obtained by adding the storm surge to the astronomical tide, the same storm could then produce a storm tide of over 8 feet MLLW. By comparison, Hurricane Isabel in 2003 produced a storm tide of 7.887 feet MLLW and caused an immense amount of damage.

FIGURE 4.10: ASTRONOMICAL AND STORM TIDES FOR 1962 STORM



Source: NOAA, 2008

Similarly, Boon (undated) concluded that sea level rise contributed to the similarity of two storms, the **August 1933 hurricane** and **Hurricane Isabel** in 2003. The storms had comparable peak storm tides of 8.018 feet MLLW (1933) and 7.887 feet MLLW (2003), and both peaks occurred very shortly before or after astronomical high tide, yet the 1933 storm occurred during spring tides and Isabel during neap tides. As a result, the storm surge in the 1933 storm was much higher and, all things being equal, the data would not have shown the storm surge that it did for Isabel had it not been for the constant adjustment of MLLW to account for as much as 1.35 feet of sea level rise between August, 1933 and September, 2003 (**Table 4.5**).

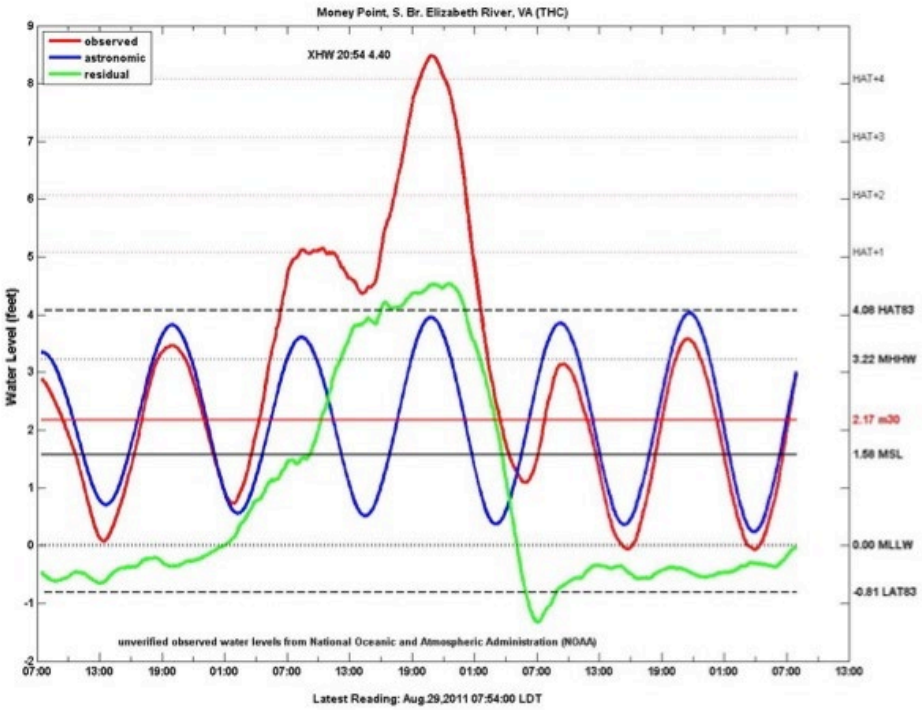
TABLE 4.5: AUGUST 1933 HURRICANE AND HURRICANE ISABEL (BOON, UNDATED)

STORM	STORM TIDE (HEIGHT IN FEET ABOVE MLLW)	STORM SURGE (HEIGHT IN FEET ABOVE NORMAL)	MEAN WATER LEVEL (HEIGHT IN FEET ABOVE MLLW)
August 1933	8.018	5.84	0.95
Isabel – September 2003	7.887	4.76	2.30
1933 -2003	0.131	1.08	-1.35

A mere tropical depression, **Ernesto** struck Hampton Roads on September 1, 2006. At Sewells Point, the storm surge reached a peak of about four feet above monthly mean sea level for the lunar month, but occurred at low tide. Boon (*Ernesto: Anatomy of a Storm Tide,* undated) concludes that if the peak storm surge had occurred at high tide, the storm tide peak would have reached seven feet MLLW, or just 0.9 feet below Isabel's peak storm tide.

Scientists have also focused on data from Money Point, Virginia, on the southern branch of the Elizabeth River near Portsmouth. In *Sea Level Rise and Coastal Infrastructure: Prediction, Risks and Solutions*, Bilal M. Ayyub and Michael S. Kearney observe that during the extratropical storm event which occurred in mid-November 2009, the maximum extratidal storm tide height of 4.69 feet at Money Point exceeded the extratidal height of 4.43 feet observed there during Hurricane Isabel. Again, during Hurricane Irene in 2011, the VIMS Tidewatch tool showed that Money Point experienced the highest water levels in the area, at 4.4 feet above highest astronomical tide. **Figure 4.11** shows observed water levels (red), predicted astronomic tide (blue), and the storm surge (green).

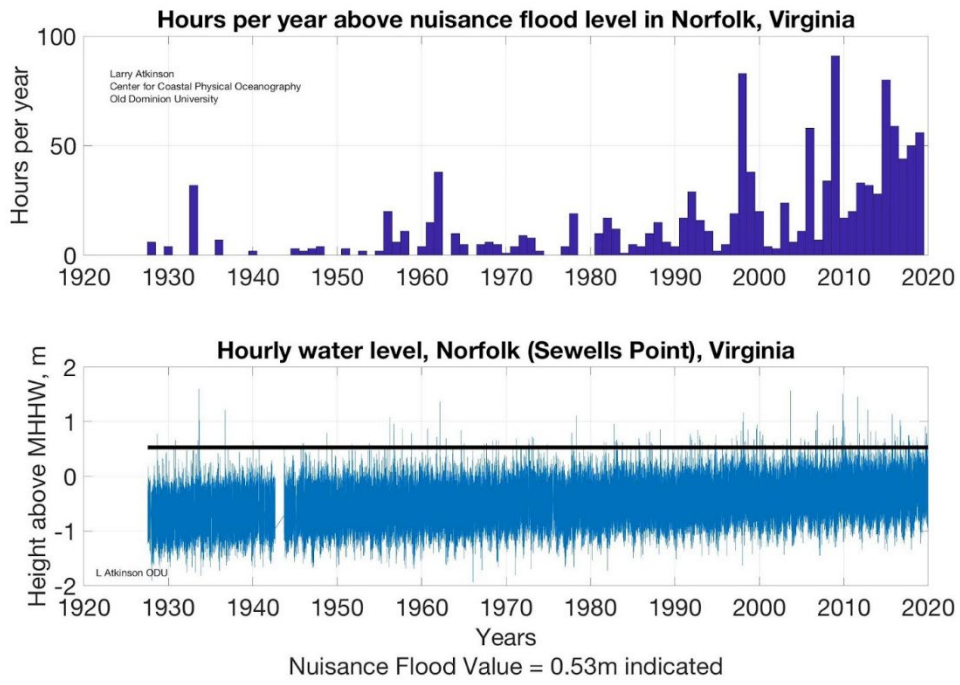
FIGURE 4.11: HURRICANE IRENE, TIDEWATCH DATA FOR MONEY POINT, VA



Source: Virginia Institute of Marine Science, 2011

The impacts of sea level rise are being felt on an almost daily basis in many parts of Hampton Roads. Dr. Larry Atkinson at the Old Dominion University Center for Coastal Physical Oceanography, compiled **Figure 4.12** which graphically shows the increasing problem of nuisance flooding in Norfolk. Nuisance flooding, sometimes referred to as "sunny day flooding" is a water level value determined by the NWS in collaboration with regional emergency managers. Regionally, that level is 0.53 meters (1.7 feet) above Mean Higher High Water: the horizontal black line in the lower panel of Figure 4.12. The upper panel shows there are occasional years with abnormally high hours of flooding. These are typical during a major hurricane or northeasters with long durations in the area. There is a slow, steady increase from about 2005. Based on this plot some exposed parts of Hampton Roads can expect at least 40 to 50 hours of nuisance flooding per year in the coming years. The lower panel shows the hourly water level since 1927.

FIGURE 4.12: NUISANCE FLOODING IN NORFOLK

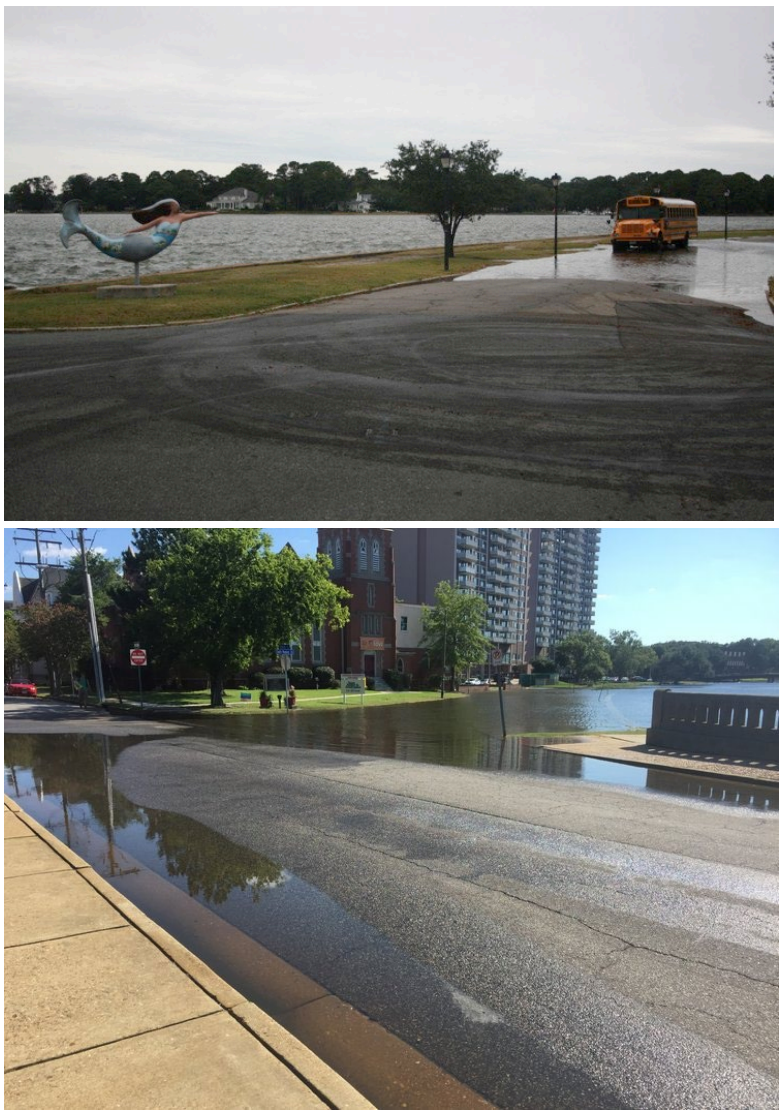


Source: L. Atkinson Online Blog, Old Dominion University, March 2020

The impacts of sea level rise are similar to the effects of flooding outlined above, but the frequency and severity of flooding can be expected to continue to increase, which has longer-term effects.

As nuisance flooding increases, Hampton Roads' population is becoming more accustomed to driving through salt-water flooded roads, cleaning out flooded buildings, and working through the impacts of each minor flood. But the longer-term economic impacts discussed above for flooding are slowly becoming more apparent. More communities must commit to long-term capital expenditures on flood mitigation and infrastructure rather than new investments in economic development, for example. More property owners must spend their wages on flood insurance, flood repair, and flood mitigation rather than on tangible goods. And the real estate market suffers when structures are subject to repetitive flooding with increasing frequency. Even nuisance flooding of crawl spaces or garages detracts from the ability of a house in a repetitive flood loss area to accrue value in the long-term. Days out of school for students locally are increasing annually due to flooding, and the impact on students and parents is sobering from an economic standpoint.

Impacts on the environment are apparent as shoreline erosion from more frequent shoreline inundation contributes to loss of trees, wetland grasses and other valuable habitats of the intertidal zone. Damage to these sensitive features is important because it could affect the important local seafood industry which relies on the intertidal zone as a fish and shellfish nursery, and because of the difficulty of recreating these habitats elsewhere. Also, eroded shorelines are more vulnerable to damage from severe flood events in the future.

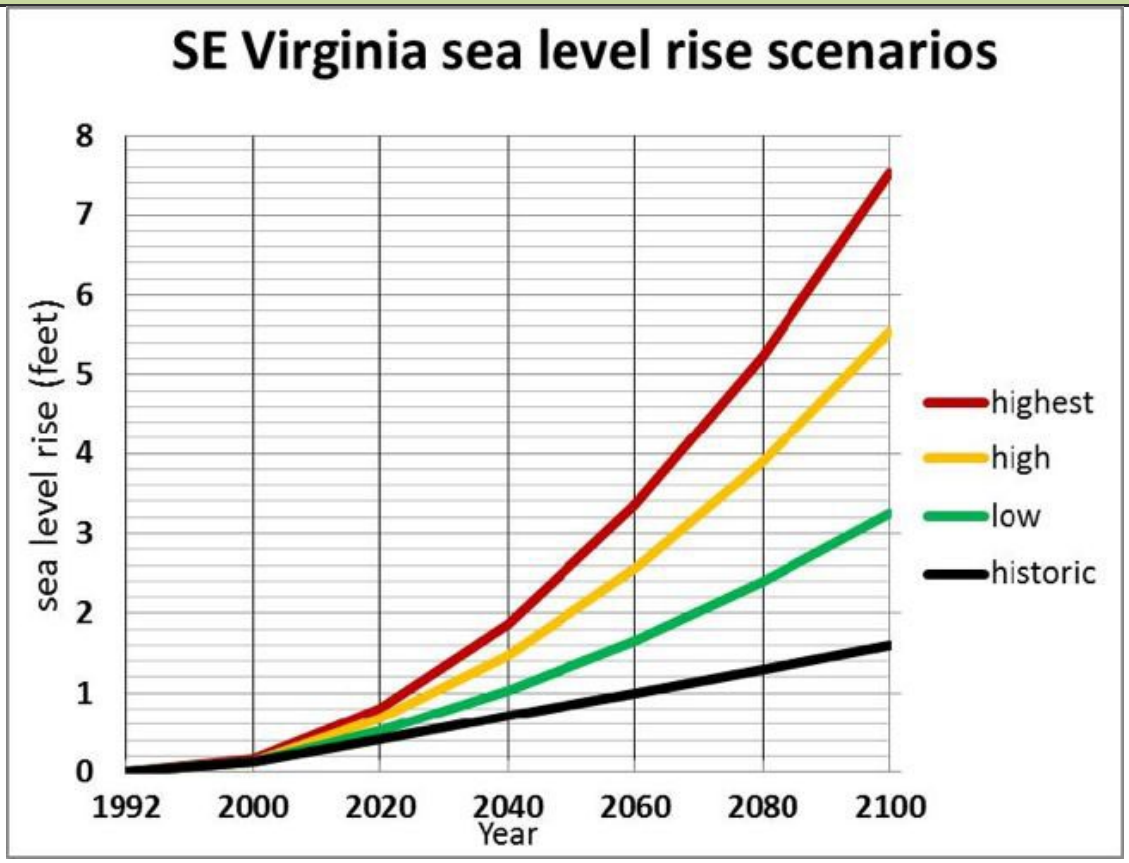


Nuisance flooding in Norfolk.
Source: Wetlands Watch

PROBABILITY OF FUTURE OCCURRENCE

In a report to the Virginia General Assembly in 2013 entitled *Recurrent Flooding Study for Tidewater Virginia*, VIMS presented four scenarios of sea level rise. Each scenario, as shown in **Figure 4.13** represents a possible trajectory for sea level rise in the region. The lowest, historic scenario is based on observed rates of rise and does not account for any acceleration. The low scenario incorporates some acceleration using assumptions about future greenhouse gas emission. The high scenario is based on the upper end of projections from semi-empirical models using statistical relationships in global observations of sea level and air temperature. And the highest scenario is based on consequences of global warming, ice-sheet loss and glacial melting. Each scenario was customized for conditions in southeastern Virginia, including using estimates for subsidence. The report concludes that regional planners should anticipate a 1.5-foot rise in sea level above the 1992 datum within the next 20 to 50 years (2033-2063). According to the VIMS report, “sea level rise will make it easier for the current patterns of weather events to generate damaging flood events in the future. Increases in storm intensity and/or frequency will only aggravate that circumstance.”

FIGURE 4.13: SOUTHEAST VIRGINIA SEA LEVEL RISE SCENARIOS

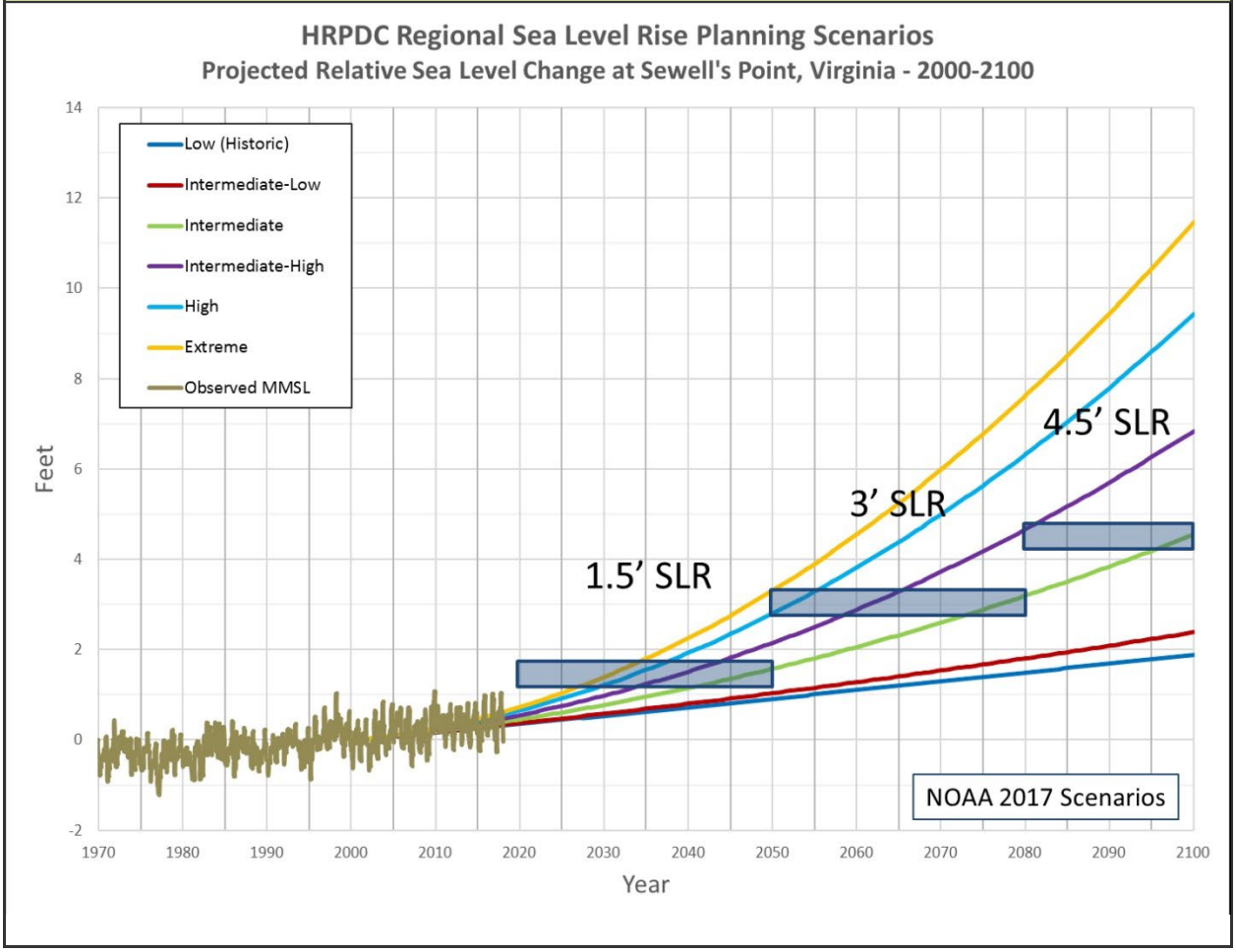


Source: VIMS, Recurrent Flooding Study for Tidewater Virginia, 2013 HRPDC web site, accessed May 19, 2021.

Following issuance of the 2013 study by VIMS and subsequent discussion, on October 18, 2018, the HRPDC approved and adopted a resolution encouraging local governments within the region to consider adopting policies that incorporate sea level rise into planning and engineering decisions. The approved Sea Level Rise Planning Policy and Approach incorporates and expounds on the concepts in the 2013 report and adds three unique time-based planning horizons. The policy recommends the following relative sea level rise scenarios as depicted in **Figure 4.14**:

- 1.5 ft above current mean higher high water (MHHW) for near-term (2018-2050);
- 3 ft above current mean higher high water (MHHW) for mid-term (2050-2080); and
- 4.5 ft above current mean higher high water (MHHW) for long-term (2080-2100).

FIGURE 4.14: SOUTHEAST VIRGINIA SEA LEVEL RISE SCENARIOS



Source: HRPDC web site, accessed May 19, 2021.

The rationale behind this important resolution of agreement is that sea level rise is projected to be significant for Hampton Roads. Factoring it into planning and design decisions will reduce risk and damage from flooding and storm surge. Significant advances in climate modeling and analysis of observed trends support development of new sea level rise projections at the local level that are improvements above previously recommended projections. A regional consensus on values and approaches for sea level rise planning can, therefore, provide support for local efforts, assist with regional coordination, and encourage state and federal agencies to adopt similar standards.

The document also recommends selecting appropriate sea level rise curves and designs based on the risk tolerance and costs associated with individual projects. HRPDC staff is working to develop more specific implementation recommendations for categories of projects and policies.

TROPICAL/COASTAL STORM

BACKGROUND



Hurricane Isabel approaches North Carolina and Virginia in September of 2003. Photo source: NASA

Hurricanes and tropical storms are characterized by closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere and with a diameter averaging 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a mechanism to transport built-up heat from the tropics toward the poles. In this way, they are critical to the earth's atmospheric heat and moisture balance. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are particularly vulnerable to storm surge, wind-driven waves, and tidal flooding which can prove more destructive than cyclone wind[2].

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is September 10th. The Atlantic Ocean averages about 10 storms annually, of which six reach hurricane status (NASA Earth Observatory online at: http://earthobservatory.nasa.gov).

As a hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour (mph), the system is designated a tropical storm, given a name, and is monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 mph the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale which rates hurricane intensity on a scale of one to five, with five being the most intense. The wind scale, recently revised to remove storm surge ranges, flooding impact and central pressure statements, is shown in **Table 4.6**.

[2] For purposes of this risk assessment, coastal flood hazards associated with hurricanes and tropical storm events are included under the "flood" hazard.

TABLE 4.6: SAFFIR-SIMPSON HURRICANE WIND SCALE		
CATEGORY	MAXIMUM SUSTAINED WIND SPEED (mph)	DAMAGE SUMMARY
1	74–95	Very dangerous winds will produce some damage.
2	96–110	Extremely dangerous winds will cause extensive damage.
3	111–129	Devastating damage will occur
4	130–156	Catastrophic damage will occur.
5	157 +	Catastrophic damage will occur.

Source: National Hurricane Center

Categories 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20% of total tropical cyclones making landfall, they account for over 70 percent of the damage in the United States. **Table 4.7** describes the damage that could be expected for each hurricane category.

TABLE 4.7: HURRICANE DAMAGE CLASSIFICATIONS		
STORM CATEGORY	DAMAGE LEVEL	DESCRIPTION OF DAMAGES
1	MINIMAL	Well-constructed frame homes could have damage to roofs, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	MODERATE	Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	EXTENSIVE	Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	EXTREME	Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	CATASTROPHIC	A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center web site, 2015

Storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to twenty feet. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. A storm surge is a wave that has outrun its generating source and become a long period swell. The surge is always highest in the right-front quadrant of the direction in which the hurricane is moving. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage.

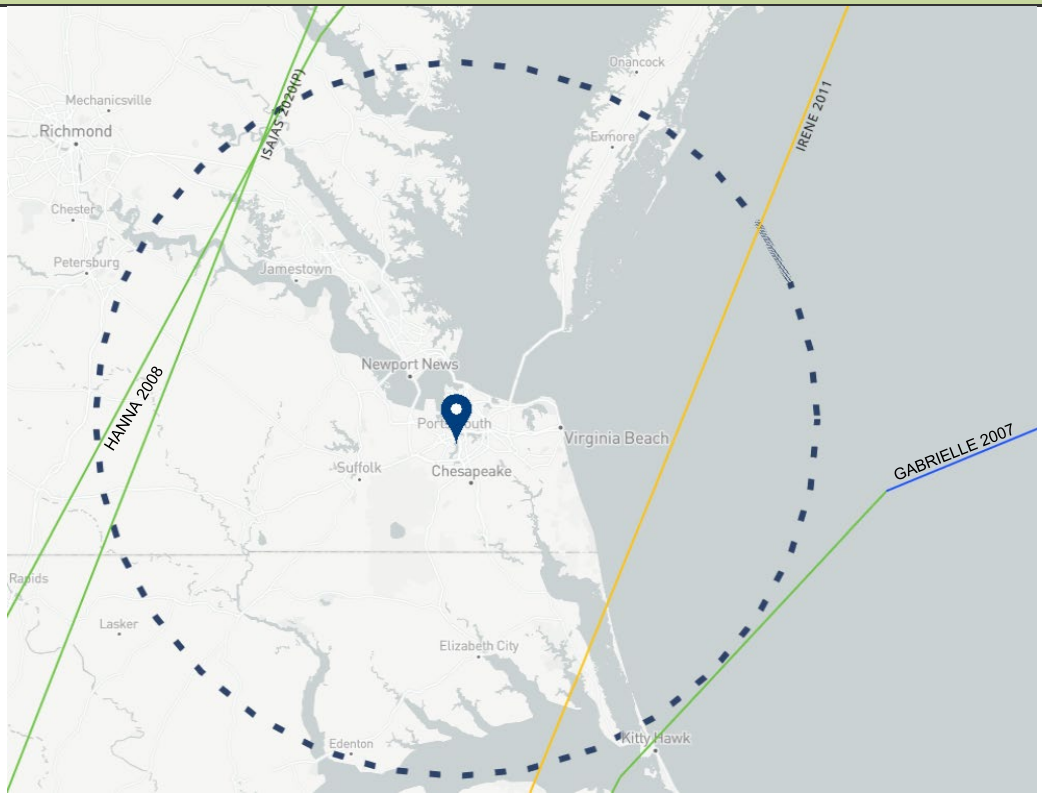
Storm surge heights and associated waves are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms. For the purposes of this report, the storm surge impacts in the region are discussed under the Flooding hazard.

LOCATION AND SPATIAL EXTENT

Hampton Roads is in an area that can expect to experience hurricane damage in any given year. Since the mid-1800s, numerous tropical cyclones have affected Virginia, causing the deaths of over 225 people and costing the Commonwealth more than a billion dollars in damages.

A total of 76 significant storms have passed within 75 miles of Hampton Roads since 1851 (**Figures 4.15 and 4.16**). Two Category 3 hurricanes passed within 75 miles of the region (unnamed storms in 1879 and 1899), eight were Category 2 hurricanes, 16 were Category 1 hurricanes and 50 were tropical storms. Tropical and extratropical depressions are not mapped in these figures.

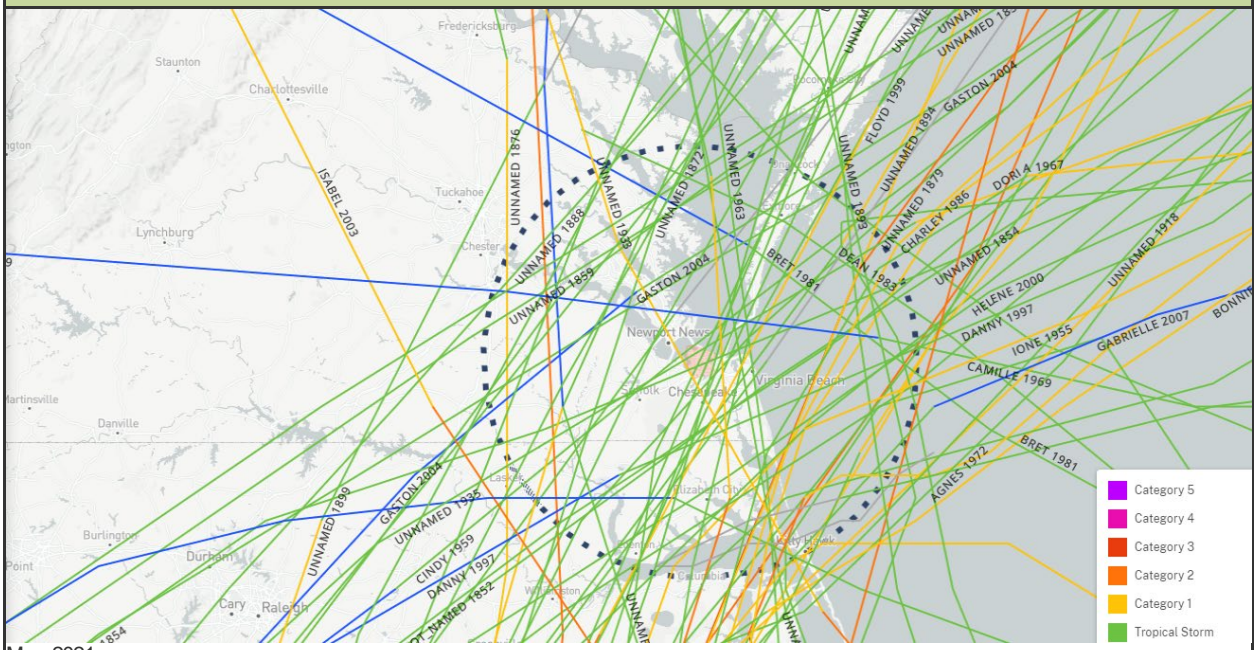
FIGURE 4.15: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS SINCE 2005



May, 2021

Source: NOAA Historical Hurricane Tracks, May 2021. Extratropical storms and Tropical Depressions at the time they passed within the radius are not included.

FIGURE 4.16: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS, 1851-2005



May, 2021

Source: NOAA Historical Hurricane Tracks, May, 2021

In Hampton Roads, the negative impacts of wind from the Category 1 and 2 hurricane events the area has experienced are consistent with the damage described in Table 4.7. Wind damage in the region from events in recent memory has been marked by a large number of downed trees, damage to roofs, siding and signs, power outages of typically less than a week as a result of downed power lines and trees across lines, and wind-blown debris damage and accumulation. Downed trees can temporarily block roadways, impeding transportation; however, these blockages are typically repaired swiftly by Virginia Department of Transportation (VDOT) and local roadway maintenance crews. Business interruptions resulting from power outages are commonplace and many restaurants and cold storage facilities can be negatively impacted, especially by prolonged outages. Commodities such as ice and gas are in high demand to power both home and business generators. Since wind and flood events typically occur simultaneously, the combined impacts are more devastating in flood-prone areas. Roof damage from wind can subsequently result in rain damage to structures, as well. Combined storm surge and wind impacts to shorefront areas at Virginia Beach, Norfolk, and Hampton may make some homes and businesses uninhabitable for days to weeks at a time.

SIGNIFICANT HISTORICAL EVENTS

The NWS began keeping weather records on January 1, 1871. Prior to that, information on past hurricanes and tropical storms to impact the Hampton Roads region were taken from ships logs, accounts from local citizens, newspapers, and other sources. There are several historical references to major storms that affected coastal Virginia in the 1600's and 1700's. Some of these storms were strong enough to alter land masses, including the widening of the Lynnhaven River (September 6, 1667) and formation of Willoughby Spit (October 19, 1749). These reports also indicate severe flooding caused by these storms (12-15 feet of flooding in some cases).

Better records have been kept since 1871. One of the first storms to be well documented was a hurricane in **October 1878** that resulted in Cobb and Smith Islands on the Eastern Shore being completely submerged.

One of the worst storms to impact the region occurred in August 1933 when a hurricane known as the **Chesapeake-Potomac Hurricane of 1933** passed just west of the Hampton Roads area. The storm made landfall in northeastern North Carolina and moved northwest. This hurricane produced the record high tide for the area which exists today, at a level of 9.69 feet above MLLW. The highest sustained wind was 88 mph at the Naval Air Station (NAS). Less than a month later, another hurricane struck the area with winds again clocked at 88 mph at NAS, but tides only rose to 8.3 feet above MLLW.

Another unnamed storm occurred in **September of 1944** creating the fastest one-minute wind speed to ever be recorded in the area of 134 mph at Cape Henry. Gusts were estimated to be 150 mph. The local NWS office recorded 72 mph winds with gusts to 90 mph.

Although the center of circulation for **Hurricane Hazel** in 1954 did not pass within 75 miles of the region, wind speeds of 78 mph were recorded at Norfolk Airport with gusts up to 100 mph and an unofficial reading of 130 mph was also reported in Hampton.

In 1960, **Hurricane Donna** passed through the region with a fastest one-minute wind speed of 73 mph at Norfolk Airport, 80 mph at Cape Henry and estimated 138 mph at Chesapeake Light Ship. Lowest pressure of 28.65 inches holds the area record for a tropical storm. Three deaths were documented in association with this hurricane.

On August 27, 1998, **Hurricane Bonnie** tracked over the region after passing over the northern Outer Banks. Winds speeds were sustained at 46 mph with gusts to 64 mph at Norfolk International Airport. Four to seven inches of rain combined with near hurricane force winds knocked out power to 320,000 customers across Virginia. Highest tide was recorded at 6.0 feet above MLLW. This was the most significant storm to impact the region since Hurricane Donna in 1960.

On September 6, 1999, downgraded **Hurricane Floyd** passed directly over Virginia Beach on a track similar to Hurricane Donna in 1960. Wind speeds were recorded at 31 mph with gusts to 46 mph. Rainfall amounts of 12-18 inches were recorded in portions of eastern Virginia, causing extensive flooding in the Southside Hampton Roads region.

In the 1990s, several storms had a less direct path over Hampton Roads, but nonetheless impacted the weather severely. In 1996, **Hurricanes Bertha and Fran** impacted the region, followed by **Hurricane Danny** in 1997, **Hurricane Bonnie** in 1998, and **Hurricanes Dennis, Floyd, and Irene** in 1999. Although each of these storms was downgraded by the time they reached Hampton Roads, they each created problems for the region when they passed through, and two resulted in Federal Disaster declarations (Bonnie and Floyd) for the region. **Tropical storms Helene** in 2000 and **Kyle** occurred in 2002, and of course, **Hurricane Isabel** caused $1.6 billion damage in the region in 2003, and claimed 33 lives (*The Virginian Pilot,* 9/4/06). During Isabel, wind speeds of 54 mph with gusts to 75 mph in Norfolk and significant beach erosion were reported.

Of the five storms that have passed through the region since the original Hazard Mitigation Plans were developed (Alberta, Ernesto, Barry, Gabrielle, Hanna and Irene), Hanna initially appeared to forecasters to have the worst characteristics. **Tropical Storm Hanna** tracked up the Mid-Atlantic coast on September 6, 2008, with maximum sustained winds around 50 mph. Hanna originally made landfall near the border of North and South Carolina around 3:20 am on the 6th. The storm tracked across eastern North Carolina during the early afternoon hours before turning northeast across southeastern Virginia later in the afternoon. Hanna eventually tracked across the Chesapeake Bay and into Delaware during the evening hours. With the track of Hanna being to the east, the strongest winds were also confined to the east of Hampton Roads. The highest sustained wind of 55 mph with a peak gust of 68 mph was recorded at the 3rd Island Bay Bridge Tunnel. Minimum pressure of 991 MB was recorded at the 3rd Island Bay Bridge Tunnel. Coastal storm tides of two feet or less above astronomical tide levels were common, with only minor beach erosion reported. Near the coast, as well as inland, tropical storm winds knocked down numerous trees and power lines, as well as caused minor structural damage. No fatalities or injuries were attributed to the winds.

Contrary to expectations and forecasts, however, **Ernesto** in early September 2006 proved very damaging because of coastal flooding. State officials blamed Ernesto for six deaths across Virginia and an estimated $33 million in statewide damage (*The Virginian Pilot,* 9/4/06). Additional discussion of the regional flood-related impacts from Ernesto is shown in Table 4.2.

Hurricane Irene, in late August 2011, first struck the U.S. as a Category 1 hurricane in eastern North Carolina, then moved northward along the Mid-Atlantic Coast. Wind damage in coastal North Carolina, Virginia, and Maryland was moderate, with considerable damage resulting from falling trees and power lines. Irene made its final landfall as a tropical storm in the New York City area and dropped torrential rainfall in the Northeast that caused widespread flooding. Irene was the first hurricane to hit the U.S. since Ike in September 2008. Irene's landfall in eastern North Carolina and path northward were accurately predicted more than four days in advance by NOAA's National Hurricane Center, which used information from weather satellites, hurricane models, aircraft observations, and other data.



Flooding at the "Triple Decker Bridge" resulting from Hurricane Sandy.

Photo credit: City of Chesapeake

Hurricane Sandy, in October 2012, was again expected to bring extreme hurricane conditions to southeastern Virginia. Fortunately, the storm track veered away from the Virginia coast and spared the region much of the devastation wrought in the northeast. Some areas of Virginia were included in the Presidentially-Declared Disaster for the storm, but Hampton Roads saw little more than flooding in low-lying areas and limited wind damage, and therefore was not among declared communities.

After landfall along the northwestern coast of Florida on June 7, 2013, **Tropical Storm Andrea** moved northeastward with additional acceleration across northeastern Florida and southeastern Georgia, with the center passing over Savannah, Georgia. During this time, the storm maintained an intensity of 40 knots, with the strongest winds occurring mainly over water to the east and southeast of the center. As the cyclone moved into South Carolina, it started to merge with a baroclinic zone, which caused Andrea to become extratropical over northeastern South Carolina. The center of the post-tropical cyclone moved rapidly across eastern North Carolina and southeastern Virginia, over the Atlantic near the New Jersey coast, and across eastern Long Island to eastern Massachusetts. One traffic incident related to the storm appears to have caused one death in Virginia, but the location of the accident was not reported in the National Hurricane Center Tropical Cyclone Report on the storm.

August 4, 2020 – The center of **Tropical Storm Isaias** tracked north just inland of the Middle Atlantic Coast from late Monday night, August 3rd through Tuesday morning, August 4th. The tropical storm produced tropical storm force winds and associated wind damage across portions of eastern Virginia. Tropical storm winds downed and uprooted several trees and power lines, produced significant structural damage, and caused power outages across the county. Wind gust of 67 mph was measured at NTU. Wind gust of 59 mph was measured at Virginia Beach. Property damage of $2.8 million was reported.

Table 4.8 shows the historical storm tracks within 75 miles of Hampton Roads since 1851 that are the basis for **Figures 4.15 and 4.16**. While Tropical Storm Arthur in 2014 does not appear to have tracked within the search radius used for **Table 4.9** and **Figure 4.16**, the storm nonetheless produced tropical storm force winds and locally heavy rainfall across portions of southeast Virginia from late Thursday night, July 3rd into midday Friday, July 4th. Rain bands associated with Arthur produced generally one to two inches of rainfall across portions of the Virginia Beach. Back Bay reported 1.30 inches of rain. A wind gust of 47 knots was measured at Oceana NAS, and a wind gust of 43 knots was measured at Lynnhaven. The gusts caused

minor structural damage which was reported to total $5,000. Norfolk International Airport reported 1.46 inches of rain. A wind gust of 38 knots was measured at Norfolk NAS.

Three additional tropical storms caused damage in the study area over the past five years that deserve mention, despite the fact that their storm tracks did not fall within the parameters outlined for Figure 4.16 or Table 4.8:

September 2, 2016 - **Tropical Storm Hermine** moving northeast along the Southeast Coast then off the Mid Atlantic Coast produced tropical storm force winds, minor to moderate coastal flooding, and locally heavy rainfall across portions of Hampton Roads, the Middle Peninsula, and the Virginia Eastern Shore from Friday afternoon, September 2nd into Saturday night, September 3rd. Rain bands produced generally 2 to 4 inches of rainfall across the county. Norfolk reported 4.15 inches of rain. Norfolk South reported 3.77 inches of rain. Norfolk International Airport reported 2.68 inches of rain. The highest sustained wind of 39 knots with a peak wind gust of 48 knots was measured at Norfolk International Airport. Wind gust of 45 knots was measured at NAS Norfolk. Tropical storm wind gusts caused minor tree and structural damage. Coastal storm tides of 2 to 3.5 feet above astronomical tide levels were common, with only minor beach erosion reported. The maximum storm tide reached 6.16 feet MLLW at Sewells Point, which resulted in moderate coastal flooding Saturday morning into Saturday afternoon. Damages tallied $35,000 across the region.

September 5, 2019 - **Hurricane Dorian** tracking northeast along the North Carolina coast and just off the Virginia coast produced tropical storm winds and associated wind damage across portions of southeast Virginia. Tropical storm winds downed and uprooted several trees and power lines, produced minor structural damage, and caused power outages across the county. Wind gust of 55 mph was measured at Naval Auxiliary Landing Field Fentress in Chesapeake. Power poles were broken in some areas, and shingles were blown off the roof of a house. Damages of $340,000 were reported.

Damages attributed to Post Tropical Cyclone Michael in October of 2016 were attributed primarily to Flooding as described in the section above.

TABLE 4.8: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS (SINCE 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (mph)	STORM CATEGORY AT LANDFALL
8/25/1851	UNNAMED	45	TROPICAL STORM
9/10/1854	UNNAMED	45	TROPICAL STORM
8/20/1856	UNNAMED	60	TROPICAL STORM
9/17/1859	UNNAMED	60	TROPICAL STORM
9/27/1861	UNNAMED	70	TROPICAL STORM
11/2/1861	UNNAMED	80	CATEGORY 1 HURRICANE
9/18/1863	UNNAMED	70	TROPICAL STORM
10/26/1872	UNNAMED	45	TROPICAL STORM
9/29/1874	UNNAMED	70	TROPICAL STORM
9/17/1876	UNNAMED	90	CATEGORY 1 HURRICANE
10/23/1878	UNNAMED	105	CATEGORY 2 HURRICANE
8/18/1879	UNNAMED	115	CATEGORY 3 HURRICANE
9/9/1880	UNNAMED	80	CATEGORY 1 HURRICANE
9/10/1881	UNNAMED	70	TROPICAL STORM
9/11/1882	UNNAMED	45	TROPICAL STORM
9/23/1882	UNNAMED	45	TROPICAL STORM
9/12/1883	UNNAMED	45	TROPICAL STORM
8/26/1885	UNNAMED	80	CATEGORY 1 HURRICANE
7/2/1886	UNNAMED	40	TROPICAL STORM
9/11/1888	UNNAMED	40	TROPICAL STORM
10/12/1888	UNNAMED	60	TROPICAL STORM
9/25/1889	UNNAMED	45	TROPICAL STORM
6/17/1893	UNNAMED	65	TROPICAL STORM
10/23/1893	UNNAMED	50	TROPICAL STORM

TABLE 4.8: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS (SINCE 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (mph)	STORM CATEGORY AT LANDFALL
9/29/1894	UNNAMED	85	CATEGORY 1 HURRICANE
10/10/1894	UNNAMED	75	CATEGORY 1 HURRICANE
9/23/1897	UNNAMED	70	TROPICAL STORM
10/26/1897	UNNAMED	60	TROPICAL STORM
8/18/1899	UNNAMED	120	CATEGORY 3 HURRICANE
10/31/1899	UNNAMED	65	TROPICAL STORM
7/11/1901	UNNAMED	80	CATEGORY 1 HURRICANE
6/16/1902	UNNAMED	40	TROPICAL STORM
9/15/1904	UNNAMED	65	TROPICAL STORM
9/1/1908	UNNAMED	50	TROPICAL STORM
8/25/1918	UNNAMED	40	TROPICAL STORM
12/3/1925	UNNAMED	45	TROPICAL STORM
9/19/1928	UNNAMED	45	TROPICAL STORM
8/23/1933	UNNAMED	80	CATEGORY 1 HURRICANE
9/16/1933	UNNAMED	90	CATEGORY 1 HURRICANE
9/6/1935	UNNAMED	75	CATEGORY 1 HURRICANE
9/18/1936	UNNAMED	100	CATEGORY 2 HURRICANE
8/2/1944	UNNAMED	50	TROPICAL STORM
9/14/1944	UNNAMED	105	CATEGORY 2 HURRICANE
10/20/1944	UNNAMED	40	TROPICAL STORM
6/26/1945	UNNAMED	50	TROPICAL STORM
7/7/1946	UNNAMED	65	TROPICAL STORM
8/14/1953	BARBARA	105	CATEGORY 2 HURRICANE
8/31/1954	CAROL	100	CATEGORY 2 HURRICANE
8/12/1955	CONNIE	80	CATEGORY 1 HURRICANE
9/20/1955	IONE	70	TROPICAL STORM
7/10/1959	CINDY	40	TROPICAL STORM
7/30/1960	BRENDA	50	TROPICAL STORM
9/12/1960	DONNA	105	CATEGORY 2 HURRICANE
9/14/1961	UNNAMED	40	TROPICAL STORM
9/1/1964	CLEO	45	TROPICAL STORM
9/17/1967	DORIA	40	TROPICAL STORM
8/28/1971	DORIA	65	TROPICAL STORM
6/22/1972	AGNES	50	TROPICAL STORM
7/1/1981	BRET	60	TROPICAL STORM
9/30/1983	DEAN	65	TROPICAL STORM
9/14/1984	DIANA	60	TROPICAL STORM
9/27/1985	GLORIA	105	CATEGORY 2 HURRICANE
8/18/1986	CHARLEY	80	CATEGORY 1 HURRICANE
9/25/1992	DANIELLE	65	TROPICAL STORM
7/13/1996	BERTHA	75	CATEGORY 1 HURRICANE
7/24/1997	DANNY	45	TROPICAL STORM
8/28/1998	BONNIE	85	CATEGORY 1 HURRICANE
9/16/1999	FLOYD	80	CATEGORY 1 HURRICANE
9/24/2000	HELENE	45	TROPICAL STORM
10/12/2002	KYLE	45	TROPICAL STORM
9/18/2003	ISABEL	100	CATEGORY 2 HURRICANE
8/14/2004	CHARLEY	40	TROPICAL STORM
9/10/2007	GABRIELLE	40	TROPICAL STORM
9/06/2008	HANNA	70	TROPICAL STORM
8/28/2011	IRENE	75	CATEGORY 1 HURRICANE
8/4/2020	ISAIAS	69	TROPICAL STORM

Source: NOAA Historical Hurricane Tracks, May 2021

PROBABILITY OF FUTURE OCCURRENCES

It is likely that the region will be impacted by hurricanes and tropical storms in the future. Direct impacts from hurricanes category 3 and 4 intensity are rare in Hampton Roads due to 1) historical tracks remaining offshore or impacting land before reaching Hampton Roads; and 2) cooler Atlantic Ocean water temperatures north of Cape Hatteras, which diminish a storm's ability to maintain intensity, or intensify. A Category 5 hurricane is considered implausible in Hampton Roads due to the cooler water temperatures mentioned above. The effects of smaller hurricanes (Categories 1 and 2 with wind speeds from 74-110 mph) and tropical storms (sustained wind speeds of at least 39 mph and torrential rains) will be frequent, as storms making landfall along the North Carolina and Virginia coastlines could impact the region in any given year.

LANDSLIDE/COASTAL EROSION

BACKGROUND

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year. Major storms such as hurricanes and tropical storms may cause more sudden, rapid erosion by combining heavy rainfall, high winds, heavy surf and storm surge to significantly impact riverbanks and the shoreline.

As it relates to natural hazards that threaten property damage, there are two types of erosion: riverine erosion and coastal erosion. The primary concern of both riverine and coastal erosion is the gradual removal of rock, vegetation and other sediment materials from riverbanks, stream beds and shorelines that result in soil instability and possible damages to property and infrastructure.

The average annual erosion rate on the Atlantic coast is roughly 2 to 3 feet per year; however, erosion rates vary greatly from location to location and year to year. A study by The Heinz Center (2000), *Evaluation of Erosion Hazards*, states that over the next 60 years, erosion may claim one out of four houses within 500 feet of the U.S. shoreline. It also states that nationwide, erosion may be responsible for approximately $500 million in property loss to coastal property owners per year, including both damage to structures and loss of land. To the homeowners living within areas subject to coastal erosion, the risk posed by erosion is comparable to the risk from flooding and other natural hazard events.

In Hampton Roads, shoreline, or coastal, erosion poses the most significant threat, and is a long-term hazard that undermines waterfront homes, businesses, public facilities and infrastructure along shorelines, even rendering structures uninhabitable or unusable. Shoreline erosion is driven by a number of natural influences such as sea level rise and land subsidence, large storms such as tropical storms, nor'easters and hurricanes, storm surge, flooding and powerful ocean waves. While coastal flooding in the region is typically a short term event, shoreline erosion in Hampton Roads may best be described as a relatively slow natural process occurring over the long term, with occasional major impacts wrought by coastal storm and flooding hazards. Manmade influences such as coastal development and some shoreline stabilization projects can exacerbate shoreline erosion, even when initially intended to minimize immediate erosive effects. Many older shoreline stabilization features in Hampton Roads are vulnerable to the effects of shoreline erosion and their failure can cause subsequent catastrophic failure of parking lots, port facilities, marinas, parks, garages, roads and other waterfront features. The features are not typically critical to the life, health and safety of residents, but nonetheless are costly and time-consuming to repair for both public and private entities. While not as sudden as other hazard events discussed in this plan, shoreline erosion influences the stability and condition of coastal property and beaches when other short-term hazard events occur. For example, erosive forces may undermine tree roots and revetments along a shoreline, exacerbating the effects of flooding and sea level rise.

In Hampton Roads' more vulnerable Atlantic Ocean and Chesapeake Bay shorelines, the same large waves that are capable of causing severe shoreline erosion often attract onlookers, tourists and surfers drawn to the waves' magnitude and power. Locally, fatalities then result when these people are unexpectedly caught up in the surf and strong offshore currents, or rip currents, hindering their return to shore.

A landslide is the downslope transport of a mass of soil and rock material and refers to a number of different varieties of ground movement landforms and processes. The primary driving force for a landslide is gravity, but other factors may contribute to the failure of a slope. Landslides are usually triggered by heavy rainfall, rapid snow melt, oversteepening of slopes by stream incision, or earthquakes, while certain man-made changes to the land, such as slope modification or drainage alteration, can greatly increase the likelihood of landslides. Sometimes a landslide may move slowly down a slope, but often the movement can occur

without warning and be extremely fast. Soil creep and slumping cause property damage gradually, whereas rockslides and debris flows can sweep away people and property instantaneously. In the United States, landslides annually cause up to $2 billion in damages and take between twenty-five and fifty lives.[3]

Landslides occur in many manifestations and are usually classified according to the type of material involved and the mode of downslope movement. The material can range from loose earth to blocks of solid rock. These materials may then move downslope by falling, sliding or flowing. The following are some of the more important types of mass movement:

Rockfalls entail large blocks of bedrock breaking off a cliff face and tumbling downslope;

Rockslides occur when a detached section of bedrock slides down an inclined surface, frequently along a bedding plane;

Earthslides involve masses of soil moving down a slip face, usually on top of the bedrock;

Creep is the slow, continuous, imperceptible downslope movement of soil and rock particles;

Rotational slides or slumps result from the rotation of a cohesive unit of soil or rock down a slip surface, leaving a curved scarp; and

Debris flows develop on steep slopes as a result of heavy rainfall that saturates the soil, which under the extra weight and lubrication breaks loose and becomes a slurry that takes everything with it, including large trees and houses. Channeled debris flows can reach speeds approaching a hundred miles an hour and strike without warning.

Landslides are most common in the mountainous terrain of Virginia because of the presence of steep slopes and highly fractured bedrock over shallow soils. The lower-relief areas of the Piedmont and Coastal Plain also have landslides, but they are often smaller and generated by human disturbance, such as making an oversteepened road cut. The most disastrous landslide events have been associated with heavy rainfall along the steep slopes of the Blue Ridge Mountains and the Appalachians. Areas that are prone to mass movement include areas where landslides have occurred in the past; steep slopes with an angle greater than 30 degrees; and oversteepened cuts and fills, particularly due to home and road building. Research in North Carolina has revealed that about fifty-six percent of recent landslides happened on slopes that had been altered in some way by development.

Landslides are capable of destroying buildings, rupturing utility and other lifelines, while blocking transportation routes. Urban development can increase the damages caused by a landslide. Damages sustained by roads and highways during a landslide can result in long-term loss of use of certain transportation routes and contribute to increased traffic and emergency response times in the affected region. The soil movement that occurs during a landslide can destabilize structural supports for pipelines potentially resulting in pipeline ruptures and decreased or loss of service in a region.

The severity of a landslide is dependent on many factors including the slope and width of the area involved, the speed of the earth movement, and any structures or infrastructure directly in the path of the slide. Impacts of a landslide can range from a minor inconvenience to a life-threatening situation when automobiles and buildings are involved.

LOCATION AND SPATIAL EXTENT

Shoreline erosion is a significant concern in the Hampton Roads region. According to VIMS, the Atlantic and Chesapeake Bay coasts in the region are very dynamic in terms of shoreline change and sediment transport processes. VIMS and other agencies occasionally perform studies to determine long-term shoreline change patterns for various locations across the region. However, these studies are largely

[3]Virginia Department of Energy, 2021

intended to track shoreline and dune evolution through natural and manmade alterations, and are not designed to determine erosion rates or areas of coastal erosion. While FEMA does not map erosion hazard areas, FIRMs produced by the agency do indicate the highest risk areas for coastal flooding with significant wave action (termed V zones, velocity zones, or coastal high hazard areas)[4]. For purposes of this plan, areas identified as coastal high hazard zones on the FIRM are also assumed to be at risk of shoreline, or coastal, erosion.

Another factor in accurately determining specific shoreline erosion hazard areas is the continuous implementation of shoreline reinforcement or nourishment projects completed by federal, state and local government agencies. Typically, areas of high concern with regard to long term erosion are addressed through shoreline hardening or stabilization projects, such as seawalls, breakwaters and beach sand replenishment. For example, in 2002, the Virginia Beach Erosion Control and Hurricane Protection Project protected more than six miles from the imminent hazards of shoreline erosion through sand replenishment. Many other projects have been completed in the region and still others are pending approval and/or funding[5].



This photo, taken while the Virginia Beach Erosion Control and Hurricane Protection Project was underway, shows the significant difference between the unimproved area and the area of the widened beach berm already completed.

Source: City of Virginia Beach

HISTORICAL OCCURENCES

Shoreline erosion events typically occur in conjunction with hurricanes, tropical storms and nor'easters, so the list of "Ocean and Lake Surf" events provided from the NCEI database is not considered comprehensive (**Table 4.9**). Some of the damages listed duplicate damages shown for coastal flooding events and/or may apply to areas outside of the study area for this plan; however, the descriptive details indicate the nature of shoreline erosion damage (and fatalities) associated with this select group of events in Hampton Roads.

[4] For more information on FEMA V-zones, refer to the Flood hazard discussion within this section.
[5] In order to counter effects of coastal erosion, Virginia Beach's shoreline has been renourished annually since 1951.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Virginia Beach	8/31/1993	Heavy Surf	1/0	$0	A 15-year-old boy drowned, presumably caught in a strong undertow, as Hurricane Emily was approaching the North Carolina coast.
Isle of Wight, Norfolk, Suffolk, Virginia Beach, Portsmouth	11/17/1994	Coastal Flooding	0/0	$655,000	Strong easterly flow between Hurricane Gordon, a category 1 storm meandering 150 miles south of Cape Hatteras, and a strong anticyclone over New England, caused significant coastal flooding and damage in Sandbridge. The worst flooding occurred on the 18th, when tides were running 4 feet above normal. The heaviest damage occurred along 14th Street, where 100 feet of the fishing pier washed away. Several homes suffered minor damage, with two requiring extra work to remain in place. A 1000-foot stretch of road and several protective steel bulkheads were damaged. Seas, which were as high as 18 feet 60 miles east of the Virginia Capes, and 7 feet near the mouth of the Chesapeake Bay, forced the Naval Carrier George Washington to remain 2 miles offshore Thursday night through Friday morning. The above-normal tides caused other minor flooding in Tidewater. The Nansemond River overflowed its banks in Suffolk, causing minor flooding. High tides on the James and Pagan Rivers, caused several roads to be under water in eastern Isle of Wight County on the 17th.
Isle of Wight, Norfolk, Suffolk, Virginia Beach	12/23/1994	Coastal Flooding	0/0	$65,000	A double-structured storm system produced minor coastal flooding in the Tidewater region on the 23rd. The effects were much less than expected as the main storm moved well east of the mid-Atlantic before curling northwest into Long Island. The secondary low pressure area was significantly weaker, but still produced northeast winds of 35 to 45 mph around Tidewater. High tides of 1 to 3 feet above normal caused most of the flooding. In the Sandbridge section of Virginia Beach, a beachfront home collapsed into the sea. The combination of pounding surf and wind from flow around Hurricane Gordon in late November and this event finished off the home. In addition, a few more bulkheads were flattened. Several roads in the Tidewater area had minor flooding, including Rescue Road in Smithfield (Isle of Wight Co).
Virginia Beach	8/13/1995	Rip Current	1/0	$0	Vacationer from New York drowned after venturing too far into severe rip current conditions.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Virginia Beach, Newport News, York County, Poquoson	4/24/1997	Coastal Flooding	0/0	$0	Moderate coastal flooding occurred across portions of the Hampton Roads area during the time of high tide April 23rd and continued into April 24th. The areas most seriously affected included the Willoughby Spit, Ghent, and downtown sections of Norfolk, the Old-Town section of Portsmouth, and Sandbridge at Virginia Beach. Tides peaked at 5.8 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk. Based on reports received from downtown Norfolk and the Grandview section of Hampton, tides were somewhat higher in the estuaries (Lafayette River, the Hague, the Harris and Back Rivers) draining into the Elizabeth River and Hampton Roads.
Norfolk, Virginia Beach, Portsmouth	6/3/1997	Coastal Flooding	0/0	$0	Minor to moderate flooding occurred across portions of Hampton Roads during high tide the evening of June 3rd. In Virginia Beach, officials reported part of a new boardwalk washed away and several lifeguard stands lost. Crawford Parkway in downtown Portsmouth was reported flooded and in downtown Norfolk, several streets were reported under water.
Norfolk, Virginia Beach, Portsmouth, Newport News, Poquoson	10/19/1997	Coastal Flooding	0/0	$0	Minor to moderate flooding occurred across portions of Hampton Roads during high tide Sunday, October 19th. Some minor flooding was reported in low-lying areas of Norfolk, with water in a few homes and a few streets closed. Minor flooding was also reported in downtown Portsmouth and in the Sandbridge and Sandfiddler areas of Virginia Beach. Tides peaked between 5.2 and 5.8 feet above MLLW at Sewells Point in Norfolk. Minor coastal flooding was reported in portions of Newport News and York county.
Norfolk, Virginia Beach, York County, Poquoson, Newport News	1/27/1998	Coastal Flooding	0/0	$1,500,000	A Nor'easter battered eastern Virginia on January 27th and 28th. Slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to 6.44 feet above MLLW at Sewells Point. Tide levels resulted in moderate coastal flooding throughout Hampton Roads. One house collapsed into the Atlantic Ocean at Sandbridge. Another home sustained severe damage. The rainfall combined with the gale and storm force winds resulted in scattered tree limbs downed across much of eastern Virginia. In addition, there were widely scattered power outages.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Virginia Beach, York County, Poquoson, Newport News	2/4/1998	Coastal Flooding	0/0	$75,000,000	A Nor'easter battered eastern Virginia from February 3rd through the 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to 7.0 feet above MLLW at Sewells Point. Tide levels resulted in moderate to severe coastal flooding throughout Hampton Roads. Norfolk, Virginia Beach and Hampton reported some structural damage to buildings along the bay and coast, as well as significant beach erosion. Norfolk reported main roads and intersections under 3 feet of water or greater with many roads impassable. North facing areas in Willoughby and Ocean View suffered the greatest damage. In the Chick's Beach area of Virginia Beach, 4 condominiums were undermined by the tidal flooding, and residents of those buildings had to be evacuated. Twenty-nine house fires were also reported in Norfolk as a result of flood water shorting out furnaces. The rainfall combined with the gale and storm force winds resulted in some trees downed across much of eastern Virginia. In addition, there were widely scattered power outages.
Hampton	9/18/2003	Coastal Flooding, Heavy Surf			Hurricane Isabel caused historic flooding and severe erosion in the region. In Hampton, the coastal flooding, heavy surf and wave action breached the barrier beach at Factory Point.
Virginia Beach	1/29/2005	Heavy Surf	1/1	$0	A small boat with 2 men on board was heading out of Rudee Inlet. They made it through the first set of breakers then stopped the boat. A wave overtook them and flipped the boat. One man climbed onto and stayed with the overturned boat and was rescued. He was treated for mild hypothermia and later released. The other man died of hypothermia.
York County, Poquoson	9/1/2006	Coastal Flood	0/0	$1,900,000	Tides of 4 to 5 feet above normal combined with 6 to 8 foot waves caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Virginia Peninsula and Middle Peninsula near the Chesapeake Bay and adjacent tributaries.
Norfolk, York County, Hampton	10/6/2006	Coastal Flood	0/0	$200,000	Strong onshore winds resulted in major coastal flooding during times of high tide. Tidal departures were 2.5 to 3.5 above normal during the event. A strong low pressure system off the North Carolina coast coupled with an upper level cutoff low to dump intense rainfall across portions of southeast Virginia. Rainfall amounts in excess of 10 inches resulted in numerous road closures and moderate to major river flooding from late Friday, October 6th through Saturday, October 7th. Up to 28,000 Dominion Virginia Power customers lost power during the event.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Chesapeake York County, Hampton	11/22 and 11/23/2006	Coastal Flood	0/0	$145,000	Strong onshore winds caused moderate coastal flooding during times of high tide. Tidal departures were about 3 feet above normal during the event. An intense low pressure system off the North Carolina coast combined with an upper level cutoff low to provide very strong winds, heavy rains, and moderate coastal flooding across portions of eastern and southeast Virginia from late November 21st into afternoon November 23rd.
Virginia Beach	5/23/2009	Rip Current	1/0	$0	A man body boarding was caught up in a rip current and pulled offshore. Officials performed CPR, but it failed to revive the man and he died.
Isle of Wight, Chesapeake, Newport News, York County, Hampton	11/12/2009	Coastal Flood	0/0	$16,200,000	An intense Nor'easter produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. The peak tide height at Money Point was 8.59 feet above MLLW, which was 6.17 feet above the astronomical tide. That tide height was 0.3 feet higher than the previous record storm tide measured at this location during Hurricane Isabel in September 2003.
Norfolk, Virginia Beach, York County, Chesapeake	12/19/2009	Coastal Flood	0/0	$30,000	A strong coastal low pressure area produced moderate to severe coastal flooding across much of eastern and southeast Virginia. The peak tide height at Money Point was 6.77 feet above MLLW. Several streets, homes and businesses were flooded in low lying areas close or directly exposed to the Chesapeake Bay. The peak tide height at Yorktown was 5.32 feet above MLLW. Several streets, homes and businesses were flooded in low lying areas of the county close or directly exposed to the Chesapeake Bay.
Virginia Beach	8/25/2011	Rip Current	1/0	-	A surfer who got caught in a rip current drowned in Virginia Beach.
Virginia Beach	6/16/2012	Rip Current	1/0	-	A man was caught up in a rip current and drowned in Virginia Beach.
Chesapeake, James City County, Newport News, York County, Norfolk, Isle of Wight, Virginia Beach, Suffolk, Hampton	10/28/2012	Coastal Flood	0/0	$2,060,000	Tropical Cyclone Sandy moving northward well off the Mid Atlantic Coast then northwest into extreme southern New Jersey produced very strong northeast winds followed by very strong west or northwest winds. The very strong winds caused moderate to severe coastal flooding across portions of eastern and southeast Virginia. Water levels reached 3.5 feet to around 4.5 feet above normal adjacent to the Chesapeake Bay resulting in moderate to severe coastal flooding. Flooding of streets due to the combination of rain and storm surge was widespread during the height of the storm. However, water levels were lower than Irene in 2011.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Chesapeake, James City County, Newport News, York County, Norfolk, Isle of Wight, Virginia Beach, Suffolk, Hampton, Poquoson	10/2-3/2015	Coastal Flood	0/0	$1,000,000 (Norfolk)	Anomalously strong/nearly stationary high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay. A tidal departure of 3 to 4 feet resulted in moderate flooding along the Chesapeake Bay.
Virginia Beach	7/9/2019	Rip Current	1/0	-	A 35 year old male drown after being caught in a rip current while trying to save a child at False Cape State Park.
Norfolk, Virginia Beach, York County, Surry County	9/6/2019	Coastal Flood	0/0	-	Very strong northeast to north winds associated with Hurricane Dorian produced tidal anomalies between 2.5 and 3.5 feet over the southern Chesapeake Bay. This caused moderate coastal flooding over portions of Hampton Roads.
York County, James City County, Surry County	10/11/2019	Coastal Flood	0/0	-	The combination of low pressure sitting off the New Jersey coast and strong high pressure over southeast Canada resulted in persistent north or northeast winds over the region. Persistent winds and high waves produced tidal anomalies between 2 and 3 feet above normal high water levels.
Virginia Beach, Norfolk	11/17/2019	Coastal Flood	0/0	-	The combination of high pressure over northern New England and low pressure just off the Middle Atlantic Coast resulted in very strong northeast to north winds over the southern Chesapeake Bay, which caused minor to moderate coastal flooding.
James City County	5/19/2020	Coastal Flood	0/0	-	Combination of strong high pressure over New England and low pressure over southeast U.S. produced a persistent northeast or east wind into James River, which caused minor to moderate coastal flooding at Jamestown tidal gauge and some locations in the county. Minor to moderate tidal flooding occurred along James River. Jamestown reached 4.72 feet MLLW.
Virginia Beach	8/4/2020	Coastal Flood	0/0	-	The center of Tropical Storm Isaias tracked north just inland of the Middle Atlantic Coast from August 3-4. Winds caused moderate (perhaps some locally major) tidal/coastal flooding across portions of SE Virginia, including portions of Virginia Beach adjacent to Back Bay.
Totals			**7/1**	**$98,755,000**	

Source: NCEI, 2021

Analysis of the landslide hazard history in the Hampton Roads study area is limited by the availability of data and reporting of incidents; however, scientists at the Virginia Department of Energy (Virginia Energy) maintain a statewide database of incidents reported to the department since 2004. That database does not contain any historical incidents in the Hampton Roads region, although one incident in New Kent County is on the border with James City County, along the Chickahominy River. The Claytor landslide, as it was termed, was reported by the homeowner who reported movement started during Hurricane Irene (2011). Headscarp is 5 feet from porch steps, two 10-foot sections of seawall at base of slope have been either toppled or covered by sediment from previous landslides. This is a series of concave erosional scarps along the riverbank. Additional reports of landslides along the James River in Surry County, especially after Hurricane Isabel (2003), have been made to county officials, but additional details were not available.

While details are preliminary, State geologists suggest that evidence shows in the Richmond-Crater and Virginia Peninsula regions, there is a higher incidence of landslide initiation near the contact between the Eastover and the Yorktown Formations, two pervasive geological units in the Virginia Coastal Plain. Slopes can be further destabilized due to excess runoff from development, including stormwater drains and gutters.

PROBABILITY OF FUTURE OCCURENCES

Shoreline erosion over the long-term and short term will likely continue to occur in the Hampton Roads region. Shoreline erosion will be more immediate and severe during hurricanes, tropical storms and nor'easters.

TORNADO

BACKGROUND

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the NWS, tornado wind speeds normally range from 40 to more than 200 mph. The most violent tornadoes (EF5) have rotating winds of 200 mph or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.



Each year, an average of over 1,200 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002 and 2014). They are more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and tens of miles long.

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states. Waterspouts occasionally move inland, becoming tornadoes that cause damage and injury. However, most waterspouts dissipate over the open water causing threats only to marine and boating interests. Typically, a waterspout is weak and short-lived, and because they are so common, most go unreported unless they cause damage.

The destruction caused by tornadoes ranges from light to devastating depending upon the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light or wood-framed construction such as residential homes (particularly mobile homes), and tend to remain localized in impact. The traditional Fujita Scale for tornadoes, introduced in 1971, was developed to measure tornado strength and associated damages. Starting in February of 2007, an “enhanced” Fujita (EF) Scale was implemented, with somewhat lower wind speeds at the higher F-numbers, and more thoroughly-refined structural damage indicator definitions. **Table 4.10** provides a summary of the EF Scale. Assigning an EF Scale rating to a tornado involves the following steps:

- Conduct an aerial and ground survey over the entire length of the damage path;
- Locate and identify damage indicators in the damage path;
- Consider the wind speeds of all damage indicators and assign an EF Scale category for the highest wind speed consistent with wind speeds from the other damage indicators;
- Record the basis for assigning an EF scale rating to a tornado event; and
- Record other pertinent data related to the tornado event.

TABLE 4.10: ENHANCED FUJITA (EF) SCALE FOR TORNADOES	
EF RATING	3 SECOND GUST (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	over 200

Source: NWS Storm Prediction Center

In Virginia, tornadoes primarily occur from April through September, although tornadoes have been observed in every month. Low-intensity tornadoes occur most frequently; tornadoes rated EF2 or higher are very rare in Virginia, although EF2, EF3, and a few EF4 storms have been observed. According to the *2018 Commonwealth of Virginia Hazard Mitigation Plan*, Virginia ranks 28th in terms of the number of tornado touchdowns reported between 1950 and 2006.

Tornadoes are high-impact, low-probability hazards. The net impact of a tornado depends on the storm intensity and the vulnerability of development in its path. Because the path of each tornado is unique to each event, general descriptions of impacts in Hampton Roads can be drawn from the impacts of previous storms (see also **Table 4.11** below). Communities rarely activate Emergency Operation Centers before tornadoes due to the short warning times, but after extreme events with catastrophic damage that displace a large number of residents, such activation may become necessary.

In Hampton Roads, a high intensity tornado, while unlikely, could be expected to impact almost everything within the storm's path: homes, especially those constructed prior to the use of building codes; infrastructure, especially above-ground power lines in the commercial zones and bridges throughout the region; cars and personal property; landscape elements such as trees, fences and shrubs; and even human lives. Downed trees can block roadways, impeding traffic and blocking access and egress if any of the region's thoroughfares are impacted. Manufactured homes are particularly vulnerable to damage in the event of tornadoes, as well, particularly if they were placed outside of flood zones and before building codes were in effect requiring foundation tie-downs.

Tornadoes associated with tropical cyclones are somewhat more predictable. These tornadoes occur frequently in September and October when the incidence of tropical storm systems is greatest. They usually form around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction. Tracking and prior notification by the National Weather Service and local news media helps save lives locally.

Most tornado strikes in the region have been EF0 or EF1 and the effects were somewhat less than as described above for severe storms. Critical damage to structures in the tornado's path is common, with indiscriminate damage to public-and privately-owned structures, some infrastructure, and downed trees that make transportation difficult. In areas adjacent to the path, minor damage, especially to roofs and windows from trees and flying debris, can also be expected. While downed trees may block transportation routes and result in power outages for some customers, these impacts are typically cleared within a few days.

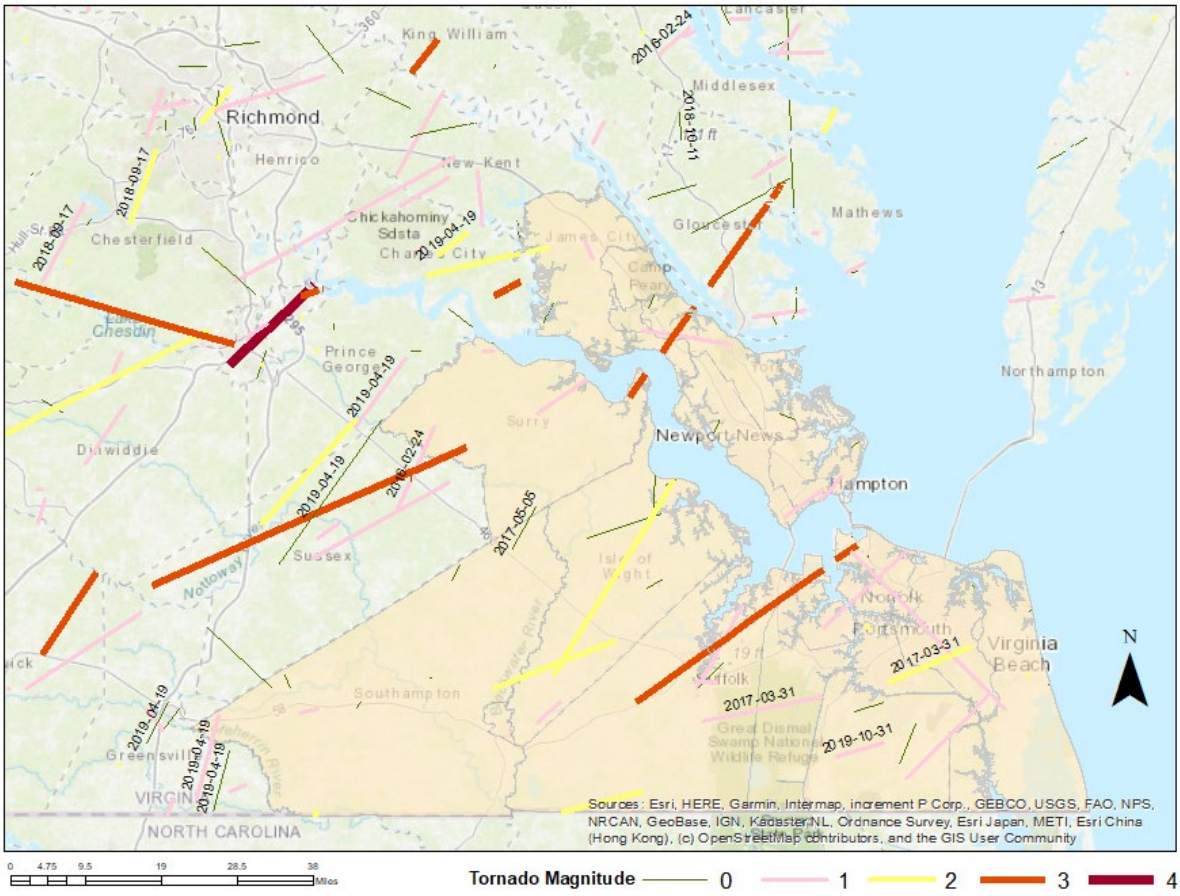
LOCATION AND SPATIAL EXTENT

Tornadoes typically impact a relatively small area; however, it is impossible to predict where in the planning area a tornado may strike. Vulnerability of individual structures is based largely on building construction materials and standards, availability of safe rooms and advanced warning system capabilities. In cases

involving intense tornadoes, the best defense against injury or death is a properly engineered safe room or tornado shelter, neither of which is standard practice in the region. Likewise, advanced warning system capabilities are limited to Reverse 911, Emergency Alert System warnings and NWS weather radio broadcasts.

Figure 4.17 illustrates the approximate location where confirmed tornadoes have touched down in and near the Hampton Roads region since 1950. The most recent tornadoes, between 2016 and 2019, are additionally notated with the date of their occurrence.

FIGURE 4.17: HISTORIC TORNADO TOUCHDOWNS AND TRACKS: 1950-2020



October, 2021

Source: NCEI, 2021

SIGNIFICANT HISTORICAL EVENTS

Hampton Roads has experienced 47 days with reported damaging tornadoes since 1995. The tornadoes occurring since 1995 had strengths up to EF3. Damage estimates for these tornadoes exceed $63.09 million. **Table 4.11** lists historical tornadoes that touched down in the study area (NCEI web site). Beginning with the Suffolk tornado in 2008, the magnitude rating switched to Enhanced Fujita Scale.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
ISLE OF WIGHT	7/12/1996	F1	0	$25,000	Small tornado damaged 10-15 homes and several trees in Moorfield subdivision of Smithfield.
YORK	7/12/1996	F1	0	$15,000	Tornado cut a 2-mile-long path across part of Naval Weapons Station Yorktown. Numerous trees, homes and cars were damaged.
HAMPTON	9/4/1996	F0	0	$1,000	Weather personnel at Langley Air Force Base observed a small tornado about 1/2 mile north-northwest of their building. Minor damage to a few vehicles and tops of trees occurred.
CHESAPEAKE	7/24/1997	F1	0	$400,000	Tornado had a track of approximately 1 mile and was an estimated 50 yards in width.
NORFOLK	7/24/1997	F1	0	$400,000	Tornado path started in south Norfolk just south of Poindexter Street on Guerriere Street. The tornado then continued north-northeast into the Berkley Avenue Industrial Park before crossing into the southern portion of Norfolk and lifting after causing damage on Roseclair and Joyce Streets. One business, a car wash was destroyed, and six sustained major roof damage. One home was damaged in Chesapeake, with damage to a couple of additional structures in the Roseclair and Joyce Street areas of Norfolk.
NORFOLK	7/24/1997	F0	0	$100,000	Tornado first touched down west of Route 460 between Liberty Street and Indian River Road. The tornado tracked north-northeast across Indian River Road and across the eastern branch of the Elizabeth River before lifting east of Harbor Park and south of I-264. Minor damage to several structures, mostly residential.
CHESAPEAKE	4/9/1998	F0	0	$25,000	Tornado with speeds of 60-70mph in Chesapeake. Damage was seen just south of intersection of Dominion Boulevard and Great Bridge Boulevard. Several trees were downed/topped in the Riverwalk Subdivision. Damage to a couple of homes as a result of trees falling on them. Tornado moved east-northeast to just northwest of intersection of Volvo Parkway and Kempsville Road. Several trees were downed/topped in this area as well, with a couple of homes damaged by falling trees/limbs. Tornado appeared to remain just above ground, with all structural damage resulting from falling trees/limbs.
HAMPTON	9/4/1999	F2	0/6	$7,720,000	Tornado touchdown in the city of Hampton. Extensive structural damage in a 3 block area. Three apartment complexes and an assisted living facility condemned. Two

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					additional apartment complexes partially condemned. Many roofs were lifted off buildings and as many as 800 vehicles were reported damaged. This tornado formed in area ahead of tropical storm Dennis.
VIRGINIA BEACH	7/24/2000	F0	0	$20,000	A waterspout that formed over Back Bay came ashore at Campbell Landing Road and destroyed 20' x 30' foot outbuilding before dissipating. Many trees were blown down; camper shells and lawn furniture were tossed across neighborhood.
SUFFOLK	5/21/2001	F0	0	$25,000	Tornado occurred in 5000 block of Manning Road. Several small outbuildings destroyed including 30' wooden shed.
SUFFOLK	6/1/2001	F1	0	$15,000	Tornado touched down near Jackson Road. Tornado became a funnel cloud and then touched down again just south of Sleepy Hole Road and passed through Sleepy Hole Golf Club. Tornado continued north northeast through Chatham Woods with extensive damage along Burning Tree Lane.
NEWPORT NEWS	8/11/2001	F0	0	$50,000	Weak tornado damaged a couple of mobile homes and produced minor damage at townhouse complex near Fort Eustis.
SUFFOLK	2/22/2003	F0	0	$25,000	Several 50-60 foot trees were pushed over into houses. Numerous tree trunks were twisted and tops sheared off.
SOUTHAMPTON	5/9/2003	F0	0	$10,000	Damage to trees and outbuildings, and minor damage to home by a tornado in northwest Southampton County.
YORK	8/7/2003	F1	0	$20,000	Tornado damage occurred near Victory Boulevard and Running Man Trail, with about a dozen trees down. Damage to 4 houses from trees snapping off and falling on the homes.
VIRGINIA BEACH	8/8/2003	F0	0	$5,000	Tornado briefly touched down with minor damage reported at Salem Crossing Shopping Center.
NORFOLK	9/18/2003	F0	0	-	Brief tornado occurred in association with Isabel. No damage reported.
SOUTHAMPTON COUNTY	6/25/2004	F1	0	$2,000	F1 tornado downed numerous large trees in a swamp.
SUFFOLK	6/25/2004	F1	0	$2,000	F1 tornado downed numerous trees near intersection of Route 660 and Route 668.
SUFFOLK	6/25/2004	F0	0	$2,000	F0 tornado damage to trees on Cypress Chapel Road in Whaleyville.
CHESAPEAKE	8/14/2004	F0	0	$5,000	Tornado associated with Tropical Storm Charley damaged a fence and downed trees.
JAMES CITY COUNTY	8/30/2004	F0	0	$5,000	F0 tornado downed or damaged several trees.
JAMES CITY COUNTY	8/30/2004	F0	0	$5,000	F0 tornado downed or damaged several trees near Drummonds Field Subdivision and the James River.
POQUOSON	8/30/2004	F0	0	$5,000	F0 tornado downed trees on River Road and Wythe Creek Road.
HAMPTON	8/30/2004	F0	0	$5,000	F0 tornado damaged a shed and trees on Hall Road.
YORK COUNTY	8/30/2004	F0	0	$10,000	F0 tornado downed trees and damaged roofs at Pinewood Drive and Highway 134.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
YORK COUNTY	8/30/2004	F0	0	$10,000	F0 tornado blew roof off of garage and damaged trees.
SOUTHAMPTON	7/2/2005	F0	0	-	F0 tornado touched down near Freemans Pond Road then crossed Route 460.
SOUTHAMPTON	7/8/2005	F1	0	$2,000	F1 tornado caused damage near Old Belfield Road.
VIRGINIA BEACH	7/14/2005	F0	0	$2,000	Brief tornado touchdown caused minor damage to golf practice facility and downed tree limbs near Dam Neck Road and Holland Road.
JAMES CITY	1/11/2006	F1	0/2	$20,000	F1 tornado caused intermittent damage at Jamestown Beach Campground and Foxfield subdivision. One trailer and pop-up camper were destroyed at campground and caused minor injuries to two occupants. Two townhomes suffered minor roof and siding damage in subdivision.
PORTSMOUTH	8/11/2006	F0	0	-	Waterspout near the mouth of the James River came on shore near Churchland High School. No damage or injuries were reported.
HAMPTON	8/11/2006	F0	0	-	Waterspout near mouth of the James River came on shore just south of Beach Road in Grandview section of Hampton.
SUFFOLK	4/28/2008	EF3	0/200	$30,000,000	A tornado touched down with damage first noted about 2 miles northeast of Lummis. The tornado crossed Route 58, downing trees as it moved northeast. The tornado strengthened just south of the intersection of Route 10 and Route 58, where it damaged several homes and an elementary school as well as downing numerous trees. The intense tornado crossed Route 58 again and then Route 10 before hitting the Freedom Plaza shopping center where it destroyed a strip mall and tossed around numerous cars. One car was impaled into a building adjacent to the strip mall. Thereafter, the tornado moved into 2 subdivisions east and northeast of Obici Hospital. Many homes were damaged with at least a dozen completely destroyed. The tornado then continued into Driver where it damaged a number of homes and businesses and downed numerous trees. The tornado then appeared to lift just north of Driver, although amateur video and pictures suggested that the tornado maintained close contact with the ground as it tracked northeast across northern portions of Portsmouth to the Norfolk Naval Air Station.
SOUTHAMPTON COUNTY	4/28/2008	EF0	0	$5,000	A brief tornado touched down about a half mile east of Capron off Highway 58 near Douglas Drive. Several trees were downed or snapped off.
PORTSMOUTH	4/28/2008	EF1	0	$60,000	The tornado moved from northeast Suffolk across northern portions of Portsmouth. The tornado maintained close contact with the ground and downed several trees and produced some structural damage. While in Suffolk, the tornado was rated as EF3, but in Portsmouth it was rated as EF1.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
NORFOLK	4/28/2008	EF1	0	$100,000	The tornado maintained close contact with the ground as it moved from northern Portsmouth to the Norfolk Naval Air Station. The tornado damaged vehicles and a building at Pier 2, and numerous trees were blown down or snapped off. The tornado remained rated as EF1 from northern Portsmouth to the Norfolk Naval Air Station.
JAMES CITY COUNTY	4/28/2008	EF0	0	$200,000	A brief tornado touched down in James City county about 6 miles northwest of Jamestown. Several trees were uprooted or snapped off, and there was some minor damage to homes in the area.
ISLE OF WIGHT	4/28/2008	EF1	0	$184,000	A tornado touched down near Carrsville in southern Isle of Wight county. The tornado damaged eleven homes and six agricultural buildings along Harvest Drive and Eleys Lane.
FRANKLIN	9/26/2008	EF0	0	-	Brief tornado touchdown in an open field near S.P. Morton Elementary School. No damage reported.
ISLE OF WIGHT	4/20/2009	EF0	0	$5,000	EF0 tornado tracked along nearly 8-mile track from near Raynor east-northeast to approximately one mile northwest of Smithfield.
CHESAPEAKE	5/4/2009	EF0	0	$10,000	EF0 tornado touched down in Great Bridge section south of Cedar Road between Shillelagh Road and Battlefield Boulevard.
SOUTHAMPTON COUNTY	10/27/2010	EF0	0	$50,000	An EF0 tornado destroyed a carport, overturned a shed and downed several trees. Debris was scattered toward northeast about 100 yards.
SOUTHAMPTON COUNTY	4/16/2011	EF1	0	$30,000	Brief tornado touched down in southwest Southampton County. Numerous trees were snapped off and a few structures were damaged. The most significant damage was to a farm equipment shelter and a roof on a home.
JAMES CITY COUNTY	4/16/2011	EF3	0	$50,000	Tornado tracked from Surry County into Kingsmill section of James City County. Tornado tracked from James City County into York County.
YORK COUNTY	4/16/2011	EF3	0	$15,000	The tornado mainly affected the Yorktown Naval Weapons Station.
ISLE OF WIGHT COUNTY	4/16/2011	EF2	0	$300,000	Tornado damage was along a nearly continuous 20-mile damage path from east of Walters to just southwest of Smithfield. More than 2 dozen homes were damaged. Farm equipment was picked up and tossed around on several farms.
VIRGINIA BEACH	8/27/2011	EF0	0	$150,000	Weak tornado (EF0) severely damaged a home on Sandpiper Road. Minor damage to one other home.
HAMPTON	6/1/2012	EF1	0	$1,000,000	Tornado began on James River just east of Monitor Merrimac Bridge Tunnel. Its track went over Chesapeake Avenue, through downtown Hampton to Hampton Yacht Club before moving across Mercury Boulevard, then dissipating over the Chesapeake Bay.
ISLE OF WIGHT	1/11/2014	EF0	0	$40,000	The tornado touched down on Bob White Road just north of Woodland Drive, then continued northeast about 2 miles nearly paralleling Woodland Drive before lifting

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					near Quaker Road in Isle of Wight. The tornado touched down just north of Route 10, then continued northeast into Mogarts Beach area. Tornado was on the ground about 1.4 miles before dissipating over James River.
HAMPTON	1/11/2014	EF0	0	$100,000	Tornado touched down near Routten Road and Cabell Lane where around 50 trees were snapped and homes had 10 to 20 percent of their roof shingles blown off. The tornado traveled east northeast damaging the roof of Fox Hill Central Methodist Church and completely ripping roof off of the City of Hampton school maintenance compound on Windmill Point Road. Tornado moved to Canal Road snapping trees, damaging residential rooftops and blowing out windows of a car. Tornado continued on to completely destroy the Fox Hill Athletic Association Building on Grundland Drive, before ending at the Grandview Nature Preserve.
VIRGINIA BEACH	7/4/2014	EF0	0	$25,000	A brief EF-0 tornado associated with a squall from Hurricane Arthur touched down near Lynnwood in Virginia Beach. Numerous trees were snapped and uprooted along Lynndale Road and Kline Drive.
NORFOLK	7/4/2014	EF0	0	$5,000	Tornado touched down near the Forest Lawn Cemetery in Norfolk.
VIRGINIA BEACH	7/10/2014	EF0	0/10	$300,000	A weak tornado caused significant damage to a home from the roof being blown off. There was also damage to several other structures including a school gymnasium. A large pool window was blown out.
SURRY COUNTY	2/24/2016	EF1	0	$15,000	Tornado tracked from Sussex County into Surry County before lifting. Several trees were down, but no structural damage was observed.
SUFFOLK	3/31/2017	EF1	0	$200,000	An EF1 tornado touched down along and just west of White Marsh Road, about 2 miles southeast of downtown Suffolk. A number of trees were downed or snapped off, and one outbuilding was destroyed and its' debris damaged the adjacent house. Tornado crossed White Marsh Road, where it entered the Great Dismal Swamp, and was no longer visible. The tornado then tracked eastward into the Deep Creek area of Chesapeake.
CHESAPEAKE	3/31/2017	EF1	0	$50,000	Tornado tracked from the Great Dismal Swamp in Suffolk eastward to the Deep Creek section of Chesapeake. There was minor tornado damage on the east edge of the Dismal Swamp in the Deep Creek section.
CHESAPEAKE	3/31/2017	EF2	0	$3,900,000	EF0 tornado first touched down on Green Tree Road in Chesapeake causing damage to three warehouses. The tornado then quickly lifted off the ground and continued east. The tornado touched down again just east of Kempsville Road along Kemp Bridge Lane as an EF0 rapidly intensifying to EF1. On the east side of Kemp Bridge

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Lane, several homes lost sections of their roofs and outer walls were removed. Winds were approximately 97 mph. The tornado intensified as it moved east destroying an empty mobile home and severely damaged a metal storage building. The tornado strengthened to an EF2 before striking Real Life Christian Church on Centerville Turnpike. The church, a large metal constructed building, was destroyed by the tornado as the sanctuary was completely demolished. The tornado weakened some as it continued to travel east and then northeast across Stumpy Lake. The tornado then tracked northeast into Virginia Beach.
VIRGINIA BEACH	3/31/2017	EF2	0	$4,000,000	Tornado emerged from Stumpy Lake along Elbow Road as an EF0 causing some significant damage to siding and shingles to homes just north of Elbow Road. The tornado crossed Round Hill Drive, and then Elbow Road itself as it re-intensified to an EF1. The tornado crossed Elbow Road as an EF1 causing significant damage to oak trees which fell trapping a car under numerous trees. Tornado continued as a weak EF1 to Salem Road causing some significant roof damage to homes. It briefly weakened as it moved northeast causing damage to siding and shingles along Starwood Arch, Antelope Place, Salem Lake Boulevard and Morning View Drive. Tornado intensified, crossed Centennial Circle damaging homes along Daiquiri Lane and Darrow Street. By the time the tornado crossed Rock Lake Loop, it had intensified back to EF1 intensity causing some severe roof damage to homes from Rip Rap Court to River Rock Arch. This is where the tornado reached its widest point, up to 350 yards wide, causing damage to around 100 homes in this area alone. Several homes in this area were damaged beyond repair as winds reached to 110 mph (high end EF1). The tornado continued northeast destroying the clubhouse and press box at the Lansdowne High School ball field. Several sets of bleachers were tossed well over 200 yards. The tornado weakened as it crossed Princess Anne Road and Tidewater Community College. The tornado moved across Rosemont Drive as an EF0 damaging numerous homes along Light Horse Loop and Storm Bird Loop. The last visible damage from the tornado was across Buckner Boulevard near the east end of Purebread Drive.
CHESAPEAKE	4/6/2017	EF0	0	$100,000	Touched down near Delia Drive where it destroyed an RV and stripped siding off a house. It moved north northeast and severely damaged a concession stand, a small barn and an outbuilding at Hickory Ridge Farm on Battlefield Boulevard. The tornado proceeded to cross Battlefield Boulevard then crossed Head of the River

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Road where it reached its strongest point with an estimated wind speed of up to 80 mph. Numerous pine trees were snapped, blocking the road and taking down power lines. The tornado then crossed Beaverdam Road maintaining intensity near 75 mph. The tornado weakened as it crossed Land of Promise Road, but was still strong enough to down a pine tree into a house.
SOUTHAMPTON COUNTY	5/5/2017	EF0	0	$4,000	First touched down just north of Route 460 along Crumpler Toad just north of Ivor. The tornado continued north northeast, crossing adjacent Warrique Road and Aberdeen Road. The survey team found several trees uprooted along this route, with chunks of asphalt from nearby road construction found to be scattered in the field. The tornado continued north northeast into Surry County.
SURRY COUNTY	5/5/2017	EF0	0	$2,000	Uprooted several trees near and along Aberdeen Road before lifting just east of Walls Bridge Road.
JAMES CITY COUNTY	10/11/2018	EF1	0	$150,000	Touched down on the northern side of the Colonial Heritage Club just south of Norge. Tracked northwest toward Toano and downed several trees. One tree went through a house on Arthur Hill Road. A roof was blown off a house near Candle Station before the tornado lifted just to the east of Toano.
SOUTHAMPTON COUNTY	4/19/2019	EF1	0	$5,000	Tracked through Greensville County and into extreme southwest Southampton County. Tornado caused damage to several trees.
ISLE OF WIGHT COUNTY	4/19/2019	EF0	0	$15,000	Touched down near Mill Swamp Road and Wrens Mill Road in northern Isle of Wight County. The tornado tracked northward crossing King`s Landing Lane before continuing into the James River. Numerous trees, including large oak trees, were snapped or uprooted along the tornado path. One tree was downed on a house.
YORK COUNTY	4/19/2019	EF0	0	$150,000	Touched down near Colonial Parkway immediately east of the interchange with Queens Drive. The tornado tracked north northeast producing substantial tree damage, power line damage, and some home damage along Queens Drive. The tornado likely lifted north of Queens Lake.
NEWPORT NEWS	4/19/2019	EF0	0	$50,000	Likely touched down as a waterspout over Warwick River. The tornado tracked northeast through Sanford, Carriage Hill, and Denbigh. It produced mainly tree damage, particularly near Sanford Elementary, and destroyed a small shed. Tornado lifted before reaching Route 60 near Denbigh Village Center.
SUFFOLK	5/11/2019	EF1	0	$350,000	Touched down just east of Main Street in downtown Suffolk and quickly moved off to the east intersecting Route 58 twice before heading into the Great Dismal Swamp after moving through the Wilson Pines area. Numerous trees were snapped off or uprooted. At least 14 homes and 6

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					business were damaged with shingles torn off roofs, windows blown in, an air conditioner ripped from a roof, and at least one home had the roof impaled by a tree.
CHESAPEAKE	10/31/2019	EF1	0	$35,000	EF1 touched down near Benefit Road. It moved rapidly to the east northeast, producing mainly EF0 damage with numerous trees uprooted or large branches snapped off. The most widespread and significant damage of EF1 category occurred near or along Dewald Road where several large hardwood trees were uprooted and a camper was destroyed. Some roof, shingle, and spouting damage to homes was also observed. The tornado then lifted prior to reaching Route 168.
SOUTHAMPTON COUNTY	8/4/2020	EF2	0	$8,000,000	TS Isaias - Path of storm damage consistent with an EF2 tornado. Damage began near Southampton Power Station off General Thomas Highway and ended 4 miles north of Sebrell near Farmers Bridge Road. It first touched down in a wooded area and caused numerous trees to be snapped about 6 miles southeast of Courtland. The tornado then moved northeast and into Courtland, where it caused damage to numerous homes and businesses along Highway 58, including lifting the second story roof off a hotel building. Several vehicles were also overturned. The tornado then continued to travel northeast where more trees were snapped or uprooted. The tornado finally lifted just north of Sebrell near Farmers Bridge Road.
SUFFOLK	8/4/2020	EF1	0	$4,000,000	TS Isaias - Path of storm damage consistent with an EF2 tornado. The damage began near the Southampton Power Station off General Thomas Highway and ended 4 miles north of Sebrell near Farmers Bridge Road. The tornado first touched down in a wooded area and caused numerous trees to be snapped about 6 miles southeast of Courtland. The tornado then moved northeast and into Courtland, where it caused damage to numerous homes and businesses along Highway 58, including lifting the second story roof off a hotel building. Several vehicles were also overturned. The tornado then continued to travel northeast where more trees were snapped or uprooted. The tornado finally lifted just north of Sebrell near Farmers Bridge Road.
SUFFOLK	8/4/2020	EF0	0	$10,000	TS Isaias - Damage began west of Great Dismal Swamp and ended 3.5 miles southeast of Windsor just north of Highway 460. Damage was limited to snapped or uprooted trees along the path.
JAMES CITY COUNTY	8/4/2020	EF1	0	$100,000	TS Isaias - Tornado came onshore near River Oaks Road and Cypress Isle in Governor's Land producing tree damage. It intensified to 85-90 mph near the intersection of River Oaks Road and

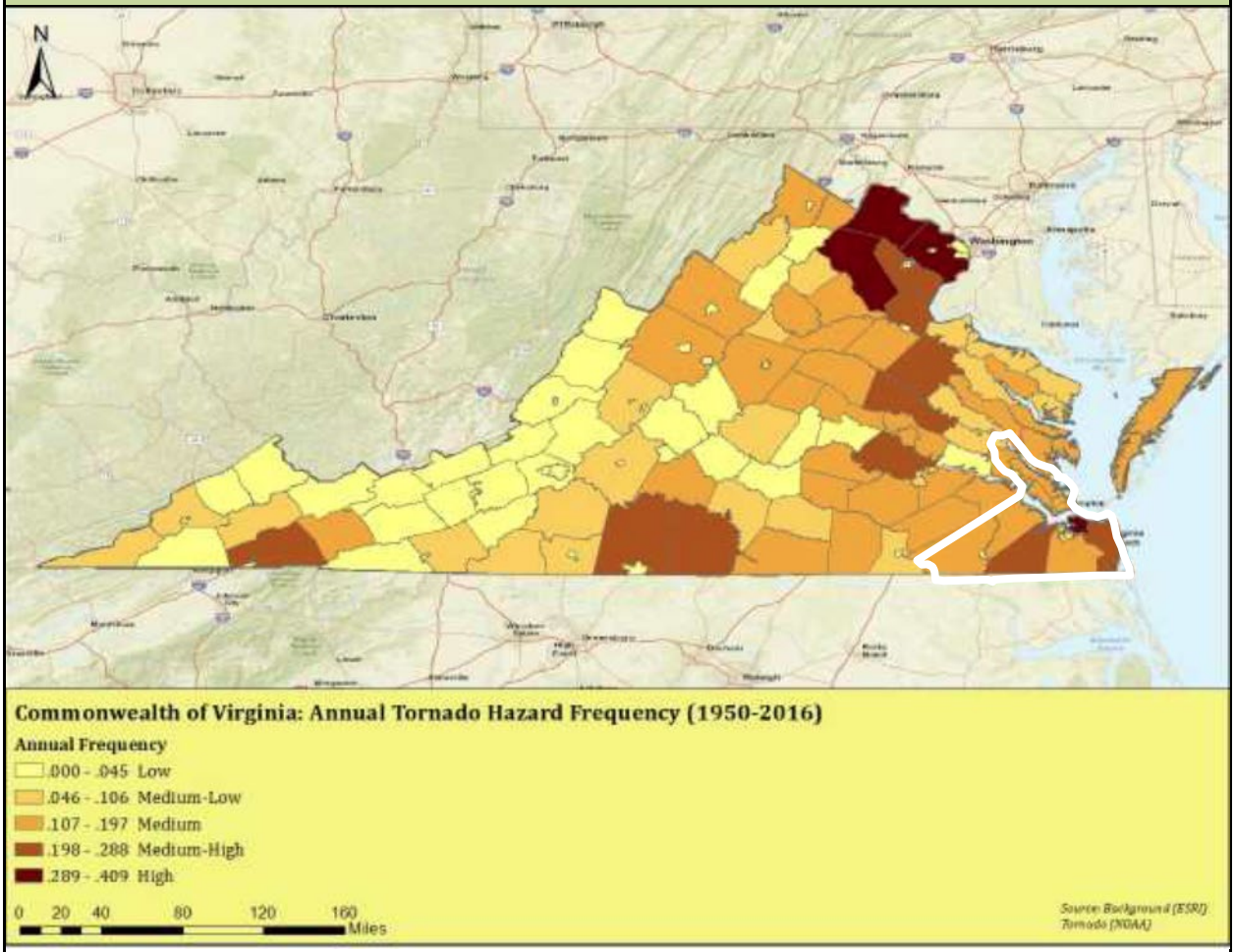
TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	**DATE OF OCCURRENCE**	**MAGNITUDE**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					Barrets Pointe, where numerous trees were snapped, shingles were blown off roofs, a garage door caved in and a brick gable collapsed. The tornado continued across two fairways of the golf course and entered an area of woods, snapping trees and limbs, before lifting along River Ridge Drive.
SOUTHAMPTON COUNTY	9/29/2020	EF0	0	$50,000	The tornado touched down one half mile west of Black Creek Road. It briefly tracked to the east northeast before lifting just northwest of Burdette. The tornado snapped and uprooted several trees along Black Creek Road. Three outbuildings were damaged and a large tree fell on a home.
ISLE OF WIGHT COUNTY	9/29/2020	EF0	0	$20,000	The tornado touched down near the intersection of Five Forks Road and Blue Ridge Trail. The tornado traveled northeast for several miles before lifting near Orbit Road. The tornado snapped or uprooted numerous trees along its path and a carport was destroyed.
SUFFOLK	12/24/2020	EF1	0	$100,000	Damage began on the south side of Corinth Chapel Road and ended just west of the intersection of Corinth Chapel Road and Gates Road. Tornado caused significant damage to at least one home, uprooted and snapped off several large trees, and flipped over a large pickup truck.
SUFFOLK	12/24/2020	EF1	0	$225,000	Damage began on the south side of Dutch Road and ended along Lummis Road just north of the intersection with Box Elder Road. Tornado caused significant damage to at least six homes along Dutch Road, with shingles torn off roofs, and also damage to large trailer. Several large trees were uprooted along the damage path.
TOTAL			**0/218**	**$63.09 million**	

Source: NCEI, May 2021

PROBABILITY OF FUTURE OCCURRENCES

Figure 4.18 presents the results of a tornado frequency analysis performed as part of the *2018 Commonwealth of Virginia Hazard Mitigation Plan*. The analysis suggests that relative to the entire Commonwealth of Virginia, the region is considered to be “Medium” to “High” in terms of tornado frequency. The State plan emphasizes that historical data may contain meteorological biases that should be considered when viewing the results of the probability analysis shown in Figure 4.18. Increased population and advanced technology have likely led to the vastly higher numbers of low intensity tornadoes reported in recent decades, and more tornadoes are reported in areas of higher population because people are more likely to see and report the resultant damage. This map is also specific to Virginia, and “high frequency” in the Commonwealth is still relatively low frequency in parts of the Midwest and southern United States.

FIGURE 4.18: HISTORICAL TORNADO HAZARD FREQUENCY

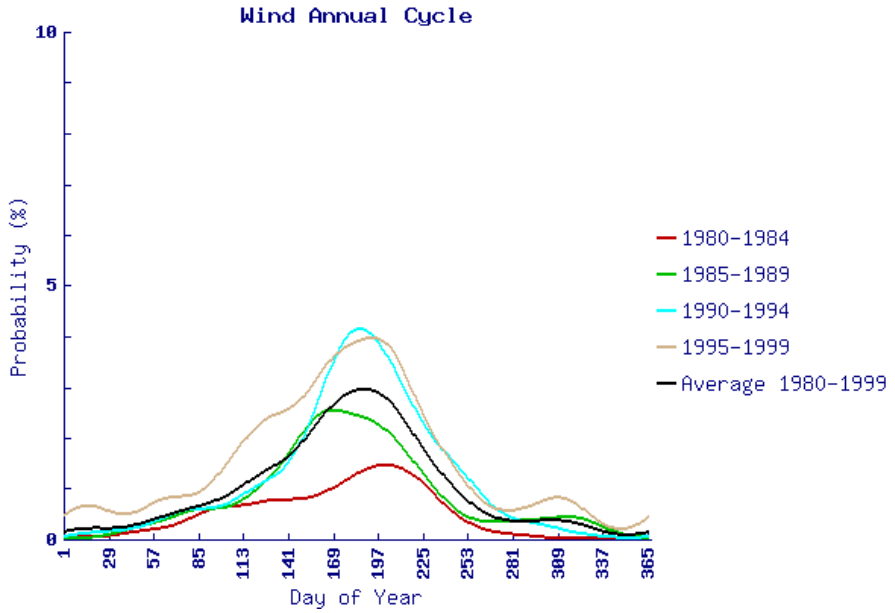


2018

Source: 2018 Commonwealth of Virginia Hazard Mitigation Plan

A tornado wind event could occur in Hampton Roads at any time of the year, but is most likely to occur from April to August, with peak probability in June, as can be seen in the Wind Annual Cycle for the region (**Figure 4.19**) below.

FIGURE 4.19: ANNUAL WIND CYCLE



Source: National Severe Storm Labs

WINTER STORMS

BACKGROUND

A winter storm can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility.

In Hampton Roads, winter storms typically include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Sleet—raindrops that freeze into ice pellets before reaching the ground—usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard, especially on roads, power lines and trees. Ice storms have also occurred in the region, when freezing rain falls and freezes immediately upon impact.



A VDOT snowplow plows I-64 East.
Source: Photo by Tom Saunders, VDOT

Communications and power in the region can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Perhaps one of the most common impacts of winter storms in the region is vehicle accidents and stranded, disabled vehicles. Unaccustomed to driving in snow and ice much of the year, drivers attempt to drive at normal speeds despite deteriorated road conditions. Lacking the large fleets of snowplows of some counties and municipalities further north, the region's secondary roads are not cleared as often or as quickly, and roads may remain unplowed or untreated for many days. This impacts persons with disabilities and others who may become housebound by severe winter storms. Most of the airports in the region also shut down for some time until the runways can be cleared.

Recent winter storms in the region have caused severe economic disruption with lengthy school and business closures, damage to vehicles and reduced community services for extended periods. In agricultural portions of the study area such as Southampton County, freezing temperatures may affect agricultural production, depending on when the event occurs relative to the growing periods of certain crops. Nor'easters often cause winter storms in the region, so the impacts of coastal flooding and shoreline erosion are also associated with winter storm events.

NCEI is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI is a regional snowfall impact scale that uses the area of snowfall, the amount of snowfall, and the number of people living within a snowstorm. Since the index uses population information, it attempts to quantify the societal impacts of a snowstorm. RSI has been calculated for large snowstorms back to 1900 and therefore the index puts a particular event into a century scale historical perspective (**Table 4.12**). A Category 5 snowstorm is a very rare event while Category 0 and 1 snowstorms are quite typical.

TABLE 4.12: REGIONAL SNOWFALL INDEX (RSI)			
CATEGORY	**RSI RAW SCORE**	**APPROXIMATE PERCENT OF STORMS**	**DESCRIPTION**
5	>18	1%	Extreme
4	10-18	2%	Crippling
3	6-10	5%	Major
2	3-6	13%	Significant
1	1-3	25%	Notable

Source: NCEI, 2021

RSI is calculated for specific regions. Only the snowfall within a particular region is used to calculate the index for that region. The Hampton Roads study area is within the Southeast study region for the RSI. The RSI differs from other indices because it includes population, which ties the index to societal impacts. Currently, the index uses population based on the 2000 Census.

Where available, the RSI value for specific storms is provided in the History section below.

SIGNIFICANT HISTORICAL EVENTS

According to the NCEI, Hampton Roads has experienced 23 significant winter storm events including snow and ice storms, since 1995 (**Table 4.13**). These events account for $20.15 million in reported property damages for the affected areas. The region received presidential disaster declarations from major winter storms in 1996 (the Blizzard of ’96) and 2000. Some of the most significant winter storms to impact the region in the twentieth century are discussed below.

On **January 30-31, 1966**, a blizzard struck Virginia and the Northeast U.S. It was the second snowstorm to hit Virginia in a week. The first storm dumped nine inches in Norfolk. With fresh snow on the ground, arctic air settled in and temperatures dropped into the teens. The second storm dumped one to two feet of snow over a large part of the state. Intense winds and drifting snow continued and kept roads closed for several days after the storm. Temperatures dropped into the single digits with some falling below zero. Wind chill temperatures were dangerously low.

The **winter of 1976-1977** was the coldest winter on the East Coast of the past century. Storms across the state dropped a few more inches every few days to keep a fresh coating on the streets that were just clearing from the previous storms. The average temperature for the month of January in Norfolk was 29.2°F which was 12° below normal. The prolonged cold wave caused oil and natural gas shortages and President Carter asked people to turn thermostats down to conserve energy. The major elements of this winter were the cold temperatures. There was little snowfall associated with this winter in the region.

The “**Presidents Day Storm**” of February 1979 dropped seven inches on snow on Norfolk on February 18-19 and 13 inches of snow were recorded for the entire month. The following winter, 20 inches fell in Virginia Beach and a foot of snow fell in Norfolk in a storm that hit the region in February. On March 1, another foot of snow fell in Norfolk and the total snowfall amount of 41.9 inches for Norfolk was the snowiest winter ever recorded in eastern Virginia.

The “**Superstorm of March ’93**,” was also known as “**The Storm of the Century**” for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. Impacts in the Southside Hampton Roads region were not as severe, but this storm still caused major disruption across a large portion of the country.

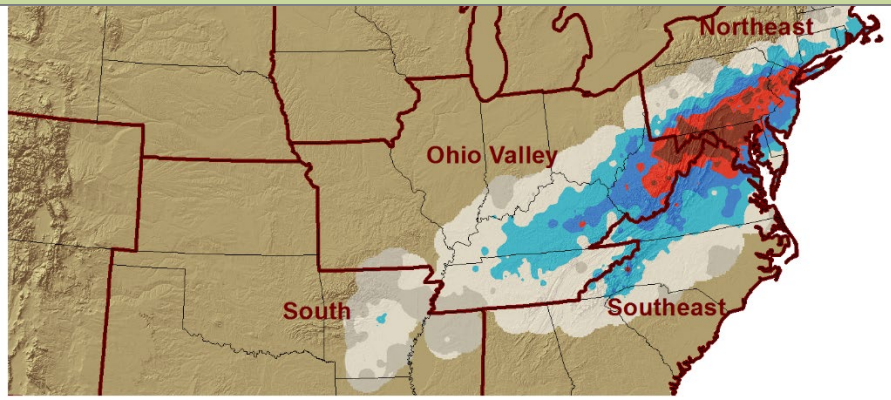
The "**1996 Blizzard**" from January 6 to January 13, 1996 affected much of the eastern seaboard. In Virginia, the winter storm left up to 36 inches of snow in portions of the state. In the Southside Hampton Roads region, most of the communities saw at least a foot of snow between January 6 and January 12.

A major ice storm at the end of **December 1998** resulted in approximately 400,000 customers being without power during the maximum outage period. Some customers were without power for about ten days during the holidays. Many accidents occurred due to slippery road conditions, especially bridges and overpasses and holiday travel. Many secondary roads were impassable due to fallen tree limbs or whole trees.

The **winter of 2010** was a memorable one for residents of Hampton Roads. The NWS winter climate data for 2010-2011 at Norfolk, indicate an average temperature of 38.9 degrees, or 3.2 degrees lower than the normal of 42.1 degrees. Total snowfall was 21.8 inches, which is remarkable when compared to the normal of 7.1 inches for an average winter. December 2010 was the 2nd-snowiest on record, at 17.8 inches, because most snow fell before January 1. There was 13.4 inches of snow for December 26, which is the fourth-biggest daily snowfall on record.[6] The December 26 winter storm created havoc on the roadways. Between midnight and 10 pm December 26, State Police recorded 421 traffic crashes, 296 disabled vehicles and 1,159 total calls for service in Hampton Roads, Eastern Shore, Williamsburg, Franklin and Emporia. The RSI ranking for the December, 2010 winter storm was a Category 2.

The **January 22-24, 2016 Winter Storm** was historic in its proportions across the northeastern United States and even in some parts of Virginia, with at least one reported death in Henry County, Virginia. From northern Virginia and into the panhandles of West Virginia and Maryland, and northeastward to the New York City area, historic amounts of snow fell, much of it blowing and drifting in the high winds. Power outages, storm damage and injuries were extreme in some areas. However, in Hampton Roads the storm's snowfall totals were merely noteworthy and not crippling, with the highest totals of 7.5 inches in James City County and 4 to 7 inches in Surry County. **Figure 4.20** shows the Regional Snowfall Index categories for the storm and how the categories varied across the various regions used in the indexing tool.

FIGURE 4.20: REGIONAL SNOWFALL INDEX, JANUARY 22-24, 2016



Region	RSI	Category
Northeast	20.138	5
Southeast	13.776	4
Ohio Valley	9.959	3
South	0.382	0

2016

Source: NOAA, 2021

Similarly, the snowstorm of **December 8-9, 2018** saw snowfall totals of almost two feet in parts of southwestern Virginia, but the accumulated snowfall in Hampton Roads ranged from virtually none in Virginia Beach and Chesapeake to 8.8 inches in Toano on the upper Virginia Peninsula.

[6] Source: *The Daily Press,* 3/11/2011, and NWS).

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)				
DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS	RSI CATEGORY
1/6/1996	Winter Storm	$25,000	No description available.	5
2/2/1996	Winter Storm	$0	A winter storm tracked northeast from the Gulf Coast states to off the Virginia coast. It spread a mixture of snow, sleet and some freezing rain from the lower Chesapeake Bay southwest into south central Virginia. Snow developed on the back side of the storm with snow accumulations across Tidewater ranging from 4 to 8 inches.	2
2/16/1996	Winter Storm	$0	A storm tracked northeast from western South Carolina Thursday night to off the North Carolina coast Friday morning. Then it moved off north and spread heavy snow across Virginia.	
3/7/1996	Winter Storm	$0	A low pressure area developed over the Carolinas and then tracked off Virginia coast. It spread light snow across central and eastern Virginia.	
12/23/1998	Ice Storm	$20,000,000	A major ice storm affected central and eastern Virginia from Wednesday into Friday. A prolonged period of freezing rain and some sleet resulted in ice accumulations of one half inch to one inch in many locations. The heavy ice accumulations on trees and power lines caused widespread power outages across the region. Approximately 400,000 customers were without power during the maximum outage period. Some customers were without power for about ten days. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads were impassable due to fallen tree limbs or whole trees.	
1/19/2000	Winter Storm	$0	Two to three inches of snow fell overnight as an area of low pressure passed south of the region. The highest amounts were measured along a line from Caroline county in the north, through the City of Richmond, then along the southern shore of the James River to near the Newport News area. Snow briefly fell heavily after midnight, creating hazardous driving conditions.	1
1/25/2000	Winter Storm	$70,000	A significant winter storm dropped 8 to 12 inches of snow across portions of eastern Virginia. There was blowing and drifting of snow from winds which gusted over 40 mph at times. The snow mixed with sleet and freezing rain occasionally during the late morning hours. In Isle of Wight County, strong winds pushed the Pagan River onto South Church Street. Isle of Wight County snowfall totaled 7 to 8 inches. Winds gusting over 50 mph created some blowing snow in the late afternoon and evening hours. Eighty-four automobile accidents were reported during the storm in Virginia Beach alone. Portions of Interstate 264 were closed. Moderate beach erosion was experienced, especially in the Sandbridge area. Blowing sand closed portions of Sandfiddler Road. The U.S. Coast Guard rescued four crew members of a vessel four miles west of Cape Charles when their craft was caught in dangerously rough seas.	3
12/3/2000	Winter Storm	$50,000	A winter storm struck parts of extreme southern and southeastern Virginia. The storm affected a relatively small area, but the areas that had snow received some hefty totals. Windsor reported 4 inches of snowfall. Local law enforcement agencies reported scores of accidents, several of which involved injuries. Schools were closed the following day in Suffolk, Franklin and Isle of Wight County.	

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)				
DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS	RSI CATEGORY
2/22/2001	Winter Storm	$0	A winter storm produced 1 to 4 inches of snow across south central and eastern Virginia. Local law enforcement agencies reported numerous accidents, some of which involved injuries. Many schools were dismissed early on the day of the storm, and several schools in the area were either closed or had a delayed opening the following day due to slippery road conditions.	
1/2/2002	Winter Storm	$0	A winter storm produced 8 to as much as 12 inches of snow across south central and southeast Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Thursday and Friday due to very slippery road conditions.	
12/4/2002	Winter Storm	$0	A winter storm produced 1 to 4 inches of snow along with 1/4 to 1/2 inch of ice from south central Virginia northeast through the middle peninsula and Virginia northern neck. Numerous trees and power lines were reported down due to ice accumulations, resulting in scattered power outages. Local law enforcement agencies also reported numerous accidents. Some schools in the area were closed Thursday due to slippery road conditions.	
1/16/2003	Winter Storm	$0	A winter storm produced 4 to 8 inches of snow across portions of central and eastern Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Friday due to very slippery road conditions.	
2/15/2003	Winter Storm	$0	A winter storm produced 1 to 3 inches of snow, along with sleet and 1/4 to 1/2 inch of ice accumulation, across central and eastern Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Monday due to very slippery road conditions.	3
1/9/2004	Winter Storm	$0	Two to as much as five inches of snow fell across portions of central, south central, and southeast Virginia. The snow produced very slippery roadways, which resulted in several accidents.	
1/25/2004	Winter Storm	$0	Two to as much as four inches of snow and sleet fell across portions of eastern and southeast Virginia. The snow and sleet produced very slippery roadways, which resulted in numerous accidents and school closings for a few days.	
2/15/2004	Winter Storm	$0	One to three inches of snow fell across portions of south central and southeast Virginia. The snow produced very slippery roadways, which resulted in several accidents and school closings for a few days.	
12/26/2004	Winter Storm	$0	A winter storm produced a narrow band of six to as much as fourteen inches of snow across the Virginia Eastern Shore, Hampton Roads, and interior southeast Virginia. The snow caused very hazardous driving conditions, which resulted in numerous accidents. Smithfield in Isle of Wight county reported 12 inches and Isle of Wight reported 11 inches.	
1/30/2010	Winter Storm	$0	Low pressure moving off the coastal Carolinas produced between five and fifteen inches of snow across central and eastern Virginia from Friday night, January 29th, into Saturday night January 30th.	2
12/25/2010	Winter Storm	$0	Low pressure moving north just off the Mid Atlantic Coast produced between five and sixteen inches of snow across central and eastern Virginia from Saturday afternoon, December 25th, into Sunday evening December 26th. Snowfall amounts were generally between nine and fourteen inches across the region. Chesapeake reported 13.0 inches of snow.	2

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)				
DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS	RSI CATEGORY
1/21/2014	Winter Storm	$0	Coastal low pressure intensifying off the Mid Atlantic Coast produced a widespread two to five inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore.	
1/28/2014	Winter Storm	$0	Coastal low pressure intensifying off the Mid Atlantic Coast produced widespread snowfall ranging from two to ten inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore. Highest snowfall amounts were over southeast Virginia.	1
2/16/2015	Winter Storm	$0	Low pressure moving from the Southern Plains east northeast and off the Mid Atlantic Coast produced between four inches and nine inches of snow across central, south central and eastern Virginia from Monday afternoon, February 16th through early Tuesday morning, February 17th.	1
2/26/2015	Winter Storm	$0	Intensifying low pressure tracking from the Gulf of Mexico northeast and off the southeast and Mid Atlantic coast produced between three inches and nine inches of snow across eastern and southeast Virginia from late Wednesday night, February 25th into midday Thursday, February 26th.	
1/22/2016	Winter Storm	$0	Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced between two and seven inches of snow and strong winds across the Virginia Eastern Shore, Middle Peninsula, and Interior Southeast Virginia. Sedley reported 5.0 inches of snow. City of Franklin reported 5.0 inches of snow. Courtland reported 4.0 inches of snow. Lightfoot had 7.5 inches of snow.	4
1/3/2018	Winter Storm	$0	Strong low pressure tracking northward just off the East Coast produced between three inches and fourteen inches of snow across Eastern Virginia. Snowfall totals ranged between four inches and nine inches across the county. Newport News reported 7.5 inches of snow. Fort Eustis reported 5.0 inches of snow.	1
1/17/2018	Winter Storm	$0	Low pressure tracking from the southeast United States northeast and off the Mid Atlantic Coast produced between two inches and seven inches of snow across south central and southeast Virginia. Snowfall totals ranged between two inches and three inches across the county. Bowers Hill reported 3.1 inches of snow.	
12/9/2018	Winter Storm	$0	Low pressure tracking northeast just off the southeast and Mid Atlantic coasts produced snowfall totals between three inches and fourteen inches across central, south central, and eastern Virginia. Snowfall totals generally ranged between four inches and nine inches across the county. Toano reported 8.8 inches of snow. Five Forks reported 6.5 inches of snow. Norge reported 6.0 inches of snow.	3
2/20/2020	Winter Storm	$0	Low pressure tracking from the Gulf Coast States east northeast and off the Southeast Coast produced snowfall totals between two inches and five inches across south central and southeast Virginia. Snowfall totals ranged from two inches to five inches across the county. Downtown Suffolk reported 4.0 inches of snow.	
28 Events		**$20,145,000**		

Source: NCEI, May, 2021

PROBABILITY OF FUTURE OCCURRENCES

Winter storms remain a likely occurrence for the region. While storms will be more likely to produce small amounts of snow, sleet or freezing rain, larger storms, though less frequent in occurrence, could also impact the region.

Historical evidence indicates that the region has been impacted by varying degrees of snow storms and ice storms over the last century. In terms of receiving measurable snowfall, the NCEI estimates that there is between 83.3 and 89.8 percent probability that the Southside Hampton Roads region will receive measurable snowfall in any given year, **Table 4.14**.

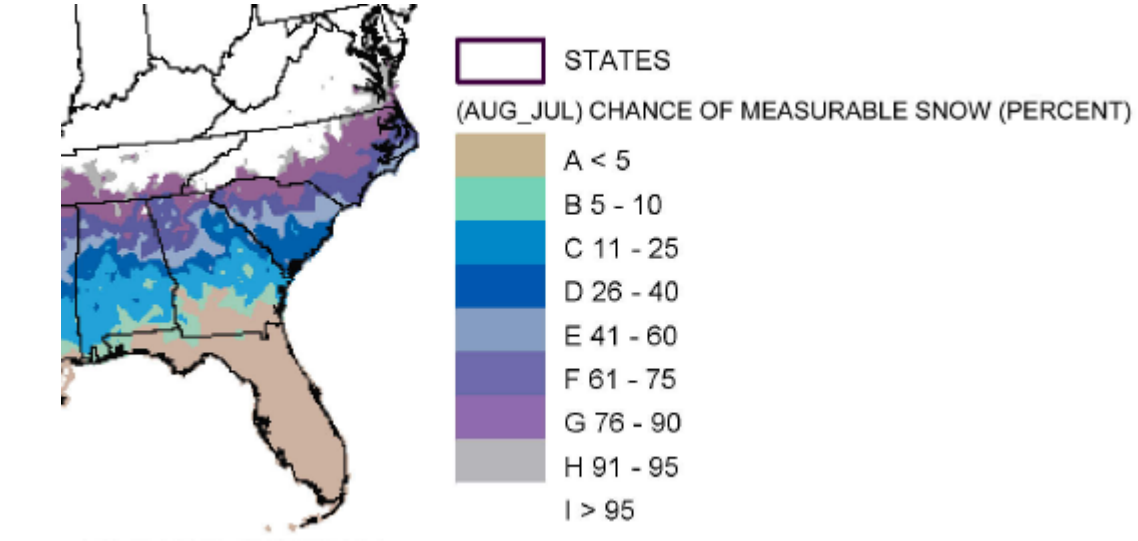
TABLE 4.14: PROBABILITY OF RECEIVING A MEASURABLE SNOWFALL

JURISDICTION	ANNUAL PROBABILITY	WINTER PROBABILITY	SPRING PROBABILITY	FALL PROBABILITY
Isle of Wight	83.3%	94.1%	25.0%	4.0%
Norfolk	89.8%	88.7%	36.4%	5.5%
Suffolk	No data	90.0%	63.6%	29.1%
Virginia Beach	84.0%	85.7%	23.5%	2.7%

Source: NOAA, (formerly) National Climatic Data Center, Snow Climatology Page, 2011

Figure 4.21 provides graphic evidence that the chance of snow annually is close to or equal to 100 percent in the rest of the study area.

FIGURE 4.21: CHANCE OF MEASURABLE SNOWFALL IN SOUTHEAST UNITED STATES (%)



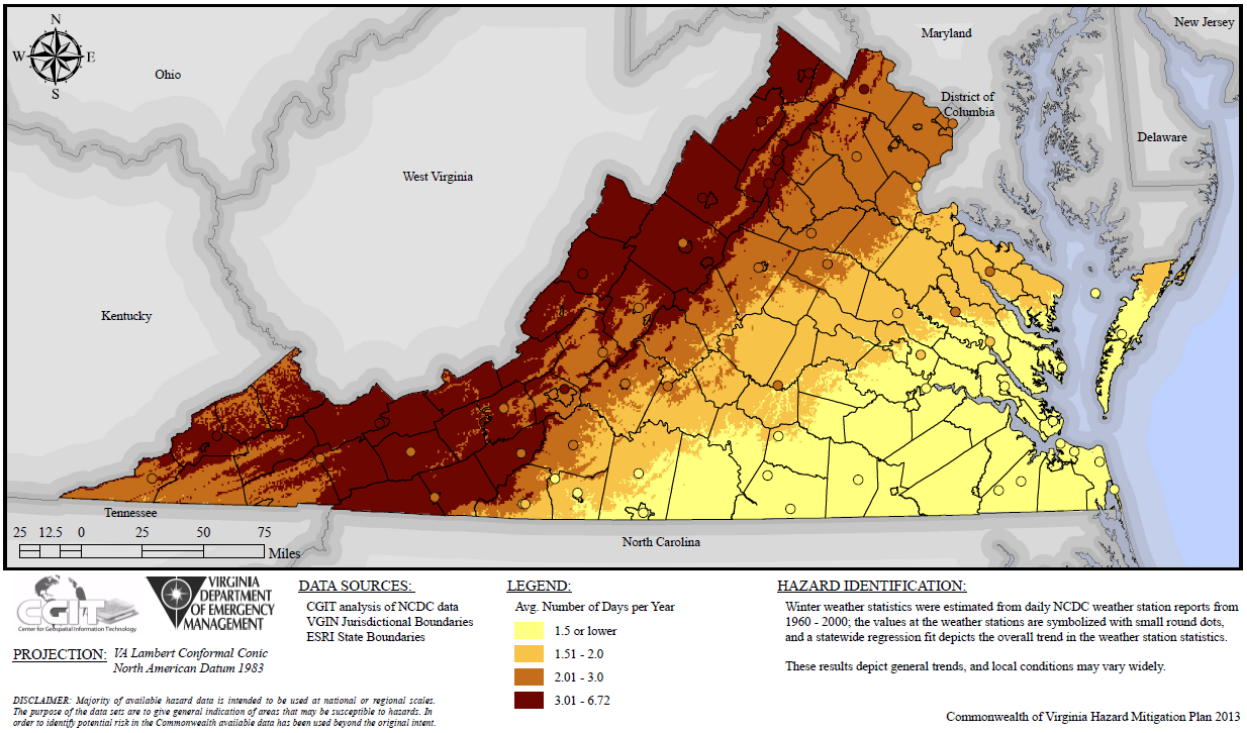
Source: NC State University, Climate Education web page: http://climate.ncsu.edu/edu/k12/.SEPrecip

Figure 4.22 indicates the average number of days the region will experience three or more days with at least three inches of snow. Data produced for the *2013 Commonwealth of Virginia Hazard Mitigation Plan* indicate the following frequency characteristics about winter storm characteristics for the region:

- 1.5 or fewer days per year with at least three inches of snow;
- 0.5 or fewer days per year with at least six inches of snow; and,

- three or fewer days per year entirely at or below 32°F.

FIGURE 4.22: AVERAGE NUMBER OF DAYS WITH AT LEAST THREE INCHES OF SNOW



2013

Source: 2013 Commonwealth of Virginia Hazard Mitigation Plan

EARTHQUAKE

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Naturally occurring earthquakes result from crustal strain, volcanism, landslides or the collapse of caverns but can also be triggered by mine blasts or collapse or nuclear testing. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology.

Earthquakes are caused by the sudden release of accumulated energy, resulting in the rupture of rocks along fault planes in the Earth's lithosphere. The areas of greatest tectonic activity occur at the boundaries of the Earth's slowly moving tectonic plates, as these locations are subjected to the greatest strain from plates traveling in various directions and speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Impacts from earthquakes can be severe and cause significant damage. Ground shaking can lead to the collapse of buildings and bridges, and disrupt utilities and critical lifelines. Death, injuries, and extensive property damage are possible from earthquakes. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure.

Smaller earthquakes occur much more frequently than larger earthquakes. These smaller earthquakes are generally not felt by people and cause little or no damage. Very large earthquakes can cause tremendous damage and may be followed by a series of aftershocks occurring in the region for weeks after the event. Aftershocks generally have a smaller magnitude than the main shock, but may still be powerful enough to cause additional damage.

Earthquakes are measured in terms of their magnitude or intensity. Magnitude is the amount of energy that is released by an earthquake. There are a number of ways that magnitude can be measured but probably the most familiar is the Richter scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of seismic wave amplitude (see **Table 4.15**). Each unit increase in magnitude on the Richter scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using Roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction).

Even though the original calculations developed by Richter to estimate earthquake magnitude have gone out of favor, newer formulae still retain the familiar Richter reporting methodology as shown in **Table 4.15**. Currently, the moment magnitude scale (MMS) is the primary reporting method used by the U.S. Geological Survey.[7]

[7] Source: https://energy.virginia.gov/geology/Earthquakes.shtml&sa=D&source=docs&ust=1641771610295397&usg=AOvVaw1u1SLzk6WWF7rtbguUKSjV

TABLE 4.15: RICHTER SCALE	
RICHTER MAGNITUDES	**EARTHQUAKE EFFECTS**
Less than 3.5	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0-7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: United States Geological Survey

The effect of an earthquake on people and structures on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally, total destruction. Although numerous intensity scales have been developed in the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity Scale. It was developed in 1931 by American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals as shown in **Table 4.16**. The scale does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.[8] The lower numbers of the intensity scale indicate the manner in which people perceive the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

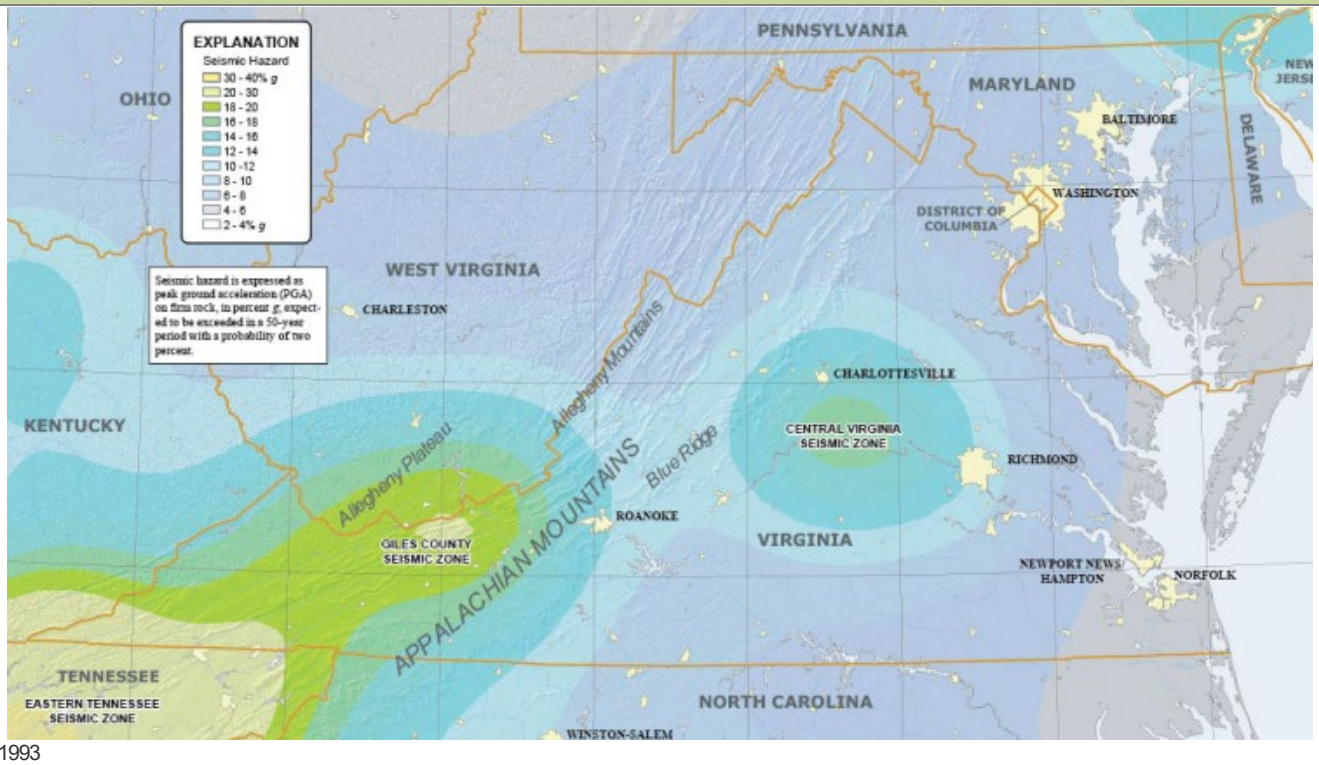
[8] Source: USGS online at: www.usgs.gov/natural-hazards/earthquake-hazards/science/modified-mercalli-intensity-scale?qt-science_center_objects=0#qt-science_center_objects

TABLE 4.16: MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES			
SCALE	**INTENSITY**	**DESCRIPTION OF EFFECTS**	**CORRESPONDING RICHTER SCALE MAGNITUDE**
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>8.1

Source: United States Geological Survey

Hampton Roads is in an area that could feel the effects of earthquakes in the Central Virginia Seismic Zone (see **Figure 4.23**), an area of frequent, yet very weak, earthquake activity located to the southwest of Charlottesville, at the New Madrid Fault in Missouri and at the Charleston Fault in South Carolina. During the last 200 years, both the New Madrid Fault and the Charleston Fault have generated earthquakes measuring greater than 8 on the Richter scale.

FIGURE 4.23: CENTRAL VIRGINIA SEISMIC ZONE



1993

Source: USGS

Earthquakes in the central and eastern U.S., although less frequent than in the western U.S., are typically felt over a much broader region. East of the Rockies, an earthquake can be felt over an area as much as ten times larger than a similar magnitude earthquake on the west coast. A magnitude 4.0 eastern U.S. earthquake typically can be felt at many places as far as 60 miles from where it occurred, and it infrequently causes damage near its source.[9] A magnitude 5.5 eastern U.S. earthquake usually can be felt as far as 300 miles from where it occurred, and sometimes causes damage out to 25 miles.

Earthquakes everywhere occur on faults within bedrock, usually several miles deep. Most bedrock beneath central Virginia was assembled as continents collided to form a supercontinent about 500-300 million years ago, raising the Appalachian Mountains. Most of the rest of the bedrock formed when the supercontinent rifted apart about 200 million years ago to form what are now the northeastern U.S., the Atlantic Ocean, and Europe.[10]

At well-studied plate boundaries like the San Andreas fault system in California, often scientists can determine the name of the specific fault that is responsible for an earthquake. In contrast, east of the Rocky Mountains this is rarely the case. The Central Virginia Seismic Zone is far from the nearest plate boundaries, which are in the center of the Atlantic Ocean. The seismic zone is laced with known faults but numerous smaller or deeply buried faults remain undetected. Even the known faults are poorly located at earthquake depths. Accordingly, few, if any, earthquakes in the seismic zone can be linked to named faults. It is difficult to determine if a known fault is still active and could slip and cause an earthquake. As in most other areas

[9] Source: www.magma.geos.vt.edu/vtso/cvsz.html
[10] Source: www.magma.geos.vt.edu/vtso/cvsz.html

east of the Rockies, the best guide to earthquake hazards in the seismic zone is the earthquakes themselves.[11]

Earthquake activity in Virginia has generally been, with a few exceptions, low-magnitude but persistent. The first documented earthquake in Virginia took place in 1774 near Petersburg.[12] Historical data is supportive of the low risk assessment. Since 1774, there have been only three confirmed earthquake epicenters within 65 miles of Hampton Roads, one on the Delmarva Peninsula and two in the Hampton Roads area. Only minor structural damage as a result of these earthquakes has been reported in the region. Impacts of a severe, unlikely earthquake centered in Hampton Roads are unknown based on the historical record, but could be generalized from damage experienced in Louisa County during the August 2011 quake described below. Damage to local structures would likely be severe because buildings in the region are not typically designed to withstand high magnitude quakes. Underground infrastructure damage is also expected to be severe and could cause long-term power, water and sewer service interruptions in the region. Likewise, damage to bridges, tunnels and roads could disrupt transportation routes for much of the population.

On Tuesday afternoon, August 23, 2011, an earthquake with a moment magnitude of 5.8 occurred about 7 miles southwest of Mineral, Virginia, which is near Lake Anna in Louisa County. The earthquake was widely felt, with felt reports received from people as far away as Detroit, Atlanta, Boston, Toronto, and Montreal. Dozens of aftershocks up to magnitude 4.5 have been recorded, including a magnitude 4.2 aftershock approximately six hours after the main shock and a magnitude 4.5 aftershock about a day and a half later. The *Washington Post* reported that the two Dominion Virginia Power nuclear plants in North Anna, Va., 10 miles from the epicenter, shut down automatically when the quake hit. They lost power from the grid and switched to four diesel generators. Damage was greatest in Louisa County and several minor injuries occurred. Structural damage to buildings was significant in cities throughout central and eastern Virginia and Washington D.C., including damage to the Washington Monument and the Washington National Cathedral. Officials at Fort Monroe, in Hampton, Virginia, also reported some minor structural damage as a result of the quake.

The *Daily Press* and *Virginian-Pilot* newspapers reported a minor, but relatively rare, earthquake with its epicenter on the Peninsula August 3, 1995. According to the *Virginian-Pilot*, the quake measured 2.6 on the Richter scale. The Virginia Tech Seismological Observatory detected the quake with instrumentation in Goochland County west of Richmond, and in Blacksburg. The quake was centered under the York River near York River State Park. According to the *Daily Press*, people at Camp Peary in York County reported feeling the quake.

The Virginia Tech Seismological Observatory provides additional information on more recent events in Virginia, including a magnitude 4.0 shock that occurred on August 17, 1984. The epicenter was approximately 15 miles to the southeast of Charlottesville. The quake was felt from Washington, DC to the North Carolina border and from Staunton to Norfolk.

A magnitude 3.2 earthquake occurred Saturday, September 22, 2001, with the epicenter near Shadwell, just east of Charlottesville. The focal depth was within a few kilometers of the surface, and this produced a strong acoustic signal that local officials attributed to an aircraft in transonic flight. In fact, such explosive sounds are frequently associated with shallow earthquakes in eastern North America. Unlike the situation in California, the rocks in the upper few kilometers of the Earth's crust in the east are extremely efficient transmitters of high frequency seismic energy, and a proportion of this energy is converted to ordinary sound waves when the seismic waves reach the Earth's surface.

The USGS Earthquake Mapping Tool, online at https://earthquake.usgs177.gov/earthquakes/, does not indicate or show any earthquakes since 1774 with epicenters in the Hampton Roads area.

[11] Source: www.magma.geos.vt.edu/vtso/cvsz.html
[12] Source: www.energy.virginia.gov/geology/Earthquakes.shtml

Earthquakes of significant magnitude are unlikely occurrences for Hampton Roads, though the proximity of the region to the Charleston Fault could increase the possibility of feeling some impact of a large earthquake if it were to occur along that fault line.

WILDFIRES

BACKGROUND

A wildfire is any fire occurring in a wildland area (i.e., grassland, forest, brush land) except for fire under prescription.[13] Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. Over 80% of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around.



A 2008 fire sparked by logging equipment in the Great Dismal Swamp National Wildlife Refuge lasted 121 days and cost more than $10 million. It was the longest and most expensive wildfire in Virginia history.
Photo Source: U.S. Fish and Wildlife Service

Fire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural disasters (such as hurricanes, tornadoes and lightning) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities.

The impacts of wildfire in the Hampton Roads region are both economic and environmental. From an economic perspective, fires destroy most homes, businesses and infrastructure in their path. The population displacement and subsequent rebuilding consumes valuable resources of private and public entities. Communities in the region spend significant capital funds both fighting wildfires and training staff, and preparing equipment and infrastructure to fight wildfire. Wildfire also endangers the lives and safety of firefighters and citizens. Loss of life is a possible impact of severe wildfire in the region, although the lack of mountainous terrain makes escape somewhat easier.

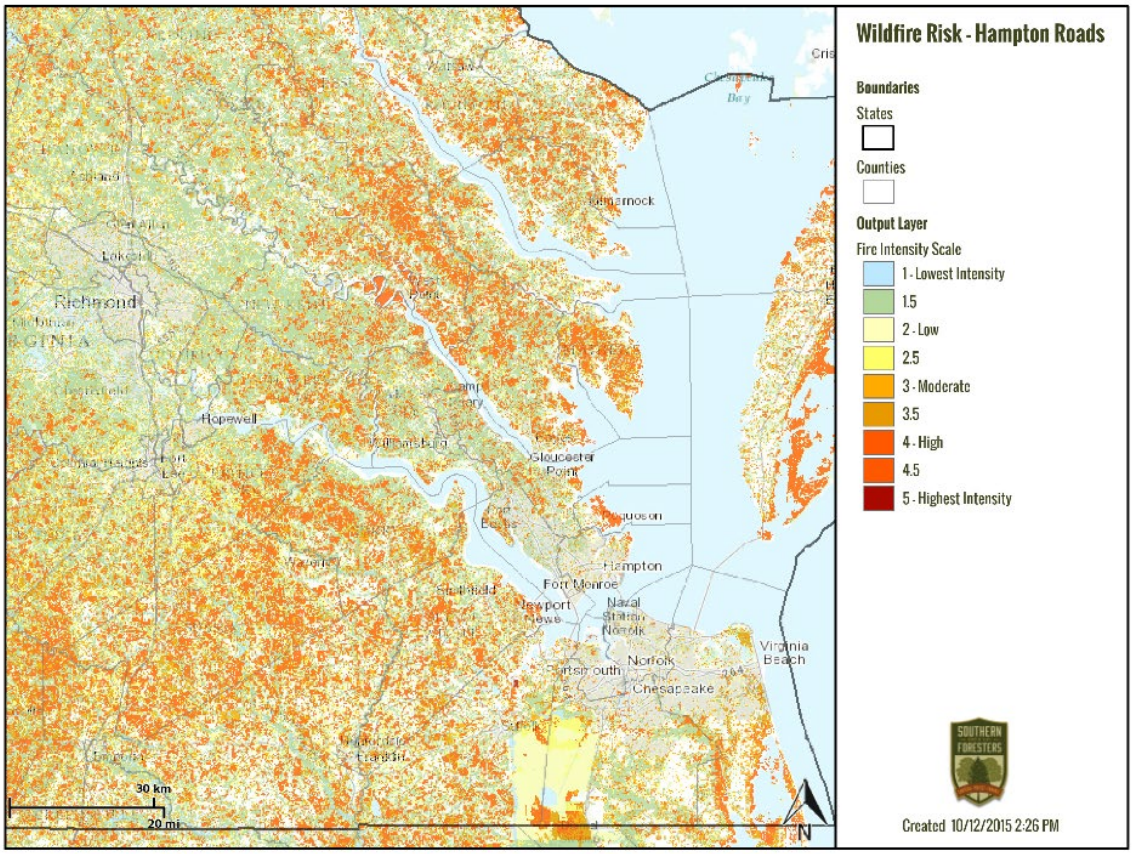
The region's air, water and soil environments are all altered by wildfire, and even wildfire in adjacent regions. Dense smoke and the fine particles and gases inside the smoke pose a risk to human health. Smoke irritates the eyes and respiratory system and can cause bronchitis or aggravate heart or lung disease even for residents hundreds of miles downwind. Wildfires raise the temperature of forest soils and potentially wipe away organic value of the soil. And although soils do eventually recover, the impact on watersheds in the interim can be detrimental to the region's water bodies. Burned organic matter in soils may negatively affect infiltration and percolation making soil surfaces water repellant. If water is unable to infiltrate, runoff quantity increases and infiltration to groundwater decreases. Both of these factors may negatively impact water quality downstream.

[13] Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

LOCATION AND SPATIAL EXTENT

In July 2003, the Virginia Department of Forestry (VDOF) released a GIS-based wildfire risk assessment for the Commonwealth of Virginia. The data are now part of the Southern Foresters web site at www.southernwildfirerisk.com that serves as a portal for data from several southern states. While this assessment of wildfire risk is not recommended for site-specific determinations of wildfire vulnerability, the data were used in this plan as an indicator of general hazard exposure within the region, as shown in **Figure 4.24**. Risk assessment designation involved several inputs, including slope, aspect, land cover, distance to railroads, distance to roads, population density, and historical fire occurrence. Potential wildfire risk areas are presented in two categories indicating the relative level of threat to the area as high or moderate. Areas without a high or moderate designation are considered to be at low risk of wildfire.

FIGURE 4.24: WILDFIRE THREAT



Source: Southern Foresters, 2013

Aerial imagery indicates that the areas classified as high wildfire threat are lightly developed wooded areas, including some marshland and other forms of undeveloped land. The moderate wildfire threat areas include both undeveloped and developed land.

SIGNIFICANT HISTORICAL EVENTS

According to VDOF records, the agency responded to 190 events between 2010 and 2020, the most recent year for which data were available. These data were compiled from completed VDOF fire reports, and do not reflect every brush and woods fire occurrence in the region for this time period. Many more fires are likely to have occurred during this timeframe that local fire departments responded to and were able to contain quickly and efficiently. Because the documented events required state-level assistance from VDOF, they are considered significant events for the purposes of this plan. Only minor property damages have been recorded as resulting from wildfire events. **Table 4.17** shows damages from wildfire events in the region between 2002 and 2020. In the period between 2010 and 2020, the fire that caused the most property damage occurred on July 9, 2018 in Southampton County as a result of equipment malfunction. Damages totaled $250,000, but only .5 acre was burned. In that same time period, there were six wildfires that burned 50 acres or more and property damages from those fires combined totaled just $50,250. Sixteen wildfires in that time period were caused by lightning.

TABLE 4.17: HAMPTON ROADS WILDFIRE OCCURRENCES (2002-2020)

YEAR	FREQUENCY	ACRES DAMAGED	COST OF DAMAGE ($)	VALUE OF RESOURCES PROTECTED ($)
2002	72	592	$89,800	$4,718,200
2003	9	42	$1,600	$0
2004	19	26	$50	$500,000
2005	19	130	$750	$1,370,000
2006	41	298	$69,950	$7,315,000
2007	40	188	$600	$1,950,000
2008	31	141	$500	$0
2009	12	47	not provided	not provided
2010	40	381	$33,450	not provided
2011	18	199	$11,000	not provided
2012	12	91	$9,200	not provided
2013	13	31	$15,900	not provided
2014	17	61	$1,200	not provided
2015	18	146	$49,900	not provided
2016	10	78	$1,700	not provided
2017	21	60	$34,100	not provided
2018	19	149	$278,950	not provided
2019	10	21	$60,600	not provided
2020	12	77	$4,300	not provided
TOTALS	**433**	**2758**	**$663,550**	**n/a**

Source: VDOF, 2021

GREAT DISMAL SWAMP FIRE THREAT AND HISTORY

On the western edge of the City of Chesapeake's border lies the Great Dismal Swamp Wildlife Refuge, 111,000 acres of complete uninterrupted wilderness and swamp owned and managed by the U.S. Fish and Wildlife Service. While the City has very limited development in close proximity to the Refuge borders and does not actively manage fire or fire threats on federal lands, there are several unique factors which could present a large wildfire risk to the cities of Chesapeake and Suffolk:

- Limited road access means many thousands of acres are completely inaccessible for normal fire apparatuses. Most of the refuge is only accessible by canal.
- Dangerous soil conditions for fires. The soils within the refuge are primarily peat soils. Peat forms when plant material, usually in marshy areas, is inhibited from decaying fully by acidic and anaerobic conditions. Peat has high carbon content and can burn under low moisture conditions.

Once ignited by the presence of a heat source (e.g., a wildfire penetrating the subsurface), it smolders. These smoldering fires can burn undetected for very long periods of time (months, years and even centuries), propagating in a creeping fashion through the underground peat layer.

In 1923 a lightning strike within the Refuge ignited a fire that burn uncontrolled for three years. This fire became known as "The Great Conflagration" and burned over 150 square miles of the refuge. Yellow peat smoke filled the air around Hampton, Newport News, and Norfolk during this period. Since the mid-1940s, fire prevention and suppression techniques have reduced both the number and magnitude of fires within the refuge and adjacent areas. However, several notable fires during this period are summarized in **Table 4.18**.

On August 4, 2011, lighting struck and ignited much of the dead trees and brush that remained from the 2008 fire. Aided by a drought that had dried plants and the soil, the Lateral West fire steadily grew. This fire produced dense smoke as the peat soil burned (**Figure 4.25**). Shortly after the fire started, Hurricane Irene dumped 12 inches of rain in 24 hours, but that did not put out the fire which burned for another two and a half months.

FIGURE 4.25: GREAT DISMAL SWAMP LATERAL WEST FIRE, 2011



Source: NASA Satellite, 2011

An active fire management program is housed on the refuge. Seasonal activities include the planning and implementation of controlled burns, and wildfire suppression. The zone program conducts burns nine months a year, and averages 35 burn days a year. Burns are conducted in a wide range of habitat types, including marsh, grasslands, pocosins, and upland pine and hardwood forest.

TABLE 4.18: GREAT DISMAL SWAMP NOTABLE FIRES	
YEAR/FIRE NAME	**BRIEF DESCRIPTION**
1923-1926 Great Conflagration	Consumed nearly 100,000 acres; it was sparked by logging debris. (*Virginian Pilot* online)
1955 Easter Sunday Fire	Started along the railroad within the northern part of the current refuge and burned nearly 150 square miles, reaching the Portsmouth city line.
1967 South of Feeder Ditch	Someone burning debris ignited this fire that burned 1,350 acres.
1988 April Fools Fire	Escaped prescribed fire burned 640 acres along the state boundary south of Lake Drummond.
1993 Clay Hill Road Fire	Lightning caused fire that burned 150 acres of pine stands near the refuge's western boundary in Suffolk.
1993 Portsmouth Ditch Fire	Fire of unknown origin burned 75 acres adjacent the refuge in Chesapeake.
2004 Corapeake Road Fire	Lightning caused fire started on NC State Natural Area land and spilled over onto the refuge burning 286 acres.
2006 West Drummond Fire	Lightning strike caused fire that burned 535 acres of maple/gum stand north of Interior Ditch.
2008 South One Fire	The South One Fire was started when logging equipment working in fallen Atlantic White Cedar and logging slash caught fire. The fire grew to 4,884 acres before being contained three months later. The fire burned through slash on the surface of the ground and crept deep into the organic peat soils where it continued to smolder and spread ultimately igniting additional vegetation on the surface. The fire cost more than 10 million dollars to suppress.
2011 Lateral West Fire	Largest fire in recent history sparked by lightning on August 4. Burned for 111 days and consumed 6,300 acres.

Source: U.S. Fish & Wildlife Service, 2014



The 2008 South One Fire burns in the distance. Photo source: Salter's Creek Consulting, Inc.

Today, lightning is the cause of most wildfires at Great Dismal Swamp National Wildlife Refuge. A typical summer afternoon thunderstorm can often result in hundreds of lightning strikes on the refuge. Most of the time, the strikes do not create a wildfire, but surface and ground fires occur on average 2.6 times each year. In the spring, early season lightning events provide the best chance for large fire growth under dry, windy conditions. In the summer months, more frequent lightning brings more starts, but less chance of large fire growth due to higher humidity and greenness of vegetation.

PROBABILITY OF FUTURE OCCURRENCES

Wildfires remain a highly likely occurrence for the region, though most will likely continue to occur in less urban areas and be small in size before being contained and suppressed. Wildfire at Great Dismal Swamp National Wildlife Refuge is similarly a highly likely occurrence.

DROUGHT

BACKGROUND

Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds and low humidity can worsen drought conditions, and make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.



A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July 2000 illustrates the drought conditions that can severely affect water supplies, agriculture, stream water quality, recreation, navigation and forest resources.

Photo source: USGS

Droughts are frequently classified as one of the following four types: meteorological, agricultural, hydrological or socio-economic. Meteorological droughts are typically defined by the level of "dryness" when compared to an average or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

In Hampton Roads, droughts can have economic, environmental and social impacts. Economic impacts include loss of income for farmers dependent on crop harvests, especially in the western portion of the region, irrigation costs for farms and gardens, higher costs of feed and water for farm animals, and impacts to farm supply businesses such as tractor sales. Wildfire resulting from drought can impact timberland. Water utilities may have additional costs to treat and provide limited water supplies, and food prices in general may be driven higher. Environmental impacts in the region may include loss or destruction of fish and wildlife habitat, and lack of food or drinking water for wild animals and resultant disease in those populations, migration of wildlife, and poor soil quality which may lead to soil erosion. Social impacts may result from changes in lifestyle associated with chronic drought and associated water restrictions. Severe drought often causes anxiety or depression about economic effects of drought in farming communities, health problems related to poor water quality and fewer recreational activities if drought continues and water supplies are curtailed.

The drought severity classification table (**Table 4.19**), shows the ranges for Palmer Drought Severity Index (PDSI) for each dryness level. Other indicators are also used, such as USGS weekly streamflow data and a standardized precipitation index. Short-term drought indicator blends focus on 1-3 month precipitation. Long-term blends focus on 6-60 months.

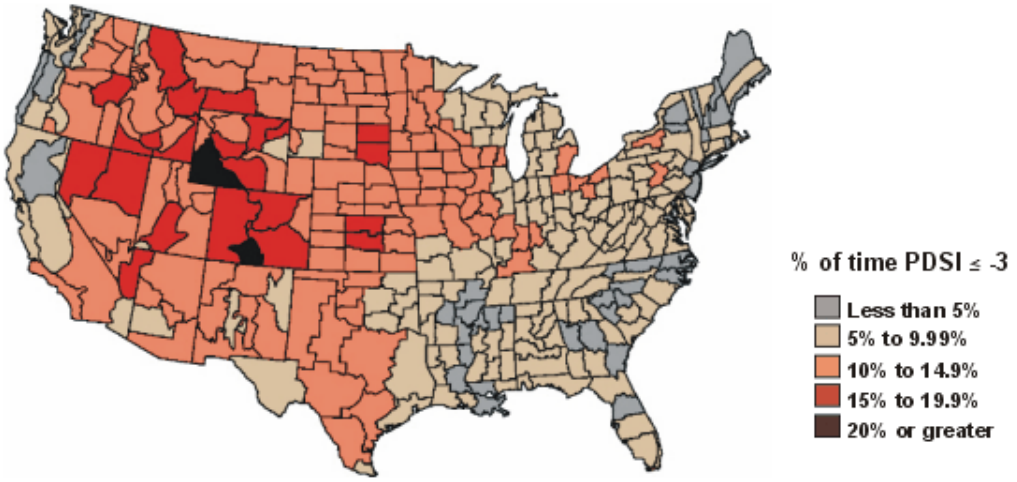
TABLE 4.19: DROUGHT CLASSIFICATION

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)
D0	Abnormally Dry	Going into drought: • short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • some lingering water deficits • pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

Source: National Drought Mitigation Center

Figure 4.26 shows the PDSI summary map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). As can be seen, the Eastern United States has historically not seen as many significant long-term droughts as the Central and Western regions of the country.

FIGURE 4.26: PALMER DROUGHT SEVERITY INDEX, 1895-1995, PERCENT OF TIME IN SEVERE AND EXTREME DROUGHT



Source: National Drought Mitigation Center

LOCATION AND SPATIAL EXTENT

Drought typically impacts a large area that cannot be confined to geographic boundaries; however, some regions of the United States are more susceptible to drought conditions than others. According to Figure 4.26, Virginia is in a zone representing 5 percent to 9.99 percent of the time with PDSI less than or equal to -3 (-3 indicating severe drought conditions), meaning that drought conditions are a relatively low to moderate risk for the Hampton Roads region. The region would be uniformly exposed to this hazard and the spatial extent of that impact could potentially be large. However, drought conditions typically do not cause significant damage to the built environment. Agricultural areas in Chesapeake, Isle of Wight County, James City County, York County and Southampton County are more likely to be impacted by drought, especially in the early stages. As water restrictions are put in place as a result of acute water shortages, impacts on urban consumers increase (use restrictions, drinking water supply effects and saltwater intrusion).

SIGNIFICANT HISTORICAL EVENTS

The drought of record for Virginia occurred in 1931 when the statewide average rainfall amount was 7.64 inches compared to an average mean rainfall amount of 17.89. This was during this period that also saw the Great Dust Bowl that helped lead to the Great Depression.

Since 1993, the NCEI has recorded only 2 instances of drought to impact the Southside Hampton Roads region (**Table 4.20**). Though instances are recorded on a monthly basis by the NCEI, events are usually part of ongoing drought conditions that last several months or years.

TABLE 4.20: OCCURRENCES OF DROUGHT, 1993 THROUGH 2016

LOCATION	DATE OF OCCURRENCE	DETAILS
17 jurisdictions, including Isle of Wight	10/31/1993	Unusually dry weather during the summer and early fall led to many communities in southeastern Virginia to place water conservation measures into effect in October 1993.
20 jurisdictions, including Isle of Wight, James City County, Williamsburg, and Suffolk	9/1/1997	A very dry period from May through September resulted in drought-like conditions across much of central and eastern Virginia. Monthly rainfall departures from normal for Norfolk included: -2.21 inches in May, -2.73 inches in June, -3.05 inches in August, and -1.93 inches in September. This caused significant crop damage throughout much of the area which was estimated to be around $63.8 million. Damages reported in the study area were $9.2 million.
Hampton Roads	10/1/2000	Although not technically a drought, much of eastern Virginia experienced extremely dry conditions during the month of October. Norfolk International Airport also received only .01 inches of precipitation during the month. This was the driest month ever recorded at Norfolk. A very wet summer prevented a more hazardous fire situation than would normally be experienced under such dry conditions. However, several small brush fires were reported over the region. Crops also were able to withstand the lack of rainfall due to a very wet summertime. No damages reported.

Source: NCEI

In addition to this official drought record, periods of drought-like conditions are also known to have impacted the region in 1997, 2002, 2003, 2005, 2007, 2008, and 2010. Water restrictions have been put into place as far back as 1997 and shallow wells have lost water in the region. Additional historical accounts were available for the most recent droughts in 2002, 2007, 2008 and 2010.

August, 2002: Drought

During the summer of 2002, Virginia experienced significant drought impacts due to precipitation deficits that dated to 1999 in most areas of the Commonwealth. While this drought did not reach the level of severity of the drought of record (1930-1932), increases in water demands when compared to the 1930's resulted in significant impacts to all sectors of Virginia's economy and society. The intensity of these drought impacts peaked in late August 2002. Wildfire indices were at levels previously unrecorded in Virginia, the vast majority of Virginia agricultural counties had applied for Federal drought disaster designation, stream flows reached periods of record lows, and thousands of individual private wells failed. During the third week of August several public water supply systems across the Commonwealth were on the brink of failure. Several large municipal systems, such as Charlottesville and Portsmouth, had less than sixty days of water supply capacity remaining in reservoirs. Several smaller rural systems that rely primarily on withdrawals from free-flowing streams, such as the towns of Farmville and Orange, had at most a few days of water supply available and were forced to severely curtail usage.

According to Commonwealth of Virginia records, a declaration of a State of Emergency Due to Extreme Drought Conditions was executed by the Governor of Virginia on August 30, 2002. The Executive Order was to be effective from August 30, 2002 through June 30, 2003. The 2002 drought resulted in several changes to the way Virginia predicts and responds to drought. In 2005, Isle of Wight County sought federal disaster drought aid because of drought conditions effecting crop production.

September, 2007: Drought

A statewide drought in late summer, early fall 2007 came very close to setting a 130-year statewide low precipitation record. Late October rainfall was helpful, but impacts to livestock, peanuts, hay and cotton were experienced and many crop insurance claims were made in Southeast Virginia.

Summer, 2008: Hydrologic Drought

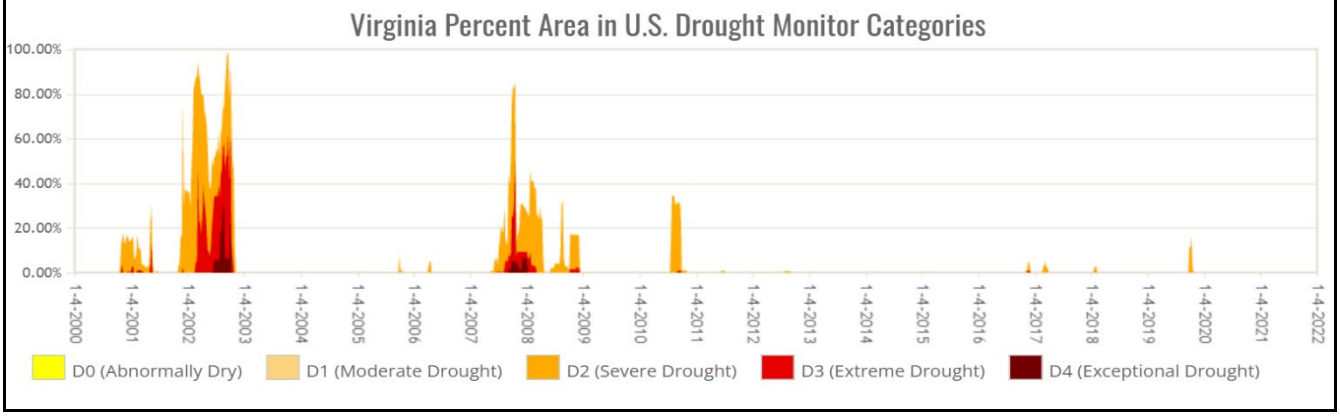
Low stream flow in summer 2008 resulted in severe hydrologic drought.

Summer, 2010: Drought

Below average rainfall across much of the state resulted in 67 localities requesting the Governor's assistance in obtaining a Federal disaster designation due to drought. Crop yields were well below average with particular emphasis on corn and soybeans.

Figure 4.27 provides a time series of U.S. Drought Monitor Categories since 2000 for the Commonwealth of Virginia, highlighting times when Virginia was in Extreme, Severe or Exceptional drought categories.

FIGURE 4.27: VIRGINIA DROUGHT HISTORY, 2000 - 2021



Source: National Drought Mitigation Center, 2021

PROBABILITY OF FUTURE OCCURRENCES

Based on current and seasonal outlook drought maps available through the National Drought Mitigation Center, Hampton Roads is not currently in an area of abnormally dry conditions as of October 2021. Based on past events, the Hampton Roads region could possibly experience recurring drought conditions when precipitation falls below normal for extended periods of time.

EXTREME HEAT

BACKGROUND

A heat wave is defined as a prolonged period of excessive heat, often combined with excessive humidity. Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. A heat wave combined with a drought is particularly dangerous.

Extreme heat combined with high relative humidity slows evaporation, limiting the body's ability to efficiently cool itself. Overexposure may result in heat exhaustion or stroke, which could lead to death. The Centers for Disease Control and Prevention state that excessive heat exposure caused 8,015 deaths in the United States between 1979 and 1999.

In Hampton Roads, humid conditions resulting from maritime air masses may also add to the discomfort of high temperatures. Health risks to residents in the region exposed to extreme heat include dehydration, heat cramps, fainting, heat exhaustion and heat stroke. According to the NWS, heat is the leading weather-related killer in the United States, although no deaths have been reported for the historical events described below. The elderly and those with medical conditions such as diabetes are most at-risk, along with those who work outdoors in hot, humid weather.

The impact of excessive heat is most prevalent in urban areas, where urban heat-island effects prevent inner-city buildings from releasing heat built up during the daylight hours. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts.

LOCATION AND SPATIAL EXTENT

For excessive heat, the NWS uses heat index thresholds as criteria for the issuance of heat advisories and excessive heat warnings. NWS heat advisory bulletins inform citizens of forecasted extreme heat conditions. The bulletins are based on projected or observed heat index values and include:

- Excessive Heat Outlook when there is a potential for an excessive heat event within three to seven days.
- Excessive Heat Watch when conditions are favorable for an excessive heat event within 12 to 48 hours but some uncertainty exists regarding occurrence and timing.
- Excessive Heat Warning/Advisory when an excessive heat event is expected within 36 hours.

These products are usually issued when confidence is high that the event will occur. A warning implies that conditions could pose a threat to life or property, while an advisory is issued for less serious conditions that may cause discomfort or inconvenience, but could still lead to threat to life and property if caution is not taken.

Extreme heat typically impacts a large area that is normally not confined to any geographic boundaries, although urban heat island effects can exacerbate effects in urbanized areas. Hampton Roads is uniformly exposed to this hazard and the spatial extent of that impact is potentially large. Extreme heat typically does not cause significant damage to the built environment, with the exception of road buckling. Summertime temperatures in Hampton Roads region can easily climb into the high 90 to low 100 degree Fahrenheit range with high humidity rates. Coastal areas may experience slightly (1 to 2 degrees) lower temperatures at some times as a result of late day sea breezes or lower water temperatures, depending on the season.

SIGNIFICANT HISTORICAL EVENTS

While temperature extremes occur fairly frequently in the region, the NCEI has only recorded three extreme temperature events recorded that have impacted the region as shown below. The committee acknowledges that there have been other, unrecorded extreme heat events during the period since 1950; however, records on these events are not available from the communities and were not reported through the NCEI or NWS.

August 1-31, 1995: Heat Wave
There were 22 injuries and $100 property damage associated with this heat wave that gripped the region.

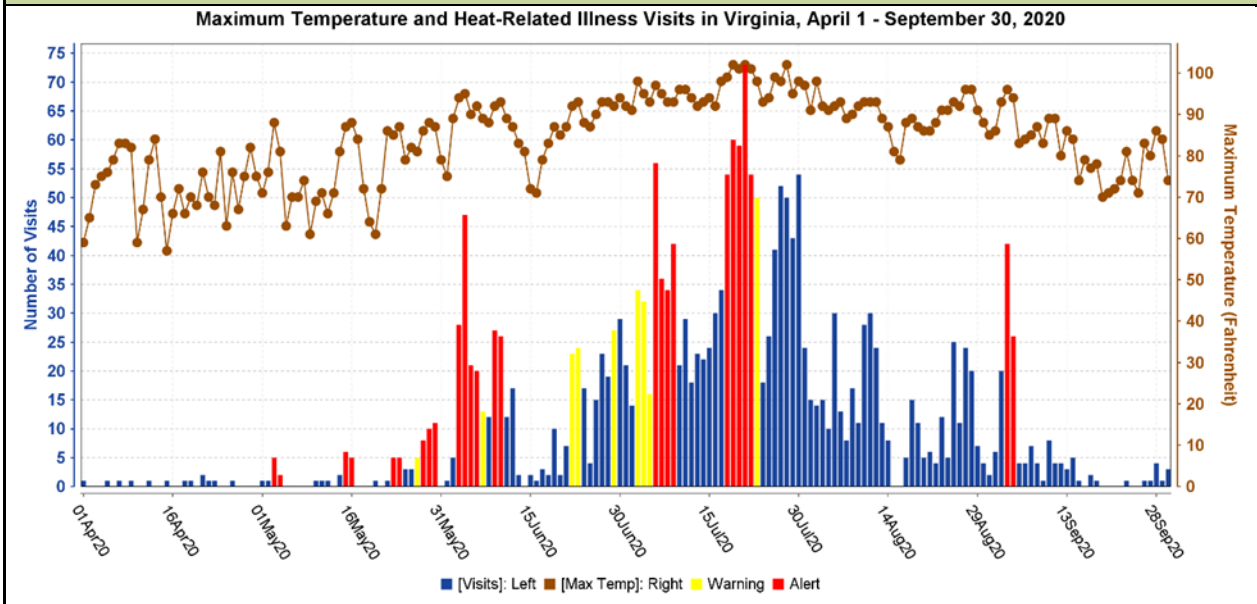
May 18−21, 1996: Extreme Heat
An early-season, four-day heat wave produced record or near record high temperatures across central and eastern Virginia. High temperatures were in the 80s and low 90s across the region on May 18. Then, on May 19, May 20 and May 21, high temperatures were in the 90s throughout the area. May 20 was the hottest of the four days as readings climbed into the mid- to upper-90s. Norfolk International Airport set a record with 98 degrees. The heat wave was responsible for numerous reports of heat exhaustion and forced many non-air conditioned schools to close or have early dismissals. There were no reported property damages, fatalities, or injuries.

The NWS reported that the summer of 2010 (June - August) had an average temperature of 81.1 degrees Fahrenheit, ranking it as the warmest on record. Previously, the warmest summer on record had averaged 80.0 degrees Fahrenheit in 1994.

July 21–23, 2011: Excessive Heat
An extended period of excessive heat and humidity occurred across most of central and eastern Virginia from July 21st to July 23rd. High temperatures ranged from 96 to 103 degrees during the afternoons, with heat index values ranging from 110 to 119. Overnight lows only fell into the lower 70s to lower 80s.

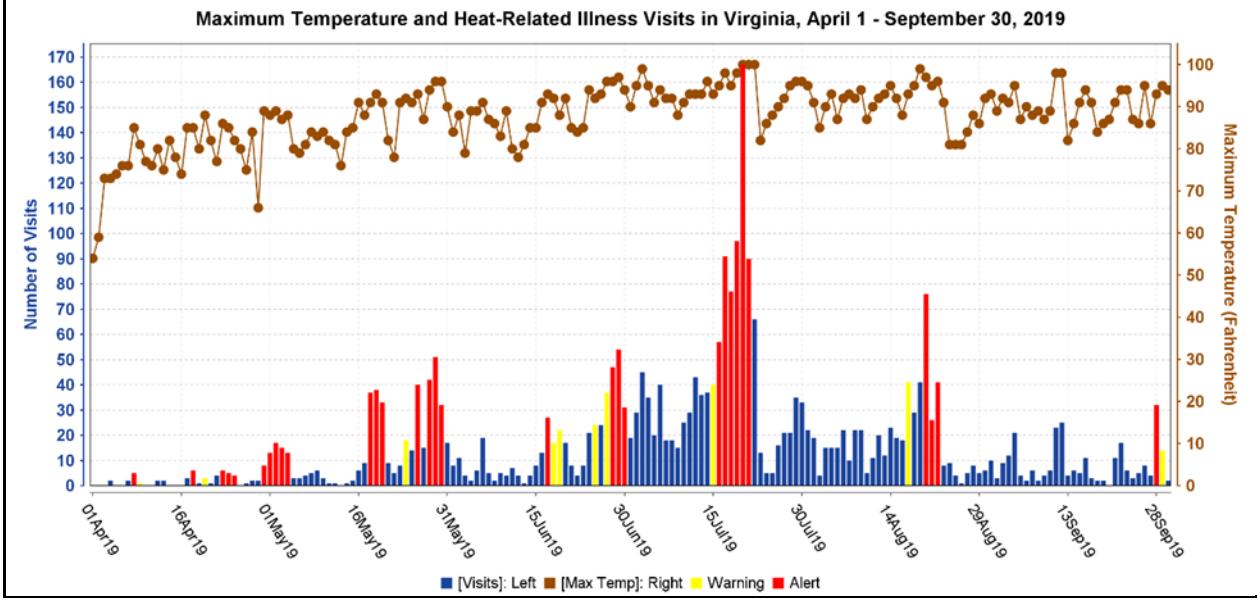
The VDH receives data on visits to emergency departments and urgent care centers in Virginia for purposes of public health surveillance. These data are analyzed through a syndromic surveillance system, known as ESSENCE, to monitor the health of the community and identify emerging trends of public health concern. In response to extreme heat, the Office of Epidemiology, Division of Surveillance and Investigation conducts surveillance for heat-related illness. While these data are not readily available by jurisdiction, the statewide data provide insights about significant extreme heat dates, the maximum temperatures and the number of hospital visits for heat-related illness, **Figures 4.28 through 4.32.**

FIGURE 4.28: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2020



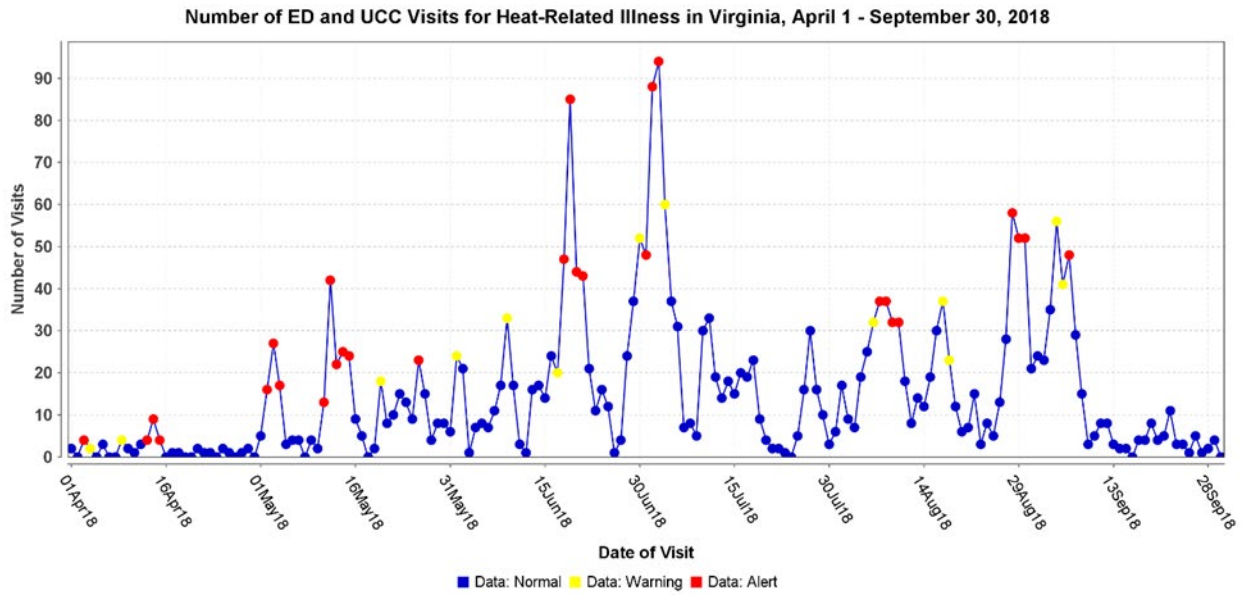
Source: VDH, accessed online 2021 https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.29: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2019



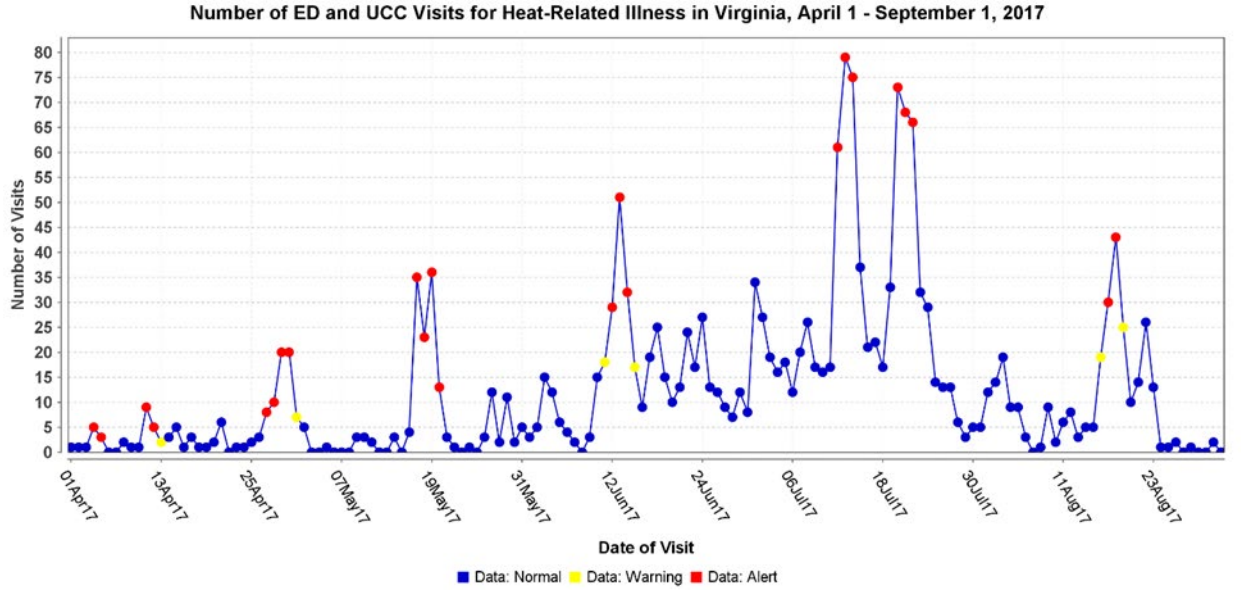
Source: VDH, accessed online 2021 https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.30: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2018



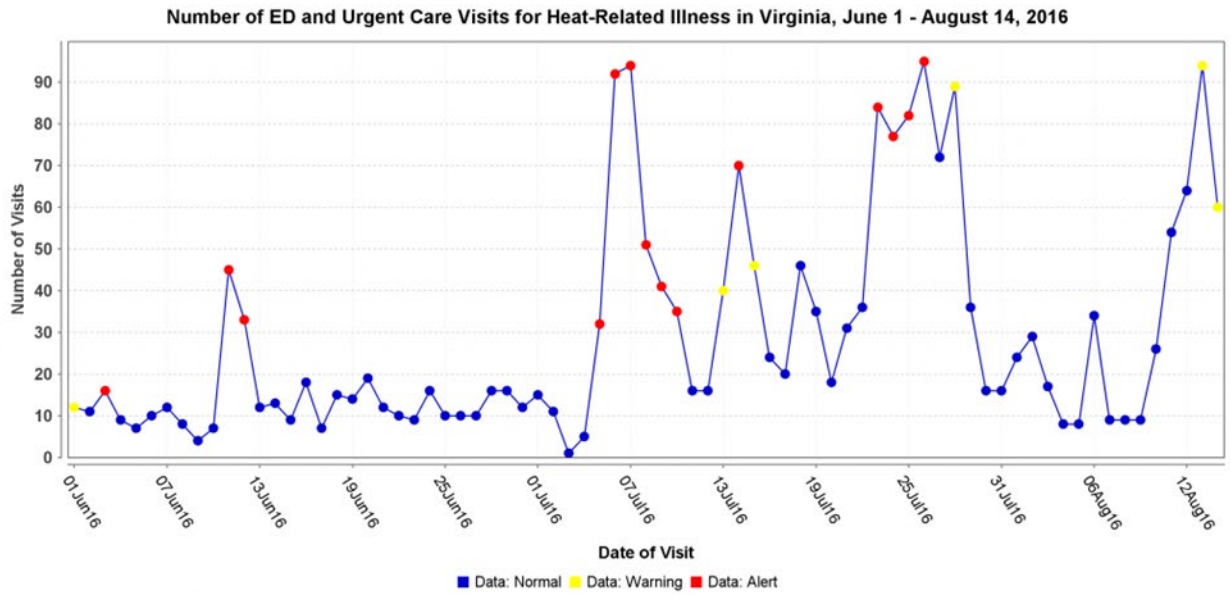
Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.31: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2017



Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.32: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2016



Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

PROBABILITY OF FUTURE OCCURRENCES

It is highly likely that the Hampton Roads region will experience periods of extreme heat in the future.

HAZARDOUS MATERIAL INCIDENTS

BACKGROUND

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the Nation's highways and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents and 266 are due to other causes (FEMA, 1997). In essence, HAZMAT incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design, as with a terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and wildlife.



City of Portsmouth Hazardous Materials Response Team.
Photo source: City of Portsmouth

HAZMAT incidents can also occur as a result of, or in tandem with natural hazard events, such as floods, hurricanes, tornadoes and earthquakes, which can also hinder response efforts. In the case of Hurricane Floyd in September 1999, communities in Eastern North Carolina were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills and a variety of other environmental pollutants that caused widespread toxicological concerns.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Hazardous material incidents may include chemical agents, or compounds with unique chemical properties that can produce lethal or damaging effects in humans, animals and plants. Chemical agents can exist as solids, liquids or gases depending on temperature and pressure. Most chemical agents are liquid and can be introduced into an unprotected population relatively easily using aerosol generators, explosive devices, breaking containers or other forms of covert dissemination. Dispersed as an aerosol, chemical agents have their greatest potential for inflicting mass casualties. Chemical agents can have an immediate effect or a delayed effect of several hours to several days, and are broadly categorized as lethal or incapacitating. Fortunately, the compounds are difficult to deliver in lethal concentrations, difficult to produce, and dissipate rapidly outdoors.

Shippers are relying more heavily on other types of transportation to move hazardous materials. The Department of Transportation reported that the use of trucks and water carriers had climbed sharply between 1997 and 2002. The volume of hazardous materials shipped by trucks increased 21 percent to 1.16 billion tons by 2002, while the amount carried by rail rose 7 percent to 109 million tons. During that period, the volume of hazardous material moving by water climbed 36 percent to 228 million tons, according to the department's Bureau of Transportation Statistics. Between 2002 and 2007, truck and rail shipments of hazardous materials again increased by 3 percent and 19 percent, respectively; but, water shipment volume decreased by 34 percent to 150 million tons, which is below the 1997 volume carried by water. Data for 2017 indicate that hazardous materials shipments of over 2.9 trillion tons were transported, in order

of highest to lowest volume, by truck (61%), by rail (3%), and by water (<1%). For comparison purposes, the Port of Virginia reports that in 2019, their cargo was moved 65% by truck, 34% by rail and 3% by barge.

In Hampton Roads, the negative impacts of hazardous materials incidents are dependent on the nature of the materials involved. While each chemical transported locally has unique qualities, there are generally three types of impacts: 1) economic, 2) environmental and 3) life/safety impacts to residents and first responders.

Economic impacts are likely greatest from potential large-scale incidents involving the port of Hampton Roads. Incidents that may result in port closure are unlikely, but even an event that blocks the port or a portion of the port for some period of time would have dire impacts on the port's ability to move commodities in or out of the entire region by train, ship or truck. Large spills or large fires have consequently high costs associated with response, control and cleanup. While local governments may only absorb some of those costs, economic costs to other industries would occur. Local emergency planners are especially aware of flammable crude oil transports in the York County portion of the planning area. Recent derailments involving this commodity, such as the one in Lynchburg in 2015, are high profile events as they often involve large spills and large fires.

Lesser, but still significant, economic impacts from HAZMAT incidents in the region could include the costs of litigation to resolve large spills, traffic control problems and lost time and wages for travelers impacted by roadway spills or incidents, as well as the impacts of corrosives such as sodium hydroxide on bridge and roadway infrastructure. In cases where evacuations are necessary to protect human life and safety, lost wages can be significant. For example, a natural gas leak in a downtown business district could result in evacuation of downtown businesses and shut down transportation routes. Derailment of a single train carrying hazardous materials shuts down the rail line to other trains for a long period of time, as well, which has economic consequences for numerous carriers, suppliers and buyers.

As intermodal transportation from overseas increases through the region, shipping through the port is growing and that increases highway traffic and rail traffic. The potential economic costs of hazardous materials incidents are, consequently, increasing in the region.

There are potential impacts to the health and safety of residents and travelers through Hampton Roads, as well. Response personnel are trained to respond in a variety of situations, but can nonetheless be exposed to harmful vapors or come into contact with hazardous chemicals. There is a potential for large-scale evacuations of businesses and residents if raw chemicals are released into the air or water under certain conditions that could endanger human health.

Environmental impacts of highest concern in Hampton Roads include the results of spills of petroleum products into the region's waterways. The region's emergency managers have contingency plans in place with the U.S. Coast Guard and others, and conduct regular training and exercises to prevent and then control further damage or secondary damage from fire or contaminant(s) spreading to sensitive environmental areas and critical infrastructure. However, a spill could still impact water quality, aquatic life and valuable wetlands along the shoreline. There is also a potential for hazardous materials incidents along roadways or railroads to impact groundwater with subsequent well water impacts for residents. Local emergency managers also noted the region's valuable migratory bird corridors, which could potentially be impacted by airborne contaminants, and the occurrence of illegal dumping which contributes hazardous materials to waterways, floodplains, wetlands, and forests without the benefit of appropriate response and cleanup.

LOCATION AND SPATIAL EXTENT

The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) was created to increase public awareness of the existence of hazardous materials in the community. The Act is a freestanding title in the Superfund Amendments and Reauthorization Act of 1986 (SARA), and requires certain facility owners/operators to routinely report the presence, quantity, and releases of hazardous materials at their facility. The Act also provides an avenue in which this information can be disseminated to the public, as

well as requiring state and local governments to undertake planning measures to respond to emergencies involving those materials.

As a result, each community in Hampton Roads has identified a Local Emergency Planning Committee (LEPC) to take on the responsibilities of hazardous materials planning. These plans reside with the Emergency Coordinator of the community and provide detailed outlines of hazardous materials response and identification. Key components of the plans include the following that address the location and spatial extent of hazardous materials within the community:

- Identification of routes that are used for transportation of extremely hazardous materials, types of hazardous materials and facility locations of the materials; and,
- Identification of critical facilities which have additional risk due to proximity of transportation routes or fixed facilities.

HISTORICAL OCCURRENCES

The Federal Railroad Administration, Office of Safety Analysis, maintains accident reports for railroad accidents with damages greater than $8,500. In Hampton Roads, there have been 24 accidents involving hazardous material cars since 1998. The worst accident was in Suffolk in 2006, when one rail car suffered $18,212 of damage and 7 people had to be evacuated. Of the 24 accidents in the past decade, 6 rail cars carrying hazardous materials were damaged, and there was no record of hazardous materials being released.

There have been 596 documented HAZMAT events in Hampton Roads since 1998 (**Appendix I**), based on information from the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety Incidents Report Database. There were no fatalities, and 15 injuries associated with these events, and a total of $1,238,922 damage. The worst event was in 2013 in Norfolk, when 4,500 gallons of ferric chloride spilled on the highway, causing $340,000 damages.

PROBABILITY OF FUTURE OCCURRENCES

Future occurrences of HAZMAT incidents, accidents or issues within Hampton Roads are considered to be highly likely.

PANDEMIC FLU OR COMMUNICABLE DISEASE

An influenza pandemic is an epidemic of an influenza virus that spreads on a worldwide scale and infects a large proportion of the human population. In contrast to the regular seasonal epidemics of influenza, these pandemics occur irregularly. Pandemics can cause high levels of mortality.

Influenza pandemics occur when a new strain of influenza virus is transmitted to humans from another animal species. Species that are thought to be important in the emergence of new human strains are pigs, chickens, and ducks. These novel strains are unaffected by any immunity people may have to older strains of human influenza and can therefore spread extremely rapidly and infect very large numbers of people.

The Centers for Disease Control and Prevention (CDC) uses a Pandemic Intervals Framework to describe the progression of an influenza pandemic, as shown in **Table 4.21**. This framework is used to guide influenza pandemic planning and provides recommendations for risk assessment, decision-making, and action in the United States. These intervals provide a common method to describe pandemic activity which can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

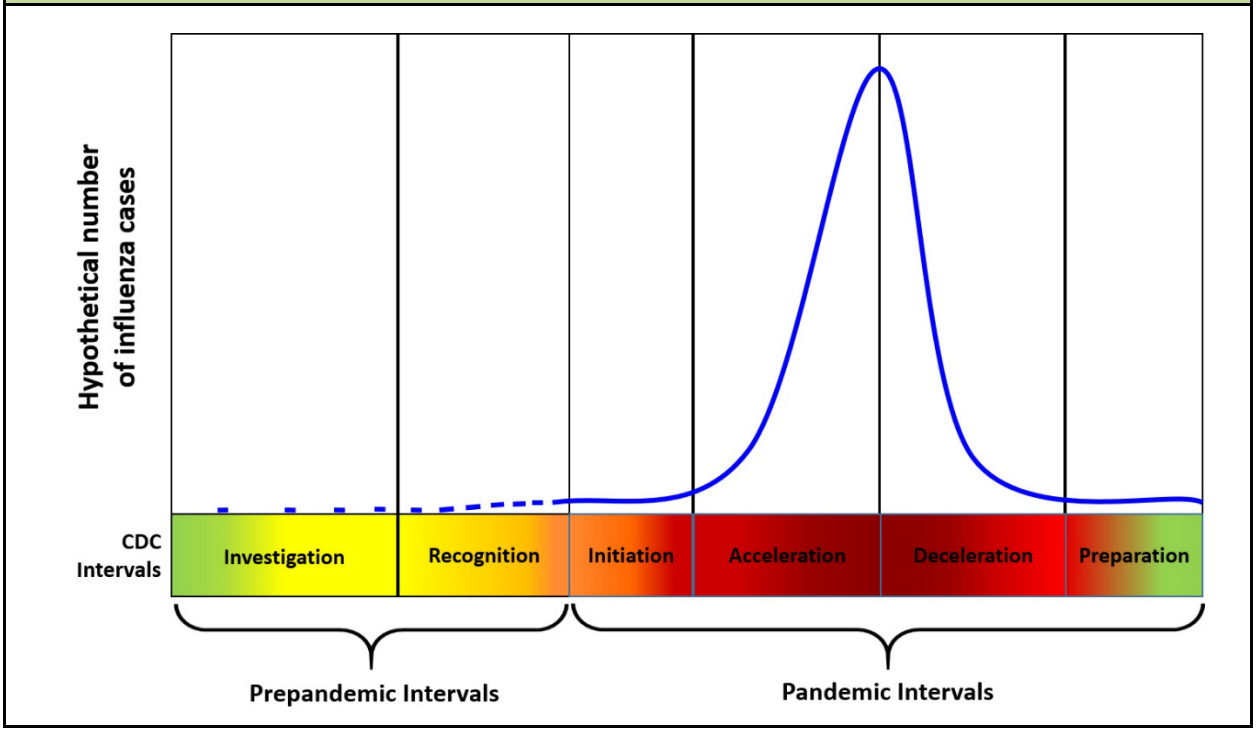
TABLE 4.21: CDC PANDEMIC INTERVALS FRAMEWORK

Interval	Description
1) Investigation of cases of novel influenza A virus infection in humans	When novel influenza A viruses are identified in people, public health actions focus on targeted monitoring and investigation. This can trigger a risk assessment of that virus
2) Recognition of increased potential for ongoing transmission of a novel influenza A virus	When increasing numbers of human cases of novel influenza A illness are identified and the virus has the potential to spread from person-to-person, public health actions focus on control of the outbreak, including treatment of sick persons.
3) Initiation of a pandemic wave	A pandemic occurs when people are easily infected with a novel influenza A virus that has the ability to spread in a sustained manner from person-to-person.
4) Acceleration of a pandemic wave	The acceleration (or "speeding up") is the upward epidemiological curve as the new virus infects susceptible people. Public health actions at this time may focus on the use of appropriate non-pharmaceutical interventions in the community (e.g., school and child-care facility closures, social distancing), as well the use of medications (e.g., antivirals) and vaccines, if available. These actions combined can reduce the spread of the disease, and prevent illness or death.
5) Deceleration of a pandemic wave	The deceleration (or "slowing down") happens when pandemic influenza cases consistently decrease in the United States. Public health actions include continued vaccination, monitoring of pandemic influenza A virus circulation and illness, and reducing the use of non-pharmaceutical interventions in the community (e.g., school closures).
6) Preparation for future pandemic waves	When pandemic influenza has subsided, public health actions include continued monitoring of pandemic influenza A virus activity and preparing for potential additional waves of infection. It is possible that a 2nd pandemic wave could have higher severity than the initial wave. An influenza pandemic is declared ended when enough data shows that the influenza virus, worldwide, is similar to a seasonal influenza virus in how it spreads and the severity of the illness it can cause.

Source: CDC 2021, accessed online at: https://www.cdc.gov/flu/pandemic-resources/national-strategy/intervals-framework.html

Figure 4.33 provides a graphical illustration of the intervals for a hypothetical virus pandemic.

FIGURE 4.33: PANDEMIC INTERVAL FRAMEWORK



Source: CDC 2021, accessed online at: https://www.cdc.gov/flu/pandemic-resources/national-strategy/intervals-framework.html

Communicable diseases are illnesses spread by bacteria or viruses that are spread from one person to another through contact with bodily fluids, blood products, contaminated surfaces, insect bites or through the air. Examples include HIV, hepatitis A, B, and C, Salmonella, measles, and blood-borne illnesses. Mitigation of spread may include testing, vaccination, and educating the public on methods of transmission.

LOCATION AND SPATIAL EXTENT

A pandemic is characterized by human-to-human spread of the virus over a very wide area, crossing international boundaries and affecting a large number of people. While many countries may not be affected early on in a pandemic, the CDC collaborates with the World Health Organization (WHO) and other international agencies to monitor and assess influenza viruses and illness. These organizations send strong signals to the public when research indicates a pandemic is imminent in their country, region, state or locality, and that the time to finalize the communication and implementation of planned mitigation measures is short.

Previous pandemics have been characterized by waves of activity spread over months and separated by oceans. Once the level of disease activity drops, a critical communications task is balancing this information with the possibility of another wave. Pandemic waves can be separated by months and an immediate "at-ease" signal may be premature. Pandemic waves can also be specific to a country or a subregion or state within a country, making local messaging a critical component in controlling the spread of the virus.

In our modern global economy that is focused on international trade and shipping, business and leisure travel to other countries can help spread an early-phase pandemic across the globe far more quickly than

in past centuries. While quarantines and travel restrictions may help restrict the spread in later intervals, the damage wrought by virus carriers early on is irreversible.

In the Eastern Virginia Health District, the VDH indicates that Hepatitis B and C, Salmonella and Campylobacteriosis are the most commonly reported communicable diseases during the period 2013 to 2018, the most recent data available. **Table 4.22** summarizes the VDH data for the region during this period. Hepatitis B and C are viruses that cause an infection that attacks the liver and leads to inflammation. The infection is spread by blood products such as unclean needles, and most people have no symptoms. Campylobacteriosis is an infection by the Campylobacter bacterium, a common bacterial infection of humans, often a foodborne illness. The bacteria produce an inflammatory diarrhea or dysentery syndrome, mostly including cramps, fever and pain. Salmonella bacteria have a similar food-related source and cause upset stomach, diarrhea, fever, and pain and cramping in the belly.

TABLE 4.22: COMMUNICABLE DISEASE IN VIRGINIA'S EASTERN HEALTH DISTRICT

Year	Top Four Diseases	Number of Cases
2013	Campylobacteriosis	119
	Hepatitis B, chronic	291
	Hepatitis C, chronic	1295
	Salmonellosis	266
2014	Campylobacteriosis	104
	Hepatitis B, chronic	285
	Hepatitis C, chronic	1486
	Salmonellosis	268
2015	Campylobacteriosis	194
	Hepatitis B, chronic	332
	Hepatitis C, chronic	1764
	Salmonellosis	279
2016	Campylobacteriosis	222
	Hepatitis B, chronic	309
	Hepatitis C, chronic	2643
	Salmonellosis	267
2017	Campylobacteriosis	209
	Hepatitis B, chronic	371
	Hepatitis C, chronic	2751
	Salmonellosis	284
2018	Campylobacteriosis	226
	Hepatitis B, chronic	387
	Hepatitis C, chronic	2424
	Salmonellosis	302

Source: VDH, October 2021, accessed at: https://www.vdh.virginia.gov/data/communicable-diseases/

SIGNIFICANT HISTORICAL EVENTS

Flu pandemics have occurred throughout history. There have been about three influenza pandemics in each century for the last 300 years. Since 1918, five significant events stand out, each with different characteristics.

1918 – 1919: H1N1 Pandemic
Illness from the 1918 flu pandemic, also known as the Spanish flu, came on quickly. Some people felt fine in the morning but died by nightfall. People who caught the Spanish Flu but did not die from it often died from complications caused by bacteria, such as pneumonia. Approximately 20% to 40% of the worldwide population became ill, and an estimated 50 million people died, including early 675,000 people in the United States. Unlike earlier pandemics and seasonal flu outbreaks, the 1918 pandemic flu saw high mortality rates among healthy adults. In fact, the illness and mortality rates were highest among adults 20 to 50 years old. The reasons for this remain unknown.

1957 – 1958: H2N2 Pandemic
In February 1957, a new flu virus was identified in the Far East. Immunity to this strain was rare in people younger than 65. A pandemic was predicted. To prepare, health officials closely monitored flu outbreaks. Vaccine production began in late May 1957 and was available in limited supply by August 1957.
In the summer of 1957, the virus came to the United States quietly with a series of small outbreaks. When children returned to school in the fall, they spread the disease in classrooms and brought it home to their families. Infection rates peaked among school children, young adults, and pregnant women in October 1957. By December 1957, the worst seemed to be over. However, a dangerous “second wave” of illness came in January and February of 1958. Most influenza–and pneumonia–related deaths occurred between September 1957 and March 1958. Although the 1957 pandemic was not as devastating as the 1918 pandemic, about 69,800 people in the United States died. The elderly had the highest rates of death.

1968 – 1969: H3N2 Pandemic
In early 1968, a new flu virus was detected in Hong Kong. The first cases in the United States were detected as early as September 1968. Illness was not widespread in the United States until December 1968. Deaths from this virus peaked in December 1968 and January 1969. Those over the age of 65 were most likely to die. The number of deaths between September 1968 and March 1969 was 33,800, making it the mildest flu pandemic in the 20th century. The same virus returned in 1970 and 1972.
Several reasons may explain why fewer people in the United States died as a result of this virus:

- The virus was similar in some ways to the 1957 pandemic flu virus. This might have provided some immunity.
- The virus hit in December of 1968, when school children were on vacation. This caused a decline in flu cases because children were not at school to infect one another. This also prevented it from spreading into their homes.
- Improved medical care and antibiotics that are more effective for secondary bacterial infections were available for those who became ill.

2009 – 2010: H1N1 Pandemic
In the spring of 2009, a new flu virus spread quickly across the United States and the world. The first U.S. case of H1N1 (swine flu) was diagnosed on April 15, 2009. By April 21, the CDC was working to develop a vaccine for this new virus. On April 26, the U.S. government declared H1N1 a public health emergency. By June, 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic. H1N1 vaccine supply was limited in the beginning. People at the highest risk of complications got the vaccine first.

By November 2009, 48 states had reported cases of H1N1, mostly in young people. That same month, over 61 million vaccine doses were ready. Reports of flu activity began to decline in parts of the country,

which gave the medical community a chance to vaccinate more people. An estimated 80 million people were vaccinated against H1N1, which minimized the impact of the illness. The CDC estimates that 43 million to 89 million people had H1N1 between April 2009 and April 2010. They estimate between 8,870 and 18,300 H1N1 related deaths. On August 10, 2010 the WHO declared an end to the global H1N1 flu pandemic.

March 2020 - 2021: SARS-CoV-2 or COVID-19

In early 2020, a novel, infectious respiratory disease began to spread worldwide and eventually impacted all aspects of life throughout the world for over a year. Scientists determined that COVID-19 spread by droplets or aerosols from the nose and mouth when an infected person coughed, sneezed or exhaled. Airborne transmission also happened in indoor spaces without good ventilation, especially with infected people breathing heavily, like when singing or exercising. Infected people were able to spread the disease before having symptoms or feeling sick, and asymptomatic people could also spread the disease without ever exhibiting a single symptom. Several variants circulated globally as the virus mutated over time. In the case of COVID-19, the variants were determined to be more contagious.

Symptoms of COVID-19 could appear 2 to 14 days after exposure and included fever, cough, shortness of breath, chills, headache, muscle pain, sore throat, fatigue, congestion, or loss of taste or smell. Other less common symptoms included gastrointestinal symptoms like nausea, vomiting, or diarrhea. Even after recovering from the virus, many people experienced lingering symptoms such as fatigue, cough or joint pain. The elderly, those living in group settings (*e.g.,* nursing homes, jails) and people of any age with serious underlying medical conditions such as lung disease or diabetes, were at highest risk for developing complications from COVID-19. Fully effective and dependable treatments for the virus were limited.

Mitigation of COVID-19 depended on wearing protective masks, distancing from others who were able to transmit disease, washing hands to prevent disease spread, contact tracing to warn those who may have had exposure, and rapid development of testing measures to determine COVID-positive populations. Despite public health campaigns to prevent spread, the disease sickened millions and killed over 884,000 in the United States alone by February 2022.[14] The virus also impacted the Hampton Roads region as shown in **Table 4.23**.

[14] CDC web site, February, 2022, accessed online at: https://covid.cdc.gov/covid-data-tracker/#datatracker-home

TABLE 4.23: COVID-19 CUMULATIVE RATES PER 100,000 BY VIRGINIA LOCALITIES				
SUBREGION	**JURISDICTION**	**CASE RATE**	**HOSPITALIZATION RATE**	**FATALITY RATE**
Peninsula	Hampton	19,315	675	194
	Newport News	19,323	577	182
	Poquoson	18,063	392	196
	Williamsburg	10,322	550	85
	James City County	17,743	450	129
	York County	13,270	247	127
Southside	Norfolk	16,450	812	159
	Portsmouth	20,937	1,151	276
	Suffolk	19,116	1,051	275
	Virginia Beach	18,980	833	145
	Chesapeake	19,246	611	158
Western Tidewater	Isle of Wight County	18,465	811	247
	Franklin	30,525	1,060	549
	Southampton County	17,912	584	425
	Surry County	15,865	846	219

Source: VDH web site, February 2022 accessed online at: /www.vdh.virginia.gov/coronavirus/covid-19-in-virginia/

In addition to the pandemic history described above, several pandemic flu threats have occurred that did not prove as dangerous as the events described above. When the 1976 swine flu was identified at Fort Dix, New Jersey it was called the "killer flu." Experts were concerned because they thought the virus was similar to the 1918 Spanish flu. To prevent a major pandemic, the United States launched a vaccination campaign. In fact, the virus—later named "swine flu"—never moved outside the Fort Dix area. Later, research on the virus showed that it would not have been as deadly as the 1918 flu if it had spread.
In 1997, at least a few hundred people caught H5N1 (avian flu) in Hong Kong. Like the 1918 pandemic, most severe illness affected young adults. Eighteen people were hospitalized. Six of those people died. This avian flu was unlike other viruses because it passed directly from chickens to people. Avian flu viruses usually spread from chickens to pigs before passing to humans. To prevent the virus from spreading, all chickens in Hong Kong—approximately 1.5 million— were slaughtered. Because this flu did not spread easily from person to person, no human infections were found after the chickens were killed.

PROBABILITY OF FUTURE OCCURRENCES

Based on historical experience and the fact that at the time of this planning process an ongoing pandemic threatens public health, the region is expected to experience waves of pandemic flu and communicable disease outbreak in the future.

RADON EXPOSURE

Radon is a colorless, odorless naturally-occurring gas that forms by the radioactive decay of uranium, thorium, or radium, found in certain types of rocks, soil, and groundwater. Radon is found naturally in the atmosphere in trace amounts, where it disperses rapidly and is generally not a health issue. Radon exposure becomes dangerous in confined areas, where the gas can accumulate, and the inert gas can be inhaled into the lungs where it adheres to lung tissue.

Under the earth's surface, radon may be transported as a soil gas or dissolved in ground water. It can enter a building via cracks in solid floors, construction joints, cracks in walls, gaps in suspended floors, gaps around service pipes and drains, cavities inside walls or through the water supply. Well water used for bathing or washing can potentially carry radon, especially if faucets are aerated. Due to less ventilation, radon concentrations in buildings are typically higher in the winter. Any home, school or workplace may have a radon problem, whether it is new or old, well-sealed or drafty, or with or without a basement. The U.S. Environmental Protection Agency (EPA) estimates that nearly one out of every 15 homes in the U.S. is estimated to have elevated annual average levels of indoor radon,[15] and that nearly one in five schoolrooms has a short-term radon level above the actionable level.[16]

The concentration of radon in buildings is highly variable and is based on the underlying rocks or sediments, weather and construction methods. The amount of radon emitted by a particular soil is controlled by the underlying rock type, the concentration of uranium, thorium, or radium in the rock or sediment, and the permeability of the rock, sediment and soil. [17]

The EPA recommends taking action to reduce radon in homes, schools or other buildings that have a radon level at or above 4 picocuries per liter (pCi/L) of air (a "picocurie" is a common unit for measuring the amount of radioactivity). That level of risk is more than 10 times the average outdoor level, more than receiving the equivalent radiation of 200 chest x-rays per year, and almost five times the average non-smoker's risk. A radon level of 40 pCi/L is more than the risk of a 2 pack-a-day smoker.

IMPACTS

The EPA indicates that radon is estimated to cause about 21,000 lung cancer deaths per year in the United States.[18] When a person breathes in radon, radioactive particles from radon gas can get trapped in the lungs, emitting radiation. Over time, these radioactive particles increase the risk of lung cancer. People who smoke and are exposed to radon are at a greater risk of developing lung cancer. Damage may be undetected for years before health problems appear.
The chances of getting lung cancer from radon depend primarily on:

- How much radon is in one's home–the location where you spend most of your time (e.g., the main living and sleeping areas);
- The amount of time spent in the home;
- Whether one is a smoker or has ever smoked;
- Whether one burns wood, coal, or other substances that add particles to the indoor air; and
- Combinations of these factors that multiply the impacts.

Lung cancer may start with a nagging cough, shortness of breath or wheezing. Other symptoms such as coughing up blood, chest pain or weight loss may also present. There are no medical tests to test the

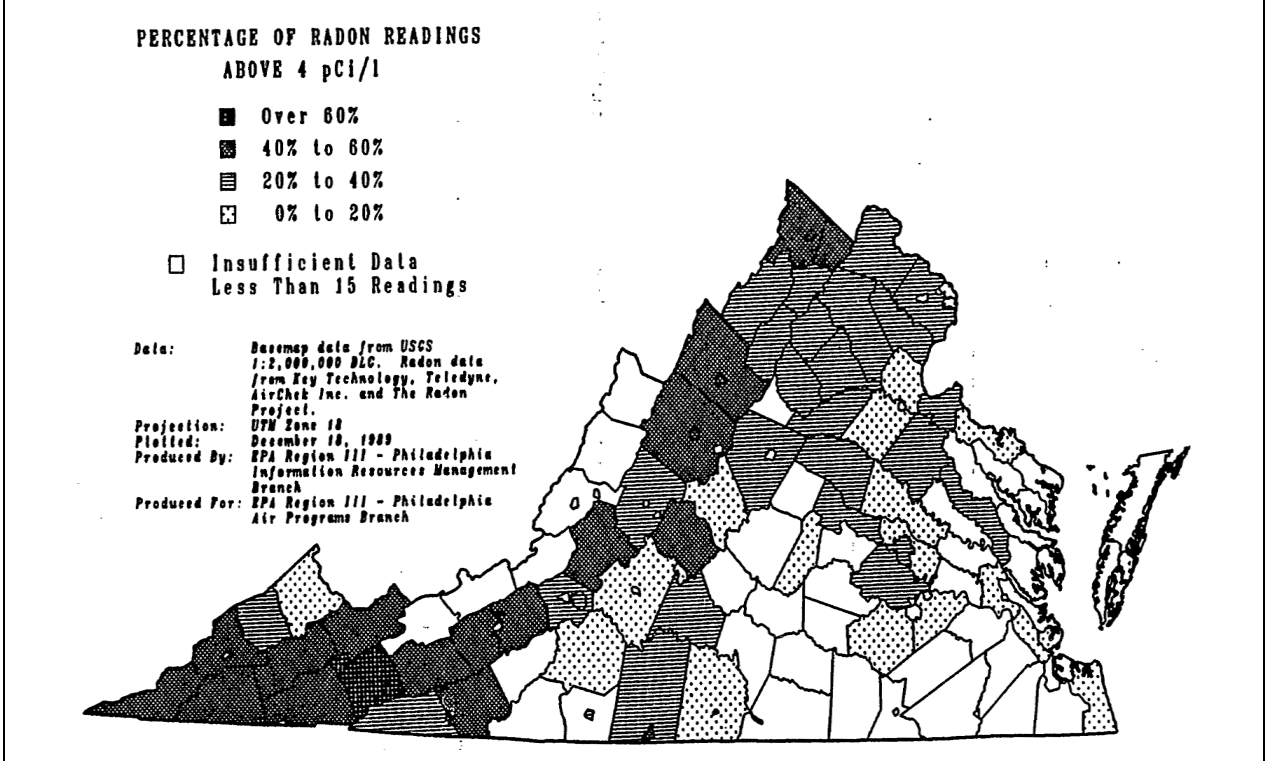
[15] *EPA's Map of Radon Zones, Virginia.* Radon Division, Office of Radiation and Indoor Air, September, 1993.
[16] EPA Radon in Schools, accessed 4/23/21 online at: https://www.epa.gov/radon/radon-schools
[17] Born, Rebecca Skye. *Radon in Yorktown Formation Sediments and Petersburg Granite, Eastern Virginia.* Undergraduate Thesis, College of William & Mary, April 1994.
[18] EPA, *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon,* EPA 402/K-12/002, 2016.

body for radon exposure, but doctors can check for signs of lung cancer and homes can be easily tested for radon levels.

SIGNIFICANT HISTORICAL EVENTS

Radon exposure from ground sources happens over a long period of time, often remaining undetected, thus historical "events" are rarely quantifiable. Section 307 and 209 of the 1988 Indoor Radon Abatement Act directed the EPA to identify areas of the United States that have the potential to produce elevated levels of radon. As part of this study, two data sources were analyzed in Virginia: 1) indoor radon data from 1,156 random homes were sampled in the winter of 1991-1992 (results shown in **Table 4.24**); and 2) non-random commercial data compiled by EPA Region 3 were examined as shown in **Figure 4.34**.

FIGURE 4.34: VENDOR SCREENING, INDOOR RADON DATA FOR VIRGINIA



Source: EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

TABLE 4.24: SCREENING INDOOR RADON DATA

	EPA 1991-1992, Residential				Alpha Energy Laboratories January 2001 to June 2020			
Jurisdiction	**Number of Tests**	**Mean (pCi/L)**	**% >4 pCi/L**	**%>20 pCi/L**	**Number of Tests**	**Mean (pCi/L)**	**% >4 pCi/L**	**%>10 pCi/L**
Hampton	7	0.3	0	0	38	1.97	10.5	5.2
Newport News	13	0.7	0	0	153	1.32	3.9	0
Poquoson	1	0.4	0	0	6	1.00	0	0
Williamsburg	1	1.0	0	0	30	2.29	10.0	3.3
James City County	1	1.0	0	0	614	3.59	27.0	5.2
York County	3	0.6	0	0	55	1.32	1.8	1.8
Norfolk	14	0.8	0	0	136	1.24	1.5	1.5
Portsmouth	6	0.4	0	0	35	0.97	0	0
Suffolk	3	0.1	0	0	58	0.99	0	0
Virginia Beach	39	0.5	3	0	236	1.22	2.1	1.3
Chesapeake	23	0.3	0	0	106	0.96	0.9	0
Isle of Wight County	1	0.9	0	0	20	1.56	10.0	0
Franklin	No data	No data	No data	No data	6	0.83	0	0
Southampton County	2	0.5	0	0	14	0.99	0	0
Surry County	1	0.6	0	0	5	1.00	0	0

Source: EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

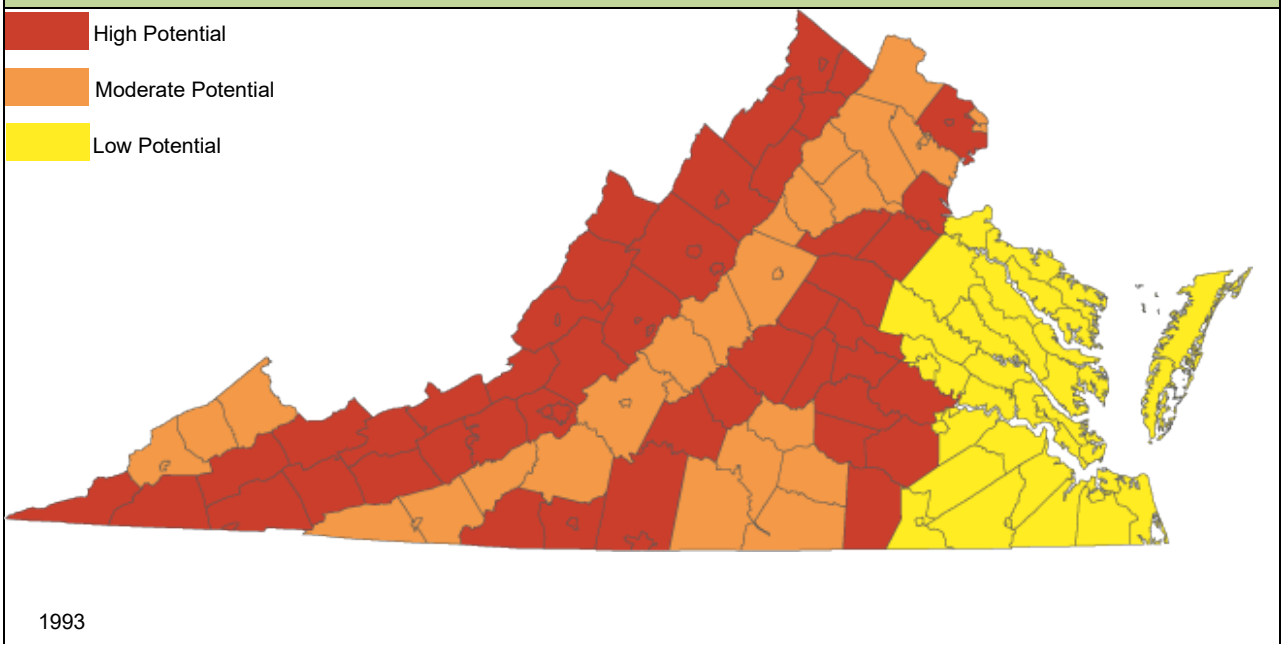
Source: Non-random test results by private business, accessed 2021 online: https://getresults.doctorhomeair.com/fmi/webd/Alpha_ResultsInArea

LOCATION AND SPATIAL EXTENT

The types and distribution of lithologic units and other geologic features in an assessment area are of primary importance in determining radon potential. Rock types that are most likely to cause indoor radon problems include carbonaceous black shales, glauconite bearing sandstones, certain kinds of fluvial sandstones and fluvial sediments, phosphorites, chalk, karst-producing carbonate rocks, certain kinds of glacial deposits, bauxite, uranium-rich granitic rocks, metamorphic rocks of granitic composition, silica-rich volcanic rocks, many sheared or faulted rocks, some coals, and certain kinds of contact metamorphosed rocks. Rock types least likely to cause radon problems include marine quartz sands, non carbonaceous shales and siltstones, certain kinds of clays, silica-poor metamorphic and igneous rocks, and basalts. Uranium and radium are commonly found in heavy minerals, iron-oxide coatings on rock and soil grains, and organic materials in soils and sediments. Less common are uranium associated with phosphate and carbonate complexes in rocks and soils, and uranium minerals.

Figure 4.35 provides the EPA's map of Radon Zones for Virginia, released in 1993. The map is based on an assessment of five factors that are known to be important indicators of radon potential: indoor radon measurements, geology, aerial radioactivity, soil parameters and foundation types.

FIGURE 4.35: U.S. EPA MAP OF RADON ZONES IN VIRGINIA

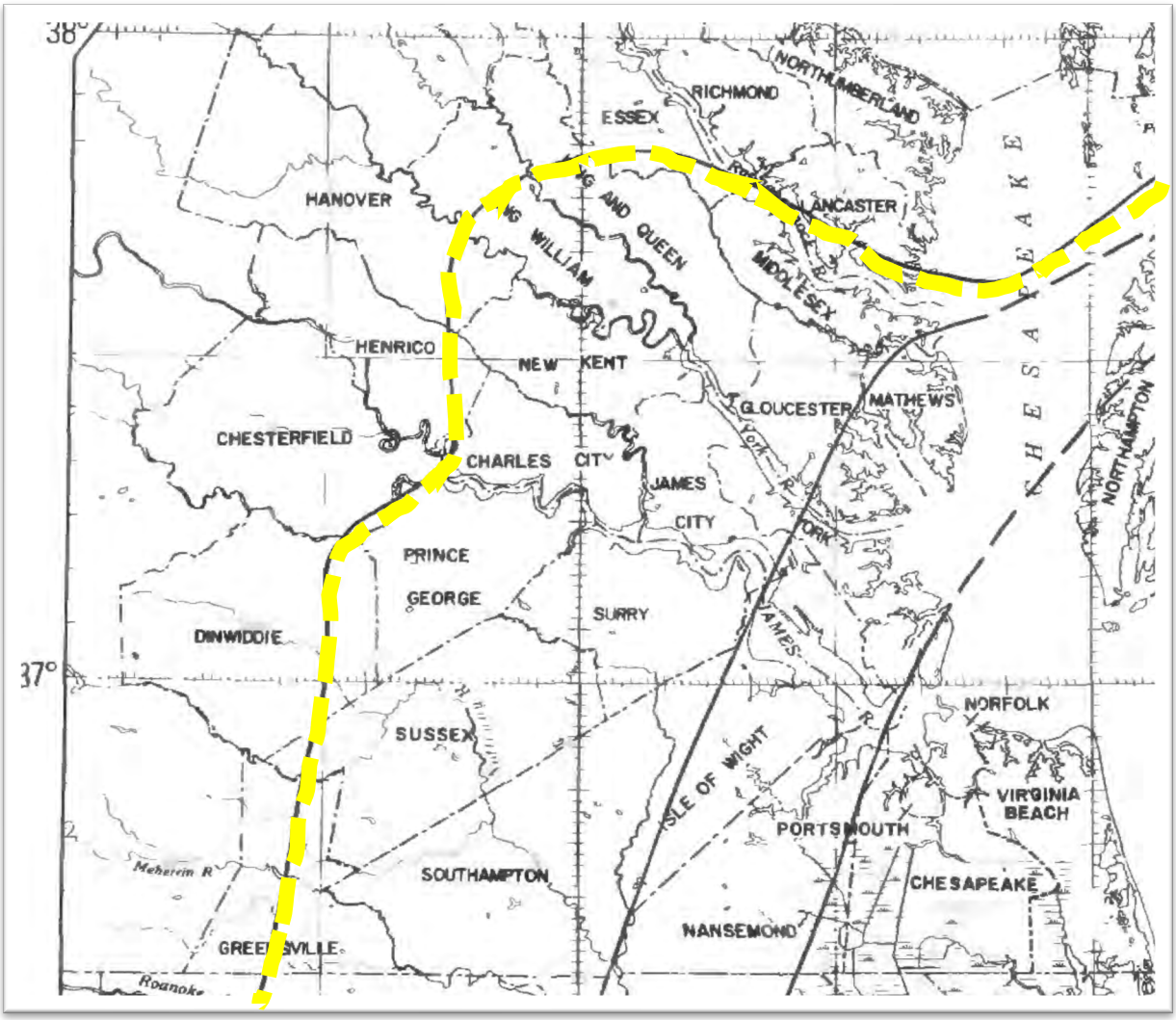


Source: Virginia Department of Energy, as modified from US EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

The Coastal Plain of Virginia (see Figure 3.2), includes all of the communities in Hampton Roads and is ranked low in geologic radon potential. In general, the upper Tertiary to Quaternary-aged sediments of the Coastal Plain have low radon potential. However, recent studies of radon potential in the sediments and marine fossils of the Yorktown Formation, a 4 to 5 million-year-old widespread geological unit in the Coastal Plain, could be a source for elevated levels of indoor radon. The Yorktown Formation is a marine unit, meaning the sediments that it is made of were once deposited underwater when sea-level was much higher than it is today (see **Figure 4.36**). It is characterized by shelly, sometimes diatomaceous, locally phosphatic, quartz sand, silt and clay.[19] As a marine unit, it holds whale bones, in particular, that are mixed into the sand/clays. The bones that accumulate in the Yorktown Formation are perhaps able to enrich themselves under certain geochemical conditions with heavy metals that might be in the water. And the high permeability of the sediments allows for radon movement and dispersion. These hypotheses are part of ongoing research at the College of William and Mary.[20] Future updates to this plan should include results of such research, particularly if the findings point to changes in the relative vulnerability presented in Figure 4.35 above.

[19] *US EPA's Map of Radon Zones, Virginia.* Radon Division, Office of Radiation and Indoor Air, September, 1993.
[20] Email exchanges with Anne Witt, Geohazards Specialist, Virginia Department of Mines, Minerals and Energy, Spring 2021.

FIGURE 4.36: WESTERNMOST EXTENT OF THE YORKTOWN FORMATION (YELLOW LINE)



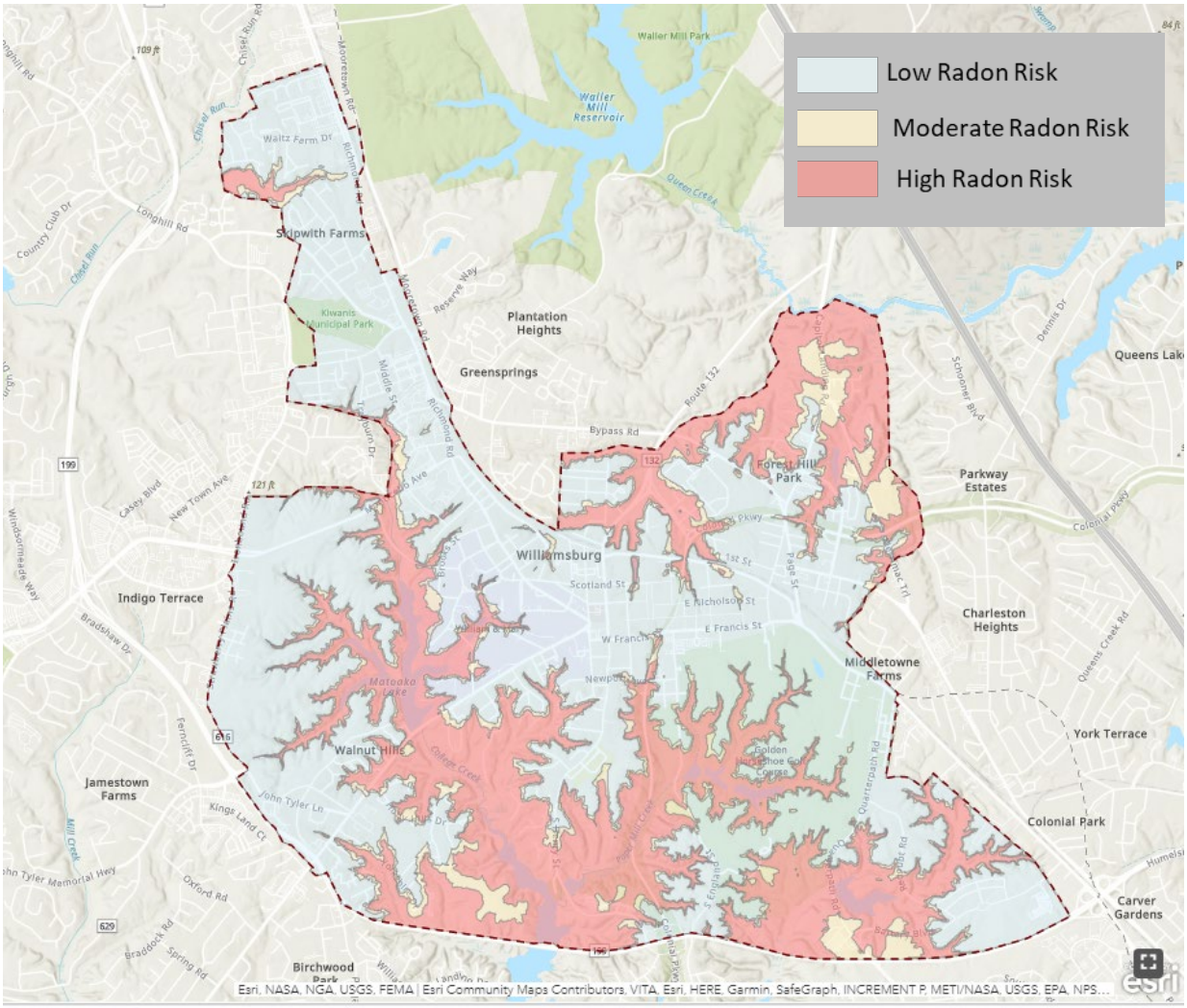
1980

Source: Ward, Lauck W. and Blake W. Blackwelder. Stratigraphic Revision of Upper Miocene and Lower Pliocene Beds of the Chesapeake Group, Middle Atlantic Coastal Plain. Geological Survey Bulletin 1482-D, U.S. Department of the Interior, 1980.

Further analysis by researchers in the Department of Geology at William & Mary has led to the creation of a more detailed map of Williamsburg and the relative radon risk for that community. According to their research, homes built within and slightly above Yorktown sediments may have higher radon levels. In Williamsburg, homes built on ground with adjacent elevations less than 58 feet are predicted to have the highest risk.[21] **Figure 4.37** shows the relative radon risk in Williamsburg.

[21] Berquist, Rick, Jim Kaste, Dorian Miller. ArcGIS Storymap online at: https://storymaps.arcgis.com/stories/10f6d3d7c0014a1087fe3ef14f306520

FIGURE 4.37: RADON RISK IN WILLIAMSBURG



2021

Source: Berquist, Rick, Jim Kaste, Dorian Miller. ArcGIS Storymap online at: https://storymaps.arcgis.com/stories/10f6d3d7c0014a1087fe3ef14f306520

In 1994, an undergraduate student at the College of William & Mary studied radon emittance from the Yorktown Formation[22]. The Yorktown Formation was selected for her study as a possible source of radon because the fossilized bones in the sediments contain uranium-238, a radioactive element that decays to form radon gas. The researcher installed alpha-track radon detectors to determine concentrations of the gas being emitted as a decay product at two sites in the College Woods neighborhood. While the purpose of the study was statistical analysis of the results against previous tests of radon in the Yorktown Formation, the student found that the radon concentrations remained high and are statistically equivalent to other research.

[22] Born, Rebecca Skye. *Radon in Yorktown Formation Sediments and Petersburg Granite, Eastern Virginia.* Undergraduate Thesis, College of William & Mary, April 1994.

VULNERABILITY ASSESSMENT

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2022 UPDATE

Each of the hazards was reviewed and updated to reflect both the revised information obtained for the updated *Hazard Identification and Analysis* section and the most recent modeling and data collection, primarily for flood. Discussion of vulnerability to Sea Level Rise and Land Subsidence has been updated using the region's most well-regarded sources. All hazard names were edited to provide consistency with the *Hazard Identification and Analysis*. Tables were updated to include new data, where available. The hazards were reranked according to new feedback from the committee and to reflect the new color-coded, matrix-based ranking system that graphically demonstrates likelihood versus consequence. The tables at the end of the section regarding Conclusions on Hazard Risk were all updated. Figures were updated to reflect current conditions. In addition, each hazard was assessed for two new components of risk: social vulnerability and the impacts of climate change.

INTRODUCTION

The *Vulnerability Assessment* section builds on the information provided in the *Hazard Identification and Analysis* section by identifying community assets and development trends in the region, then assessing the potential impact and amount of damage (loss of life and/or property) that could be caused by each hazard event addressed in the risk assessment. The primary objective of this level of vulnerability assessment is to prioritize hazards of concern to the region, adding to the foundation for mitigation strategy and policy development. Consistent with the preceding sections, the following hazards are addressed in this assessment:

- FLOODING
- FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM
- SEA LEVEL RISE AND LAND SUBSIDENCE
- TROPICAL/COASTAL STORM
- LANDSLIDE/COASTAL EROSION
- TORNADO
- WINTER STORM
- EARTHQUAKE
- WILDFIRE
- DROUGHT
- EXTREME HEAT
- HAZARDOUS MATERIALS INCIDENT
- PANDEMIC FLU OR COMMUNICABLE DISEASE
- RADON EXPOSURE

To complete the vulnerability assessment, best available data were collected from a variety of sources, including local, state and federal agencies, and multiple analyses were applied through qualitative and quantitative means (further described below). Additional work will be done on an ongoing basis to enhance, expand, and further improve the accuracy of the baseline results, and it is expected that this vulnerability assessment will continue to be refined through future plan updates as new data and loss estimation methods become available.

The findings presented in this section with regard to vulnerability were developed using best available data, and the methods applied have resulted in an approximation of risk. These estimates should be used to understand relative hazard risk and the potential losses that may be incurred; however, uncertainties are inherent in any loss estimation methodology, arising from incomplete knowledge concerning specific hazards and their effect on the built environment, as well as incomplete data sets and from approximations and simplifications that are necessary in order to provide a meaningful analysis. Further, most data sets contain relatively short periods of record which increases the uncertainty of any statistically-based analysis.

METHODOLOGIES USED

Two distinct risk assessment methodologies were used in the formation of this vulnerability assessment. The first consists of a ***quantitative*** analysis that relies upon best available data and technology, while the second approach consists of a somewhat ***qualitative*** analysis that relies on the local knowledge and rational decision making skills of local officials. Upon completion, the methods are combined to create a

"hybrid" approach for assessing hazard vulnerability for the region that allows for some degree of quality control and assurance. The methodologies are briefly described and introduced here and are further illustrated throughout this section.

QUANTITATIVE METHODOLOGY

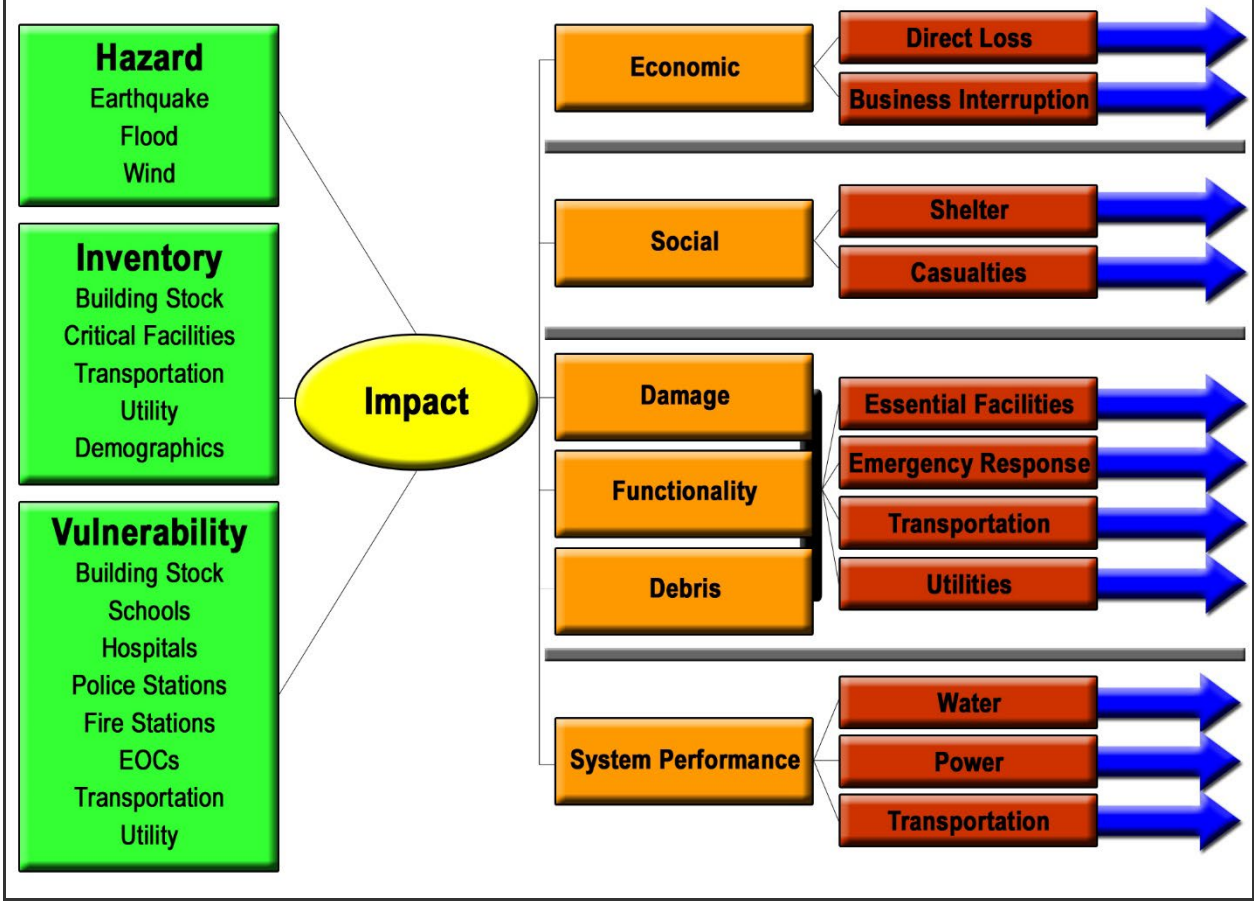
The quantitative assessment involved the use of the most recent version of Hazards U.S. Multi-Hazard (Hazus) software, a geographic information system (GIS)-based loss estimation tool available from FEMA, along with a statistical risk assessment methodology for hazards outside the scope of Hazus. For the flood hazard, the quantitative assessment incorporates a detailed GIS-based approach. When combined, the results of these vulnerability studies are used to form an assessment of potential hazard losses (in dollars) along with the identification of specific community assets that are deemed at-risk.

Explanation of Hazus and Statistical Risk Assessment Methodology

Hazus is FEMA's standardized loss estimation software package, built on an integrated GIS platform using a national inventory of baseline geographic data (including information on the region's general building stock and dollar exposure). Originally designed for the analysis of earthquake risks, FEMA expanded the program in 2003 to allow for the analysis of multiple hazards: namely the flood and wind (hurricane wind) hazards. By providing estimates on potential losses, Hazus facilitates quantitative comparisons between hazards and assists in the prioritization of hazard mitigation activities.

Hazus uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information. The Hazus risk assessment methodology is parametric, in that distinct hazard and inventory parameters—such as wind speed and building type—were modeled using the Hazus software to determine the impact on the built environment. **Figure 5.1** shows a conceptual model of Hazus methodology. More information on Hazus loss estimation methodology is available through FEMA at www.fema.gov/hazus.

FIGURE 5.1: CONCEPTUAL MODEL OF HAZUS METHODOLOGY



Source: FEMA

This risk assessment used Hazus to produce regional profiles and estimated losses for three of the hazards addressed in this section: flooding, tropical/coastal storm winds, and earthquake. For each of these hazards, Hazus was used to generate probabilistic "worst case scenario" events to show the extent of potential damages. Both earthquake and wind were modeled using Hazus Level 1 and flood was modeled using Hazus Level 2.

Explanation of GIS-based (Non-HAZUSMH) Risk Assessment Methodology

For hazards outside the scope of Hazus, a statistical risk assessment methodology was designed and in previous plans, this method was applied to generate potential loss estimates. The approach was based on the same principles as Hazus, but did not rely on readily available automated software. Historical data were compiled for each hazard to relate occurrence patterns with existing hazard models. Statistical evaluations were then applied to generate annualized losses.

The use of the statistical risk assessment methodology was used in previous plans to provide a determination of estimated annualized loss[1] for several hazards. However, in recent years, the historical data from which these conclusions were made have become less reliable. For example, damages for wildfire were not reported for two recent reporting periods, and the communities reviewing the historical damage data from the NCEI expressed concern that the damages were severely underestimated. Until

[1] By annualizing estimated losses, the historic patterns of frequent smaller events are coupled with infrequent but larger events to provide a balanced presentation of the long-term risk.

more reliable historical damage data can be provided, planners determined that a qualitative methodology for examining historical losses and making conclusions about future risk was needed as shown below to supplement the quantitative analysis.

Despite the shortcomings of certain historical data, this analysis included collection of and updates to relevant GIS data from local, state and national sources. These sources include each community's GIS department, FEMA, VDOF, and NOAA. Once all data were acquired, GIS was used to demonstrate and spatially analyze risks to people, public buildings and infrastructure. Primary data layers included geo-referenced point locations for public buildings, critical facilities, and infrastructure elements. Using these data layers, risk was assessed and described by determining the parcels and/or point locations that intersected with the delineated hazard areas.

QUALITATIVE METHODOLOGY

The qualitative assessment relies less on technology and more on historical and anecdotal data, community input, and professional judgment regarding expected hazard impacts. The group used a scoring matrix to summarize risk by placing each hazard in a color-coded graph that ranks hazards individually by consequence on the y-axis and likelihood on the x-axis. Risk level ranking was based on historical and anecdotal data, as well as input from committee members. This ranking was done collaboratively in Workshop #1 for each hazard; results are found at the end of this section.

While the quantitative assessment focuses on using best available data, computer models and GIS technology, this qualitative ranking system relies more on historical data, local knowledge, and the general consensus of the planning committee. The results allow identified hazards to be ranked against one another.

SOCIAL VULNERABILITY ANALYSIS

The National Risk Index (NRI) is a relatively new dataset and online application from FEMA that identifies communities most at risk to various natural hazards. For each of the 18 natural hazards explored in the NRI, risk is calculated by multiplying each hazard's expected annual losses by social vulnerability (a consequence enhancing component of risk that measures the susceptibility of social groups to the adverse impacts of natural hazards) and dividing by community resilience (a consequence reduction component of risk that measures the ability of a community to plan for, absorb, recover from and adapt to the impacts of hazards). In other words:

Risk = Expected Annual Loss x Social Vulnerability x (1/Community Resilience)

In the risk equation, each component is represented by a unitless index score that depicts a community's score relative to all other communities at the same level. The Risk Index score is a unitless index and represents a community's relative risk in comparison to all other communities at the same level. All calculations are performed separately at two levels—County and Census tract—so scores are relative only within their level. It must be stressed that scores are relative, representing a community's relative position among all other communities for a given component and level. Scores are not absolute measurements and should be expected to change over time either by their own changing measurements or changes in other communities.

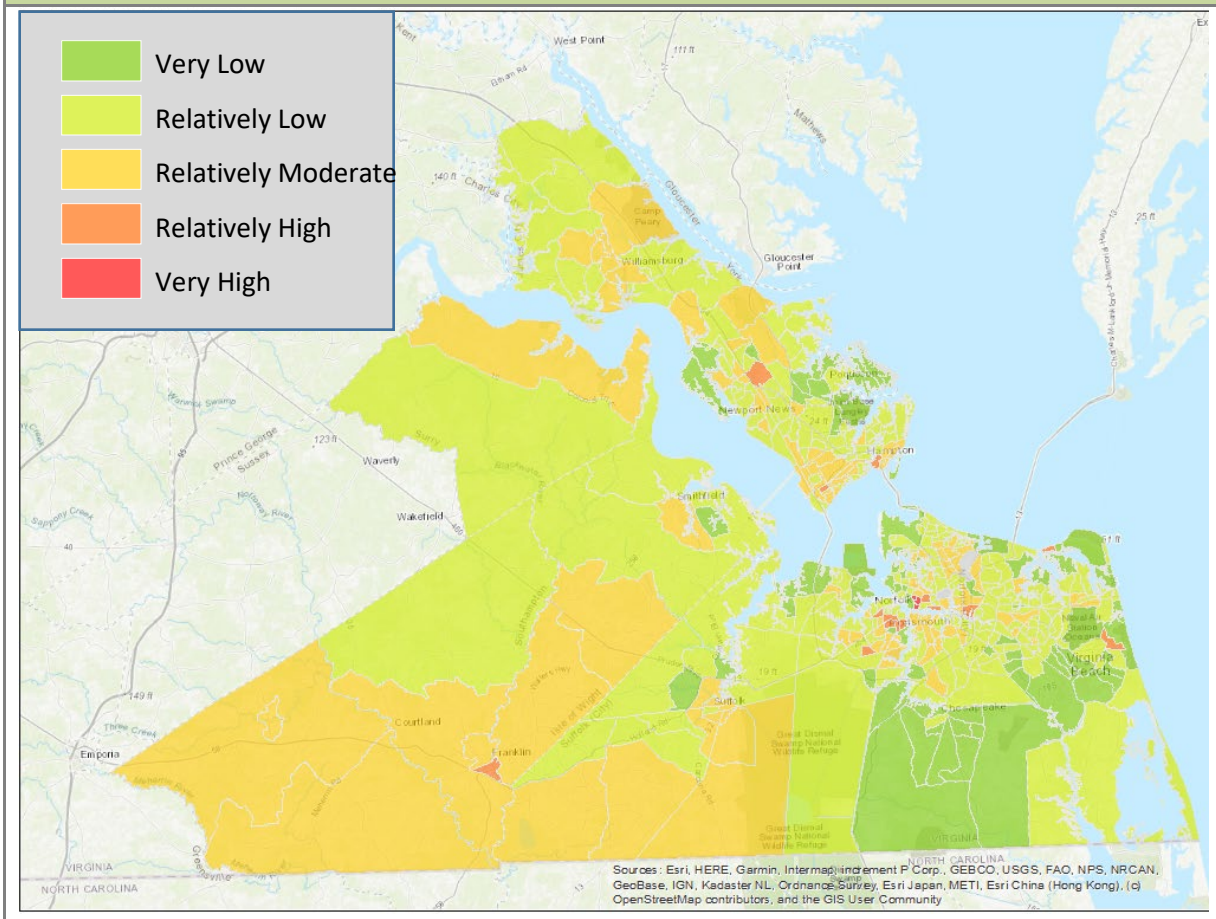
For every score, there is also a qualitative rating that describes the nature of a community's score in comparison to all other communities at the same level, ranging from "Very Low" to "Very High." Because all ratings are relative, there are no specific numeric values that determine the rating. For example, a community's Risk Index score for a single hazard could be 8.9 with a rating of "Relatively Low," but its Social Vulnerability score may be 11.3 with a rating of "Very Low." The rating is intended to classify a community for a specific component in relation to all other communities at the same level.

Source data for the social vulnerability component are derived from the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) Social Vulnerability Index (SoVI). SoVI is a location-specific assessment of social vulnerability that utilizes 29 socioeconomic variables that contribute to a community's reduced ability to prepare for, respond to, and recover from hazards:

Median gross rent for renter-occupied housing units
Median age
Median dollar value of owner-occupied housing units
Per capita income
Average number of people per household
% population under 5 years or age 65 and over
% civilian labor force unemployed
% population over 25 with <12 years of education
% children living in married couple families
% female
% female participation in the labor force
% households receiving Social Security benefits
% unoccupied housing units
% families with female-headed households with no spouse present
% population speaking English as second language (with limited English proficiency)
% Asian population
% African American (Black) population
% Hispanic population
% population living in mobile homes
% Native American population
% housing units with no car available
% population living in nursing facilities
% persons living in poverty
% renter-occupied housing units
% families earning more than $200,000 income per year
% employment in service occupations
% employment in extractive industries (e.g., farming)
% population without health insurance (County SoVI only)
Community hospitals per capita (County SoVI only)

Figure 5.2 maps the foundational social vulnerability using the factors above, without analysis of resilience or loss data for a particular hazard. This map is used to interpret social vulnerability for hazards not specifically addressed in the NRI such as Flooding Due to Impoundment Failure/High Hazard Dam. The map data are also used to rate mitigation actions for those hazards. This plan uses the full NRI dataset to produce maps of relative social vulnerability to several of the prominent natural hazards, including: flooding, tropical/coastal storms, and tornadoes.

FIGURE 5.2: RELATIVE SOCIAL VULNERABILITY IN THE STUDY AREA



2021

Source: FEMA and SoVI, 2021

SUMMARY

Using both the qualitative and quantitative analyses to evaluate the hazards that impact the region provided planning committee members with a dual-faceted review of the hazards. This allowed officials to recognize those hazards that may potentially be costly, but also to plan and prepare for hazards that may not cause much monetary damage, but could put a strain on the local resources needed to recover.

All conclusions of the vulnerability assessment completed for the region are presented in "Conclusions on Hazard Risk" at the end of this section. Qualitative findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows, beginning with an overview of general asset inventory and exposure data for each jurisdiction.

OVERVIEW OF VULNERABILITY

GENERAL ASSET INVENTORY

The total dollar exposure of buildings within the study area is estimated to be over $204 billion. This figure is based on an estimated 560,000 buildings located throughout the region based on the HAZUS default inventory (**Table 5.1**). The data provide an estimate of the aggregated replacement value for the region's assets and indicate that at least 60 percent of the structures are of wood construction.

TABLE 5.1: EXPOSURE OF THE BUILT ENVIRONMENT

SUBREGION	COMMUNITY	BUILDING INVENTORY BY TYPE OF CONSTRUCTION			
		WOOD	MANUFACTURED HOMES	MASONRY, CONCRETE, STEEL	TOTAL
Peninsula	Hampton	$9,758,587,000	$40,526,000	$6,003,186,000	$15,802,299,000
	Newport News	$12,425,313,000	$109,107,000	$8,710,073,000	$21,244,493,000
	Poquoson	$1,220,563,000	$8,625,000	$527,619,000	$1,756,807,000
	Williamsburg	$975,728,000	$0	$1,044,932,000	$2,020,660,000
	James City County	$7,292,959,000	$71,375,000	$3,881,678,000	$11,246,012,000
	York County	$6,449,455,000	$18,669,000	$3,220,222,000	$9,688,346,000
Southside	Norfolk	$14,517,438,000	$33,010,000	$14,710,171,000	$29,260,619,000
	Portsmouth	$6,019,526,000	$16,861,000	$3,927,817,000	$9,964,204,000
	Suffolk	$6,570,498,000	$55,335,000	$3,526,244,000	$10,152,077,000
	Virginia Beach	$36,520,390,000	$89,026,000	$20,584,308,000	$57,193,724,000
	Chesapeake	$17,861,554,000	$106,931,000	$9,915,247,000	$27,883,732,000
Western Tidewater	Isle of Wight County	$2,857,414,000	$95,999,000	$1,611,477,000	$4,564,890,000
	Franklin	$525,235,000	$0	$422,564,000	$947,799,000
	Southampton County	$1,138,139,000	$57,923,000	$687,433,000	$1,883,495,000
	Surry County	$509,304,000	$26,917,000	$259,858,000	$796,079,000
TOTAL		**$124,642,103,000**	**$730,304,000**	**$79,032,829,000**	**$204,405,236,000**

Source: Hazus

ESSENTIAL FACILITIES

There is no universally accepted definition of what constitutes essential facilities and infrastructure, nor is one associated with FEMA and DMA 2000 planning requirements. However, for purposes of this Plan, essential facilities and infrastructure are identified as "*those facilities or systems whose incapacity or destruction would present an immediate threat to life, public health, and safety or have a debilitating effect on the economic security of the region*." The data source for this update was Hazus, which provides a consistent set of facility types across the study area, and is publicly accessible. This typically includes the following facilities and systems based on their high relative importance for the delivery of vital services, the protection of special populations, and other important functions in the region:

- Emergency Operations Center (EOC)
- Hospital and medical care facilities
- Police stations and fire stations
- Public schools designated as shelters
- Hazardous materials facilities
- Water (and wastewater) facilities
- Energy facilities (electric, oil and natural gas)
- Communication facilities

Table 5.2 shows the results of an overlay analysis of the essential facilities that are located in the 100-year floodplain, 500-year floodplain, and the Storm Surge Zone for a Category 3 hurricane. Many of these facilities are addressed in the Mitigation Action Plan, through targeted mitigation actions, or more generalized actions calling for additional study and analysis of the building plans and future vulnerability of these facilities.

TABLE 5.2: CRITICAL FACILITIES LOCATED IN HAZARD AREAS

SUBREGION	COMMUNITY	FLOOD WAY	100-YEAR FLOODPLAIN	500-YEAR FLOODPLAIN	STORM SURGE ZONE
Peninsula	Hampton		4 fire (inc. 2 LAFB), 5 schools	EOC, 3 fire (inc. 1 FMA), 1 police, 8 schools	17 hazmat, 2 EOCs, 14 fire (inc. LAFB & FMA), 3 medical, 6 police, 54 schools (inc. LAFB)
	Newport News		2 hazmat, 1 fire (Eustis)	2 medical, 1 school	16 hazmat, 4 fire (inc. Eustis), 2 medical, 2 police, 17 schools
	Poquoson		EOC, 1 fire, 1 police, 1 school	1 fire, 1 school	EOC, 2 fire, 1 police, 4 schools
	York County		1 fire		28 hazmat, 2 fire, 1 school
Southside	Norfolk		10 hazmat, 2 fire, 6 schools	4 fire, 2 medical, 4 police, 14 schools	30 hazmat, EOC, 20 fire, 8 medical, 9 police, 103 schools
	Portsmouth		EOC, 14 hazmat, 2 fire, 2 police	1 hazmat, 1 fire, 1 medical, 4 schools	15 hazmat, EOC, 9 fire, 2 medical, 2 police, 39 schools
	Suffolk				9 hazmat, 1 fire, 1 medical, 8 schools
	Virginia Beach		2 fire	4 schools	3 hazmat, EOC, 21 fire (inc. Ft Story), 1 medical, 4 police, 117 schools
	Chesapeake		29 hazmat, 3 fire, 4 schools	4 hazmat, 5 schools	59 hazmat, EOC, 10 fire, 5 police, 52 schools
	Franklin	22 hazmat	34 hazmat, 1 fire		
	Southampton County	EOC, 1 police			
	Town of Courtland		EOC, 1 police	4 hazmat, 1 police, 1 school	
REGION TOTAL		**24**	**129**	**68**	**537**

FLOODING

The vulnerability assessment for the flood hazard includes the findings of the qualitative assessment conducted, an overview of NFIP statistics, repetitive loss properties (as defined and identified by the NFIP), estimates of potential losses, and future vulnerability.

As described in detail in the *Hazard Identification and Analysis* section, the NCEI has records for 87 significant flood events in the past 25 years (1995 to 2020) for the region, amounting to approximately $190 million in reported property damage. Also discussed in the *Hazard Identification and Analysis* are historic storms such as Hurricanes Isabel, Floyd and the 1933 hurricane that each caused notable flooding in the region. Historically, Hampton Roads is vulnerable to the flood hazard and flood events, which occur on a frequent basis.

NFIP STATISTICS AND REPETITIVE LOSS PROPERTIES

Table 5.3 provides basic background information regarding the communities in the study area that participate in the NFIP. As shown in Table 5.3, the communities in the Hampton Roads region joined the NFIP throughout the 1970s, 1980s and into the 1990s. In order to join the NFIP, each participating jurisdiction is required to adopt and enforce its own floodplain management ordinance. As a result, structures built after joining the NFIP are assumed to be less vulnerable to flood hazards than those built prior to joining, assuming other environmental conditions remain constant.

The towns of Capron, Dendron and Newsoms do not participate in the NFIP. The Town of Capron, in Southampton County, is located approximately 2 miles from the nearest SFHA of Three Creek. The southern and eastern parts of the Town of Dendron in Surry County are mapped SFHA; however, the town was suspended from the NFIP in December, 1992. Upon closer examination in the VFRIS, there do not appear to be any structures in the SFHA of Dendron. Although a very small portion of Newsoms is mapped in the SFHA, town leadership has chosen not to participate in the NFIP despite numerous entreaties from State officials since the original Flood Hazard Boundary Map for the area was issued in 1977. Using VFRIS, there appears to be one structure in the SFHA of Darden Mill Run, near Old Chapel Road.

TABLE 5.3: NFIP DATA FOR PARTICIPATING COMMUNITIES

SUBREGION	COMMUNITY	NFIP ENTRY DATE	CURRENT EFFECTIVE FIRM DATE
Peninsula	Hampton	1/15/1971	5/16/16
	Newport News	5/2/1977	12/9/2014
	Poquoson	5/16/1977	12/16/2014
	Williamsburg	11/20/1981	12/16/15
	James City County	2/6/1991	12/16/2015
	York County	12/16/1988	1/16/2015
Southside	Norfolk	8/1/1979	12/17/17
	Portsmouth	7/2/1971	8/3/2015
	Suffolk	11/16/1990	8/3/2015
	Virginia Beach	4/23/1971	1/16/2015
	Chesapeake	2/2/1977	12/16/2014
Western Tidewater	Isle of Wight County	8/19/1991	12/2/2015
	Smithfield	12/5/1990	12/2/2015
	Windsor	8/1/1990	12/2/15
	Franklin	8/15/1980	9/4/2002
	Southampton County	12/15/1982	9/4/2002
	Boykins	4/1/1982	9/4/2002
	Branchville	3/30/1979	9/4/2002
	Courtland	7/5/1982	9/4/2002
	Ivor	11/4/2002	No special flood hazard area identified
	Surry County	11/02/1990	05/04/2015
	Claremont	10/16/1990	05/04/2015

Source: NFIP Community Status Book, May 19, 2021

Table 5.4 provides more detailed information on the number of flood insurance policies and the value of those policies for NFIP-participating communities in the study area, as well as the change in policy number and coverage since 2015.

TABLE 5.4: NFIP POLICY DATA FOR PARTICIPATING COMMUNITIES

SUBREGION	COMMUNITY	POLICIES IN FORCE 2015	POLICIES IN FORCE 2021 (PERCENT CHANGE)	INSURANCE IN FORCE 2015	INSURANCE IN FORCE 2021 (PERCENT CHANGE)	TOTAL CLAIMS 1978-2021	TOTAL CLAIM PAYMENTS 1978-2021
Peninsula	Hampton	11,076	9,972 (-10%)	$2,752,401,900	$2,646,416,900 (-4%)	5,775	$74,750,291
	Newport News	2,515	1,853 (-26%)	$627,732,100	$518,802,300 (-17%)	1,026	$23,139,496
	Poquoson	3,310	3,168 (-4%)	$877,069,600	$886,785,200 (1%)	4,217	$71,678,445
	Williamsburg	47	41 (-13%)	$11,971,100	$12,761,400 (7%)	18	$118,850
	James City County	1,006	960 (-5%)	$275,598,300	$282,972,600 (3%)	359	$6,310,238
	York County	3,394	3,134 (-8%)	$980,284,400	$945,982,400 (-3%)	1,567	$33,851,809
Southside	Norfolk	12,324	11,804 (-4%)	$3,203,123,000	$3,282,155,900 (2%)	5,962	$68,344,791
	Portsmouth	3,618	3,935 (9%)	$884,828,100	$999,844,500 (13%)	1,704	$19,769,707
	Suffolk	943	1,002 (6%)	$280,794,800	$316,318,300 (13%)	223	$5,069,727
	Virginia Beach	24,200	23,636 (-2%)	$6,453,533,800	$6,776,920,000 (5%)	6,182	$103,426,658
	Chesapeake	8,841	8,714 (-1%)	$2,383,084,100	$2,511,538,200 (5%)	2,570	$27,028,316
Western Tidewater	Isle of Wight County	397	323 (-19%)	$116,904,100	$100,242,300 (-14%)	149	$4,724,311
	Smithfield	108	85 (-21%)	$32,979,900	$26,319,200 (-20%)	42	$608,217
	Windsor	6	6 (0%)	$1,204,000	$1,715,000 (42%)	0	$0
	Franklin	148	106 (-28%)	$39,465,400	$31,938,100 (-19%)	103	$5,312,419
	Southampton County	127	126 (-1%)	$26,582,600	$27,916,700 (5%)	78	$2,974,777
	Boykins	7	6 (-14%)	$1,901,500	$1,723,800 (-9%)	0	$0
	Branchville	0	0 (0%)	$0	$0 (0%)	0	$0
	Courtland	20	23 (15%)	$5,822,600	$7,828, 800 (34%)	5	$39,366
	Ivor	1	0 (-100%)	$350,000	$0 (-100%)	0	$0
	Surry County	25	27 (8%)	$7,135,400	$7,651,000 (7%)	45	$1,488,980
	Claremont	16	18 (13%)	$4,319,800	$4,279,900 (-1)%	38	$1,273,693

Source: NFIP data dated April 30, 2015 and April 13, 2021.

Reducing the number of repetitive loss (RL) properties insured by the NFIP is a nationwide emphasis of FEMA. The NFIP defines an RL as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978.[2] A repetitive loss property may or may not be currently insured by the NFIP. Per NFIP data provided by the Virginia Department of Conservation and Recreation in June 2015 and some additional data provided by FEMA for some communities, a total of 4,832 RL properties as defined by the NFIP have been identified within the study area communities. These properties have experienced a total of $148 million individual insured losses for the structure and contents combined. The average payment for each qualifying claim was $10,900. In 2015, there were 4,408 residential properties (98 percent) and 106 non-residential properties on the list; that ratio is presumed to be applicable now but the data were not available to verify.

The NFIP also designates severe repetitive losses (SRL) in a community. As defined by the Flood Insurance Reform Act of 2004, SRLs are 1- to 4-family residences that have had four or more claims of more than $5,000 or at least two claims that cumulatively exceed the building's value. The Act created new funding mechanisms to help mitigate flood damage for these properties. The study area communities have 502 SRL properties identified by the NFIP, with a total of 1,621 losses. Total payments for these 502 properties were over $39 million. **Table 5.5a** provides summary details for the communities with regard to each community's repetitive losses. The number of residential versus commercial repetitive loss properties is similar to those ratios in the previous hazard mitigation plan.

TABLE 5.5a: NFIP REPETITIVE LOSS PROPERTIES

REGION	COMMUNITY	REPETITIVE FLOOD LOSSES			
		NUMBER OF PROPERTIES	VALUE OF LOSSES	NUMBER OF LOSSES	AVERAGE PAYMENT PER CLAIM
Peninsula	Hampton (2015)	936	$48,166,174	2,541	$18,956
		SEVERE REPETITIVE FLOOD LOSSES			
		70	$10,407,881	365	$28,515
	Newport News (2015)	121	$13,037,268	294	$44,344
		SEVERE REPETITIVE FLOOD LOSSES			
		3	$189,943	11	$17,268
	Poquoson (2021)	795	Not provided	2,466	Not provided
		SEVERE REPETITIVE FLOOD LOSSES			
		204	Not provided	Not provided	Not provided
	Williamsburg (2015)	4*	$104,271	9	$11,586
	James City County	35	$2,345,563	95	$24,690
		SEVERE REPETITIVE FLOOD LOSSES			
		2	$146,768	8	$18,346
	York County (2015)	236	$15,330,549	560	$27,376
		SEVERE REPETITIVE FLOOD LOSSES			
		11	$1,772,861	50	$35,457
Southside	Norfolk (2020)	942	$32,321,814	2,217	$14,440
		SEVERE REPETITIVE FLOOD LOSSES			
		95	$11,988,043	533	$22,949
	Portsmouth (2015)	229	$10,009,951	631	$15,864
		SEVERE REPETITIVE FLOOD LOSSES			
		16	$2,070,120	86	$24,071

[2] The FEMA Hazard Mitigation Assistance Program defines RL as having incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

TABLE 5.5a: NFIP REPETITIVE LOSS PROPERTIES					
REGION	COMMUNITY	REPETITIVE FLOOD LOSSES			
		NUMBER OF PROPERTIES	VALUE OF LOSSES	NUMBER OF LOSSES	AVERAGE PAYMENT PER CLAIM
	Suffolk (2015)	17	$2,285,818	50	$45,716
	Virginia Beach (2015)	574	$34,205,856	1,768	$19,347
		SEVERE REPETITIVE FLOOD LOSSES			
		62	$8,673,919	361	$24,027
	Chesapeake (2015)	395	$19,611,525	1,214	$16,154
		SEVERE REPETITIVE FLOOD LOSSES			
		37	$3,523,288	199	$17,705
Western Tidewater	Isle of Wight County (2015)	23	$1,584,416	60	$26,407
	Smithfield (2015)	3	$71,418	7	$10,203
	Franklin (2015)	6	$686,165	12	$57,180
	Southampton County (2015)	9	$557,595	19	$29,347
	Surry County (2021)	5	$578,071	14	$41,291
		SEVERE REPETITIVE FLOOD LOSSES			
		2	$297,572	8	$34,947
Totals		4,832	$148,165,583	13,578	$626,186

** Williamsburg officials have conducted additional research into these data and contend the data do not represent a pattern of repetitive overland flooding.*
Sources: FEMA and NFIP

In May 2022, FEMA provided additional data regarding repetitive losses in the study area. These data are not reflected in the planning process or the repetitive loss area mapping below, but may prove useful for the region's communities in future repetitive loss planning. The data are shown in **Table 5.5b**.

TABLE 5.5b: 2022 NFIP REPETITIVE FLOOD LOSSES			
SUBREGION	**COMMUNITY**	**REPETITIVE FLOOD LOSS PROPERTIES**	**SEVERE REPETITIVE FLOOD LOSS PROPERTIES**
Peninsula	Hampton	956	109
	Newport News	129	10
	Poquoson	983	50
	Williamsburg	3	0
	James City County	37	4
	York County	245	15
Southside	Norfolk	977	125
	Portsmouth	255	27
	Suffolk	24	3
	Virginia Beach	676	128
	Chesapeake	420	78
Western Tidewater	Isle of Wight County	23	5
	Smithfield	6	1
	Windsor	0	0
	Franklin	7	1
	Southampton County	8	2
	Boykins	0	0
	Branchville	0	0
	Capron	0	0
	Courtland	0	0
	Ivor	0	0
	Newsoms	0	0
	Surry County	6	2
	Claremont	4	3
	Dendron	0	0
Total		4,759	563

Figures 5.3 through 5.11 contain maps of the region's repetitive loss areas. Each designated area was identified by referencing maps of all historical NFIP flood claims, NFIP RL lists, the SRL list, a Digital Elevation Model (DEM)-based depth grid of the 100-year floodplain, and the HAZUS results regarding predicted flood damages from a 100-year flood for individual structures. As shown in Table 5.5, there are 4,514 properties on FEMA's repetitive loss list and an additional 55,179 parcels identified as being within those repetitive loss areas. Other structures near the ones listed by the NFIP may have been uninsured during the floods, may have had single flood insurance claims, or may have had multiple claims under different policies that the claims system did not recognize as being the same repetitively flooded address. **Table 5.6** provides additional detail regarding the repetitive loss areas identified for each community.

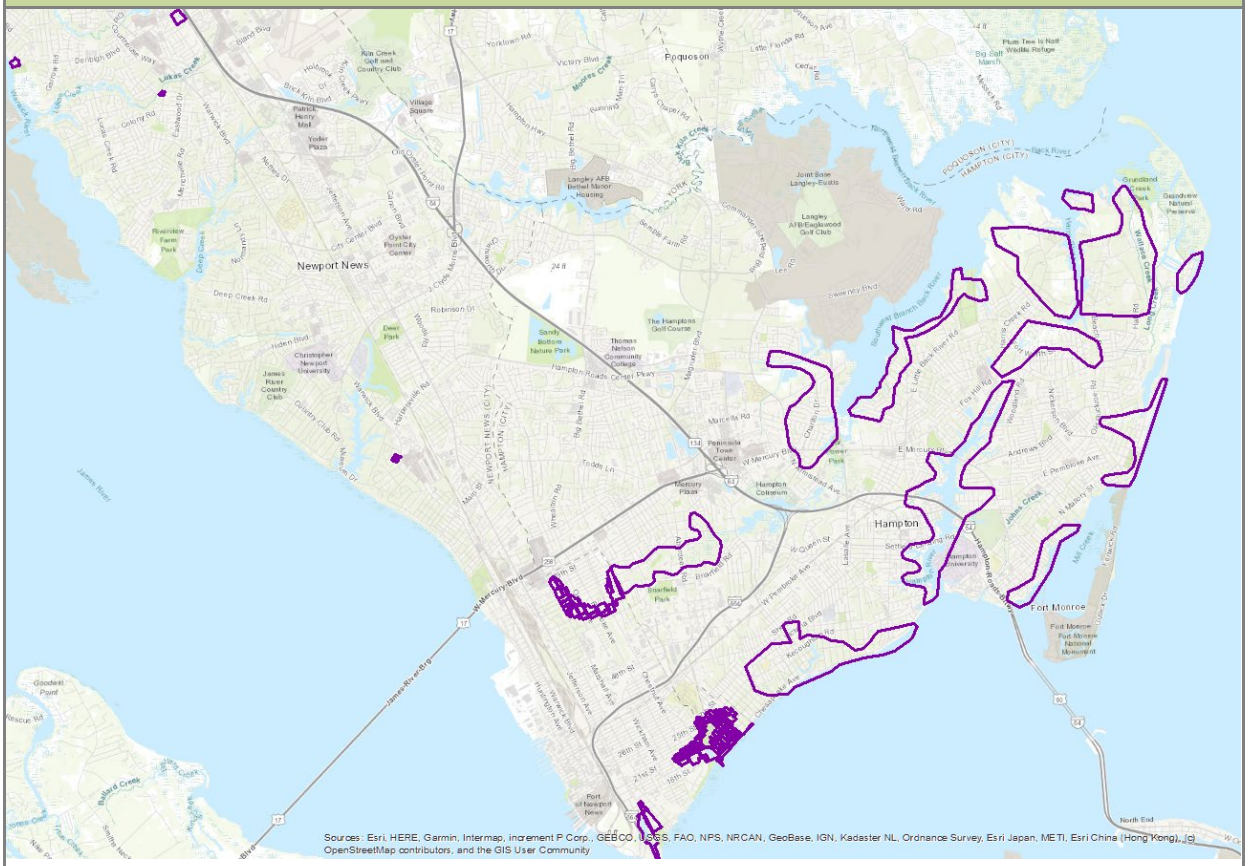
TABLE 5.6: REPETITIVE FLOOD LOSS AREA DETAILS

REGION	COMMUNITY	REPETITIVE FLOOD LOSS AREAS		
		NUMBER OF RL AREAS	NUMBER OF PROPERTIES OR BUILDINGS	SOURCES OF FLOODING
Peninsula	Hampton	12	7,736	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Newmarket Creek overflows banks during coastal storms and heavy rains. Wind driven storm tides drive water into smaller tributaries and flood low-lying areas. Along Chesapeake Bay, wind and wave velocity, coastal flooding and overwash during coastal storms causes damage.
	Newport News	8	1,662	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Newmarket Creek overflows banks during coastal storms and heavy rains. Wind driven storm tides drive water into smaller tributaries and flood low-lying areas. Along James River, wind and wave velocity, coastal flooding and overwash during coastal storms causes damage.
	Poquoson	1	4,810	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	James City County	10	643	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds.
	York County	20	1,681	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
Southside	Norfolk	114	8,764	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods.
	Portsmouth	25 maps	1,974	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods. Seawall damaged.
	Suffolk	12	81	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.

TABLE 5.6: REPETITIVE FLOOD LOSS AREA DETAILS

REGION	COMMUNITY	REPETITIVE FLOOD LOSS AREAS		
		NUMBER OF RL AREAS	NUMBER OF PROPERTIES OR BUILDINGS	SOURCES OF FLOODING
	Virginia Beach	156	3,888	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods.
	Chesapeake	62	3,869	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Flat terrain hinders stormwater
Western Tidewater	Isle of Wight County	13	151	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	Smithfield	1	45	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	Franklin	2	462	Blackwater River overflows its banks and tributary banks as a result of heavy rain in the upper parts of the watershed causing severe flooding in the downtown area.
	Southampton County	4	74	The Blackwater and Nottoway River systems overflow their banks as a result of heavy rain in the watershed, causing pockets of flooding especially where tributaries flow into main rivers.
	Surry County	4	89	Low-lying land along the banks of the James River cause much of the repetitive flooding near Pleasant Point and the Jamestown-Scotland Ferry Terminal. A low-lying area near Claremont is outside the SFHA, but experiences urban flooding when infrastructure cannot carry stormwater away from structures. Another area near Dendron experiences flooding within and beyond the SFHA of the nearby Cypress Swamp.
Totals		419	39,098	

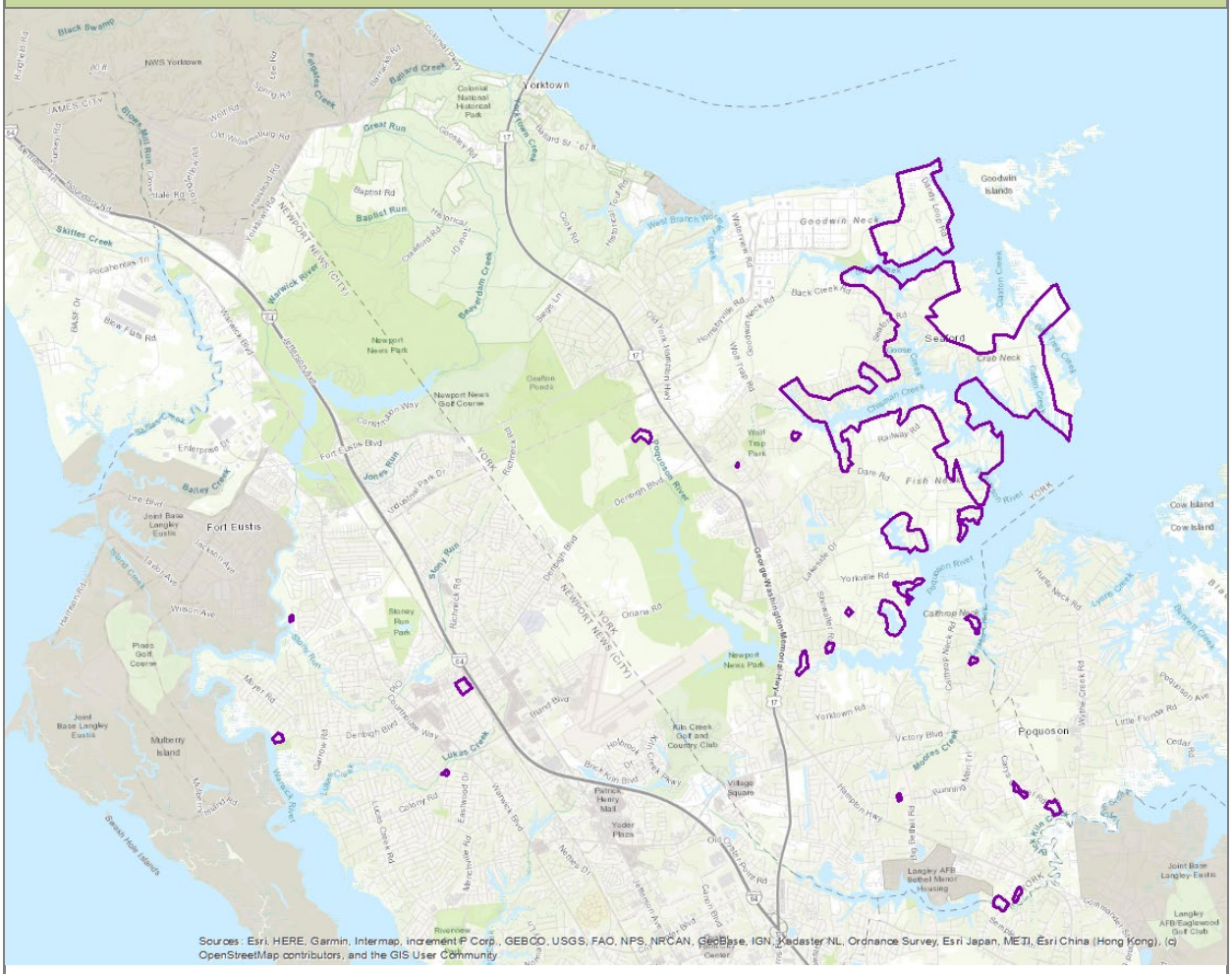
FIGURE 5.3: NFIP REPETITIVE FLOOD LOSS AREAS, LOWER PENINSULA



2021

**Poquoson designated entire SFHA as repetitive loss area. See Figure 4.1.*

FIGURE 5.4: NFIP REPETITIVE FLOOD LOSS AREAS, MIDDLE PENINSULA



Repetitive Loss Areas

2021

FIGURE 5.5: NFIP REPETITIVE FLOOD LOSS AREAS, UPPER PENINSULA

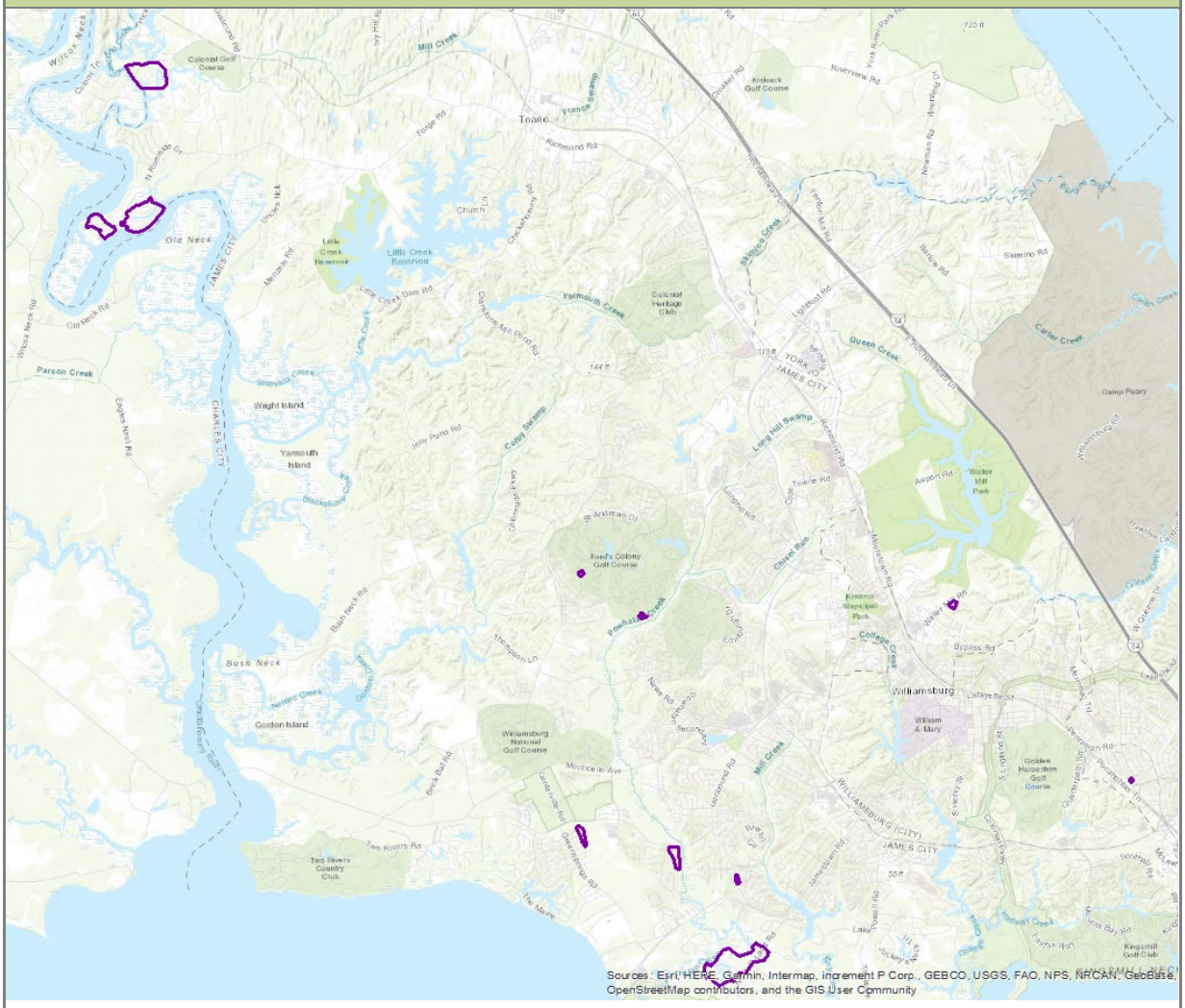
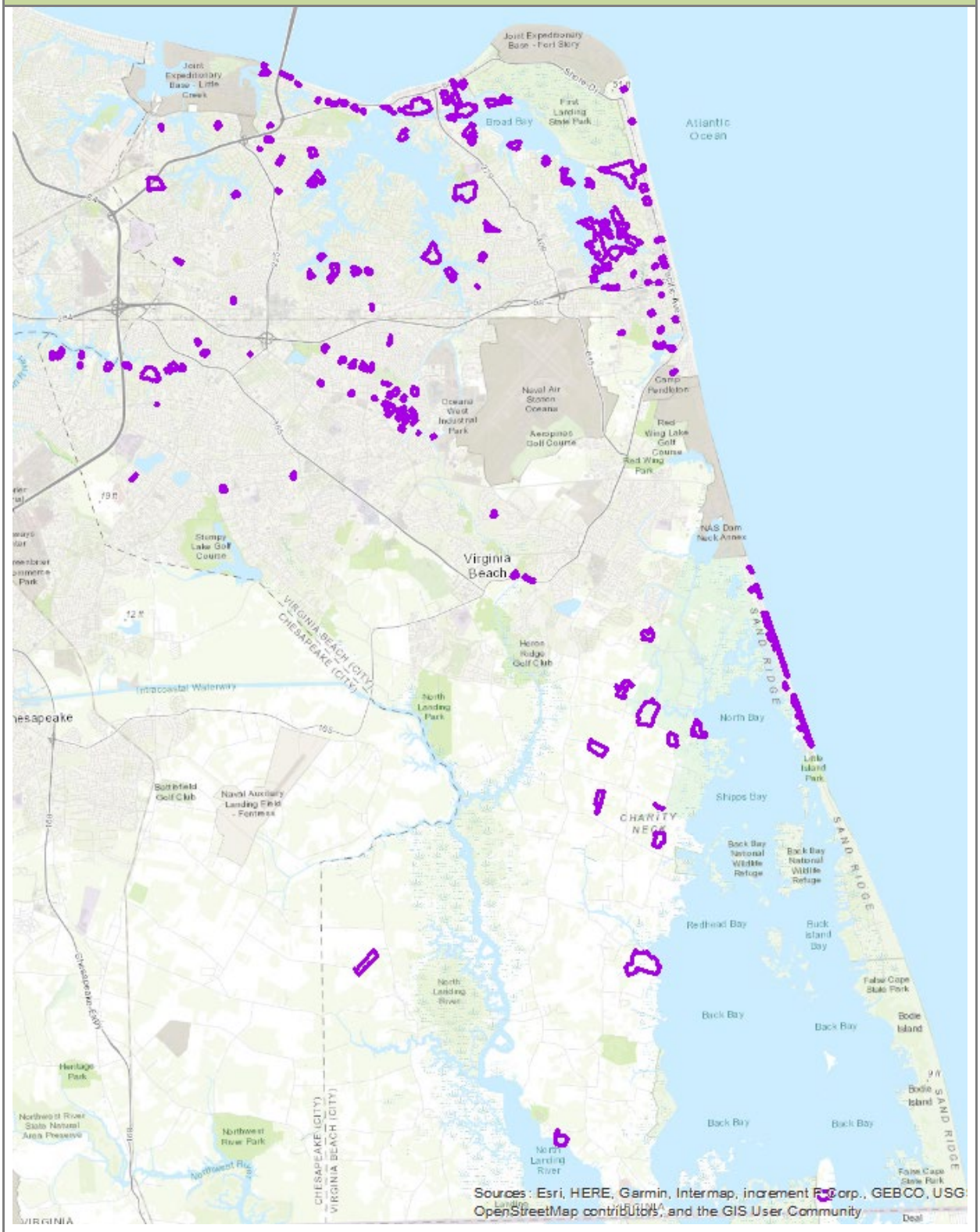


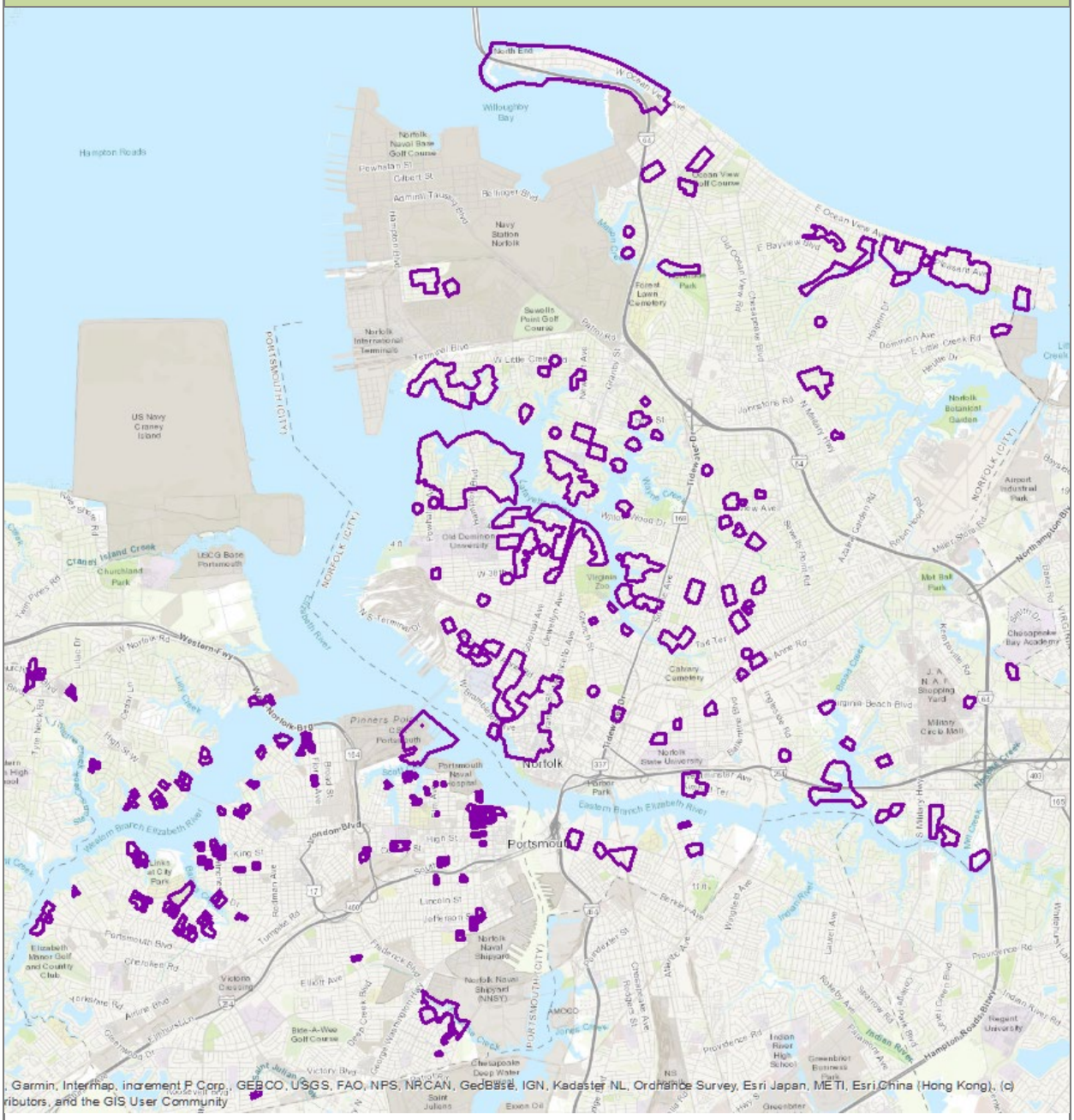
FIGURE 5.6: NFIP REPETITIVE FLOOD LOSS AREAS, VIRGINIA BEACH



Repetitive Loss Areas

2021

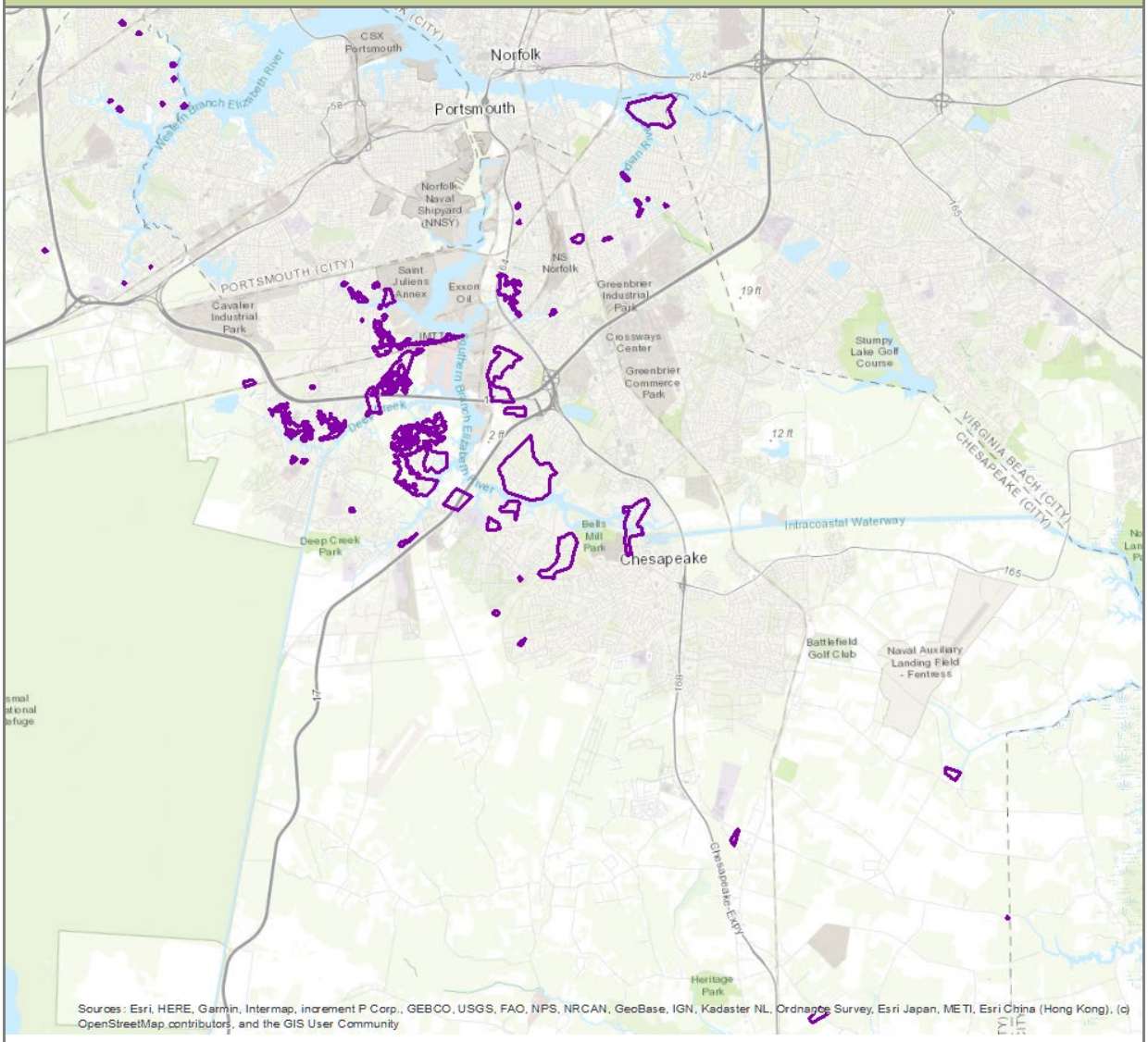
FIGURE 5.7: NFIP REPETITIVE FLOOD LOSS AREAS, NORFOLK, PORTSMOUTH



Repetitive Loss Areas

2021

FIGURE 5.8: NFIP REPETITIVE FLOOD LOSS AREAS, CHESAPEAKE



2021

FIGURE 5.9: NFIP REPETITIVE FLOOD LOSS AREAS, SUFFOLK

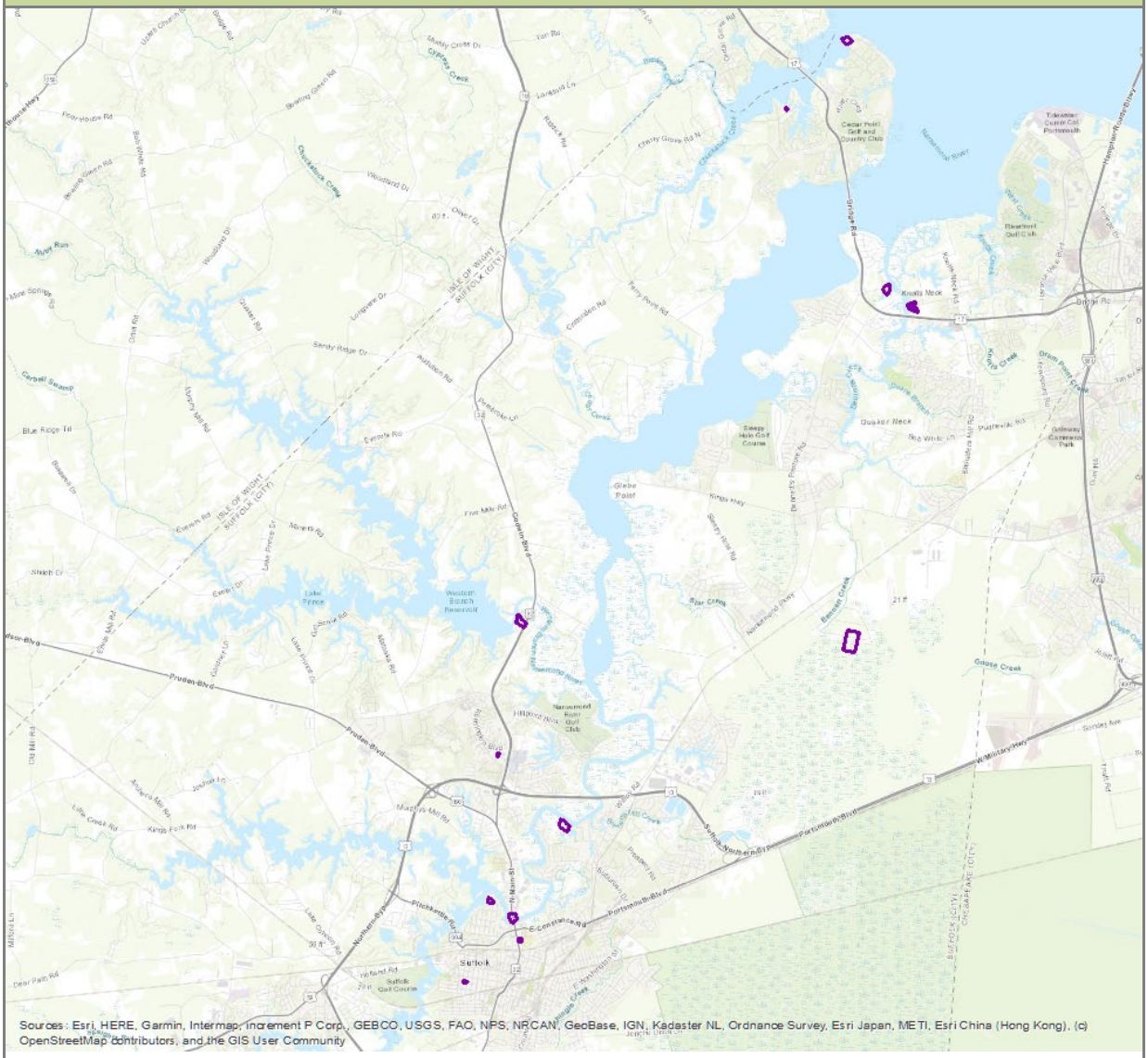


FIGURE 5.10: NFIP REPETITIVE FLOOD LOSS AREAS, ISLE OF WIGHT, SMITHFIELD, SOUTHAMPTON COUNTY, FRANKLIN

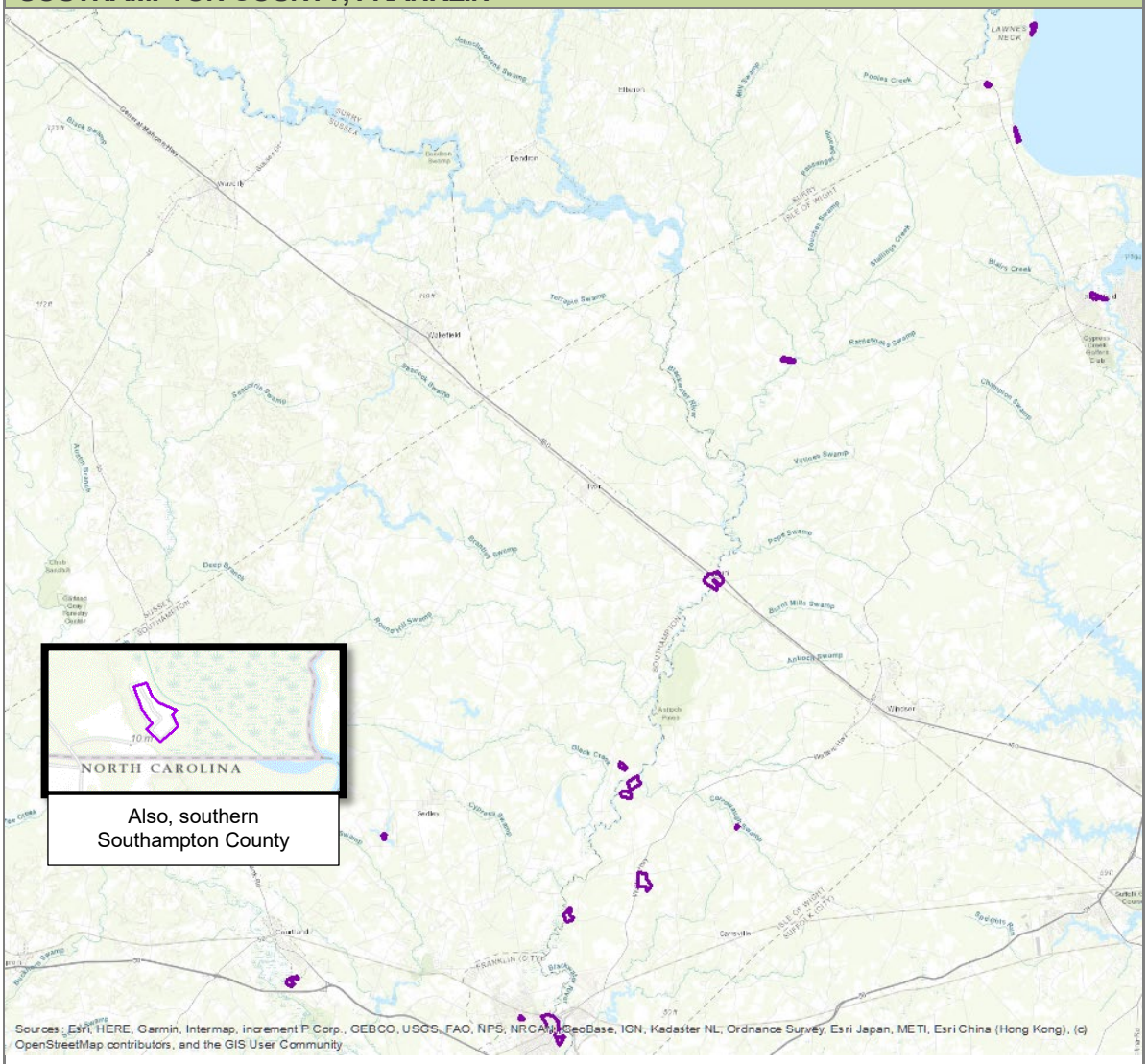
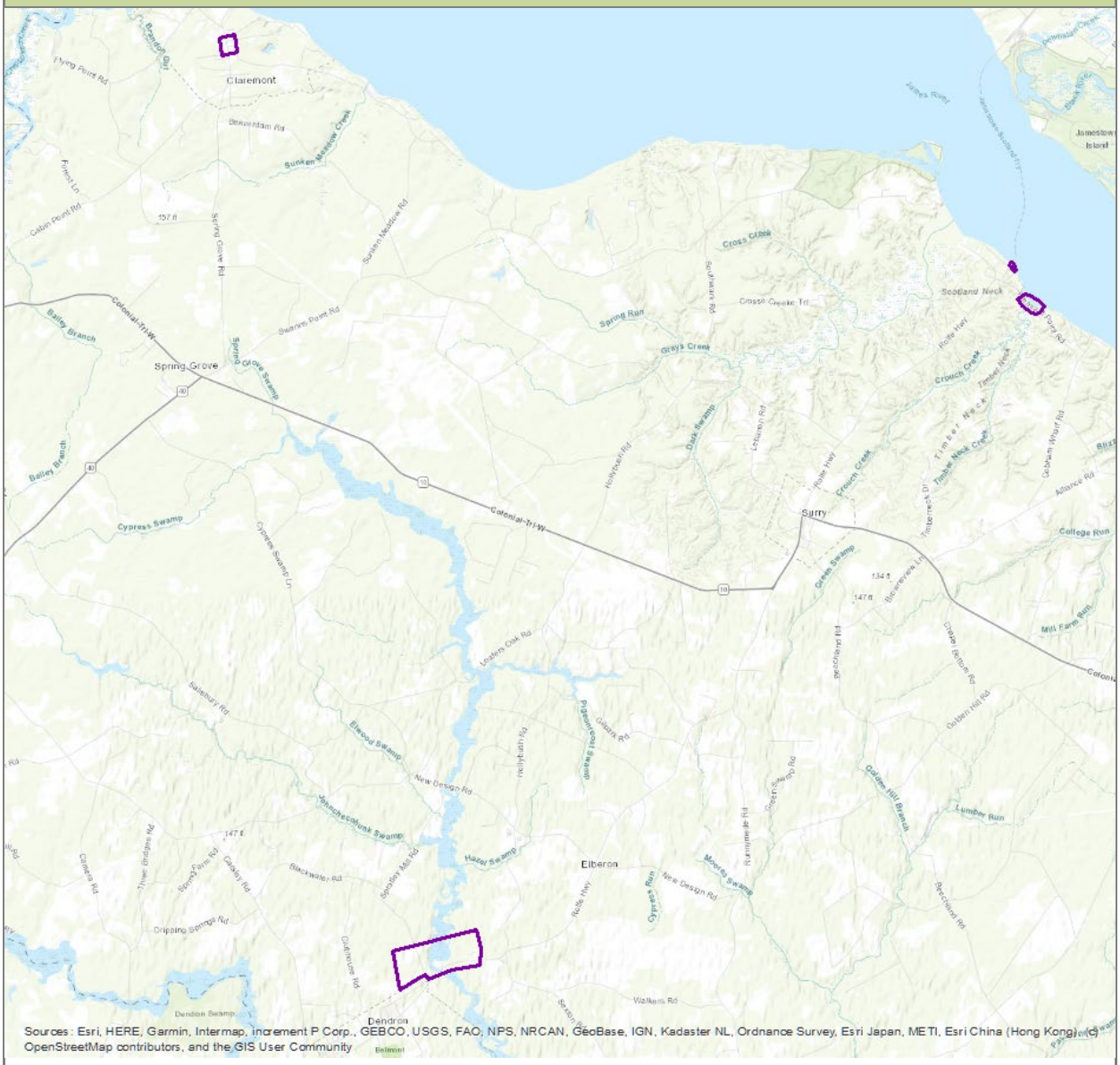


FIGURE 5.11: NFIP REPETITIVE FLOOD LOSS AREAS, SURRY COUNTY



ESTIMATES OF POTENTIAL LOSSES

For the updated flood vulnerability analysis, participating communities were asked to share as much information as possible about individual structures in their communities, including:

- Elevation Certificate data or lowest floor elevation;
- address;
- year built;
- number of stories;
- building cost;
- content cost;
- building type;
- square footage;
- construction class;

- foundation type; and/or
- occupancy/use code.

A majority of the communities in this Plan had flood hazard vulnerability assessments performed at the individual structure level (Level 2 Hazus analysis) using flood depth raster data generated external to Hazus. Due to the nature of the FEMA FIRMs level of detail, Franklin and Southampton County were modeled using Hazus Flood Level 1 analysis, which generated flood depth rasters internal to Hazus making use of 30 meter digital elevation data from the USGS. Williamsburg was not modeled because previous studies had found no single family residential structures in the SFHA. For all of the other communities in the study area, an individual structure level analysis, also known as a User-Defined Facilities (UDF) analysis within Hazus Level 2, was performed for flood hazards as shown on the FIRM, including coastal and riverine flooding.

The following highlights the data source and processing methodology for each of the input datasets required by Hazus for the UDF analysis:

User Defined Facilities (Building Data, including First Floor Elevations)
HRPDC provided Hazus UDF building data for 11 of the 12 cities and counties where the UDF analysis was performed. These data were only for single family residential structures (RES1 specific occupancy type in Hazus), which typically make up 70-90% of all structures in the mapped floodplain. The City of Virginia Beach directly provided UDF building data for all structure types.

These UDF datasets had been previously developed based on approaches documented in the following three HRPDC reports:

Phase 1 Report: Developing First Floor Elevation Data for Coastal Resilience Planning in Hampton Roads, February 2019 (available at https://www.hrpdcva.gov/library/view/932/developing-first-floor-elevation-data-for-coastal-resilience-planning-in-hampton-roads)

Phase 2 Report: Applying First Floor Elevation Data to Flooding Vulnerability Assessments in Hampton Roads, February 2020 (available at https://www.hrpdcva.gov/library/view/1124/applying-first-floor-elevation-data-to-flooding-vulnerability-assessments-in-hampton-roads)

Phase 3 Report: A Regional Approach to Applying First Floor Elevation Data to Coastal Flooding Vulnerability Assessments in Hampton Roads, November 2020 (available at https://www.hrpdcva.gov/library/view/1386/a-regional-approach-to-applying-first-floor-elevation-data-to-coastal-flooding-vulnerability-assessments-in-hampton-roads)

These reports detail the data sources and approaches used to establish structure location and characteristic data, such as square footage and number of stories, from local assessor's parcel data. These reports also give a detailed description of how first floor elevations were derived for the structures, using a mix of actual surveyed first floor elevations from completed FEMA Elevation Certificates and modeling approaches to assign typical height above grade of first floors based on structure characteristics such as foundation types.

Flood Hazard Data and Depth Rasters
Geospatial analysts obtained the most recent effective Digital Flood Insurance Rate Map databases from the FEMA Map Service Center for the region. This included newly developed flood depth rasters (required inputs for Hazus flood UDF analysis) for the 100-year frequency flood event in all 12 cities and counties modeled using UDF analysis.

While this single flood depth raster allowed loss modeling for the 100-year event, HRPDC was interested in exploring ways to estimate average annual damages (AAD), as well. Estimating AAD requires having flood rasters for at least four additional flood frequency events (such as the 10-year, 25-year, 50-year, and 500-year events). The existing Flood Insurance Studies (FIS) in each of the communities includes multi-return period information that provides most or all of these additional return periods. Therefore, four

additional flood depth rasters were derived for the 12 cities and counties modeled with UDF analysis using the following approach:

1. The flood profiles and transect tables of each city and county were reviewed and an "average" flood profile was selected for each jurisdiction, represented as a specific category of FEMA Probability of Elevation or PELV Curve values. PELV Curves for flood A zones range from A1 to A30 and flood V zones range from V1 to V30, where each curve represents a specific offset between the 10-year and 100-year elevation. For example, the A5 curve represents a flood profile with 2.5 feet between the 10-year and 100-year flood elevation. Each curve has a best-fit line to derive the relative flood elevation offsets to any other return periods, including the 25-year, 50-year, and 500-year required for the Hazus AAD calculations.
2. Once the PELV curve was established for each jurisdiction, new flood depth rasters were derived by subtracting the offset value for that return period from the official FEMA 100-year flood depth raster. For example, for a jurisdiction assigned the A5 PELV curve, the 10-year flood depth raster was estimated by subtracting 2.5 feet from each raster cell in the 100-year flood depth raster. This resulted in some raster cells with zero or negative values, which Hazus ignores in the flood UDF analysis.
3. The following shows the PELV Curve assumptions for the jurisdictions modeled using this approach:
    - Chesapeake, Norfolk, Portsmouth, Virginia Beach - A4 (2 foot offset between 10-year and 100-year)
    - Isle of Wight County, James City County, Newport News, Poquoson, Suffolk, Surry County - A5 (2.5 foot offset between 10-year and 100-year)
    - Hampton, York County - A7 (3.5 foot offset between 10-year and 100-year)

Using the five flood depth rasters and UDF building data listed above, a building level flood vulnerability analysis was conducted for each flood-prone community. Because of the large number of analyses that needed to be conducted (5 return periods for 12 jurisdictions), the newly developed Hazus FAST Tool was used. The FAST Tool uses a Python script-based approach to automate running a Hazus flood UDF analysis with the simple selection of an input UDF database and the selection of one or more flood depth rasters. The FAST tool outputs a text file with the analysis results for each structure determining the building and content damage percentage and dollar losses for each structure.

One final set of refinements was needed after running the FAST tool for the five return periods in each community. The HRPDC detailed structure data only included lowest floors and other characteristics for single-family residential structures. In order to estimate losses for all structure types, a companion Hazus Level 1 analysis was conducted for each of the 11 jurisdictions with only RES1 data using the 100-year FEMA flood depth raster as an input. The aggregated loss estimates from these Level 1 analyses were used to develop multiplication factors to apply to the building and contents losses in each community to account for non-residential structures. In addition, the final AAD value was derived using the standard Hazus calculation for the five return periods modeled.

Table 5.7a provides a detailed listing of the number of residential structures expected to be damaged by flooding (coastal storm surge and riverine flooding), and the total dollar losses predicted for all structures for the 100-year event, and Average Annual Damages.

TABLE 5.7A: HAZUS FLOOD DAMAGE VULNERABILITY RESULTS						
SUBREGION	**COMMUNITY**	**NUMBER OF SINGLE FAMILY RESIDENTIAL BUILDINGS DAMAGED (100-YR EVENT)**	**TOTAL ALL BUILDING TYPE LOSSES (100-YR EVENT)**	**TOTAL CONTENT LOSSES (100-YR EVENT)**	**TOTAL LOSSES (100-YR EVENT)**	**AVERAGE ANNUAL DAMAGES**
Peninsula	Hampton	4,012	$93,763,321	$70,335,791	$164,099,112	$6,813,410
	Newport News	435	$6,045,697	$4,586,632	$10,632,329	$486,054
	Poquoson	1,405	$43,631,875	$31,715,660	$75,347,535	$3,715,393
	Williamsburg	Not modeled; there are no single family residential structures in mapped floodplain				
	James City County	64	$1,762,201	$1,000,658	$2,762,858	$156,374
	York County	266	$4,716,520	$3,376,412	$8,092,932	$687,866
Southside	Norfolk	2684	$163,342,598	$177,157,526	$340,500,124	$19,264,918
	Portsmouth	658	$8,197,586	$8,921,847	$17,119,433	$982,084
	Suffolk	40	$1,997,698	$1,421,059	$3,418,757	$190,613
	Virginia Beach	2322	$149,052,336	$65,543,442	$214,595,778	$9,524,586
	Chesapeake	1382	$17,411,115	$14,887,712	$32,298,827	$1,795,921
Western Tidewater	Isle of Wight County	47	$3,278,669	$2,844,448	$6,123,118	$410,568
	Franklin*	NA*	$109,000	$91,000	$200,000	$11,000
	Southampton County*	NA*	$854,000	$929,000	$1,783,000	$111,446
	Surry County	23	$1,052,801	$906,209	$1,959,011	$111,192
Totals		**13,338**	**$495,215,418**	**$383,717,396**	**$878,932,814**	**$44,261,424**

*Modeled using Hazus Level 1 Flood analysis
Source: Hazus

In an effort to ensure that this plan reflects the latest analyses available for the region, the planning team also examined the results of the *Virginia Coastal Resilience Master Plan – Phase One, December 2021.* Although this plan was released after the planning process for this plan was substantially complete, the team felt it was important to include the results of the later coastal study as a companion to the Hazus results for all flood types. Using a separate methodology as explained in detail in the new document's Appendix C, the *Virginia Coastal Resilience Master Plan – Phase One, December 2021*, showsaverage annual loss results that provide additional insights regarding the impacts of coastal flooding in Hampton Roads. The analysis in the *Coastal Resilience Master Plan* does not address riverine flooding not caused by storm surge.

TABLE 5.7B: COASTAL STORM SURGE IMPACTS, 2020						
SUBREGION	COMMUNITY	EXPOSED POPULATION	AAL RESIDENTIAL	AAL COMMERCIAL	AAL AGRICULTURAL	# PUBLIC STRUCTURES IMPACTED, 100-YEAR FLOOD
Peninsula	Hampton	6,849	$25,279,708	$6,750,368	$30,295	135
	Newport News	350	$1,551,702	$276,989	-	137
	Poquoson	1,114	$26,598,367	$1,259,621	-	25
	Williamsburg	-	-	-	-	-
	James City County	80	$2,001,233	$178,023	$17,550	1
	York County	868	$11,034,534	$1,051,836	$67,686	79
Southside	Norfolk	9,458	$89,208,351	$86,403,233	-	143
	Portsmouth	4,615	$9,336,570	$3,283,350	-	218
	Suffolk	194	$983,209	$605,126	$2,237	5
	Virginia Beach	10,906	$40,107,944	$20,975,453	$426,353	120
	Chesapeake	5,145	$24,316,555	$9,135,644	$55,650	209
Western Tidewater	Isle of Wight County	60	$ 637,785	$1,191,561	$6,791	-
	Franklin	-	-	-	-	-
	Southampton County	10	$38,625	$23,932	-	-
	Surry County	-	$1,550,375	$46,113	$32,335	-
Totals		39,649	$232,644,958	$131,181,249	$638,897	1,072

Source: Virginia Coastal Resilience Master Plan – Phase One, December 2021

Vulnerability to stormwater flooding caused by precipitation and/or stormwater management infrastructure issues was not directly evaluated due to insufficient and inconsistent data across the study area. Although some municipalities have made progress in evaluating this specific type of flooding and have started collecting data to reflect historic occurrences and future vulnerabilities, data are not available to express quantitative risk in a meaningful way for the whole region.

Clearly, much of the Hampton Roads region is susceptible to costly damage resulting from flood events and Figure 4.1 indicates where the flood risk is highest. The lower Peninsula (Hampton and Poquoson) and developed areas of Southside (Norfolk, Virginia Beach, Chesapeake and Portsmouth) have the highest numbers of repetitive losses and highest predicted number of structures expected to be damaged in a 100-year flood event based on the HAZUS data. Hampton, Poquoson, Norfolk and Chesapeake all have more than 1,000 structures that are highly vulnerable to the 100-year flood event, and these areas are likely the most vulnerable in the region. York County has fewer structures susceptible, but the value of those structures is higher, so the vulnerability is consequently higher. The repetitive flood loss areas shown in Figures 5.3 through 5.11 indicate where within each community the flood damage has historically been highest and can be expected to continue into the future without large-scale mitigation measures to reduce flood vulnerability.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future vulnerability will be determined, in part, by local officials. Flood hazard and SLOSH maps are available to indicate what areas of the region are most vulnerable to these hazards. These planning tools are used to help guide development away from hazardous areas. Local officials are responsible for

enforcing local floodplain management regulations, flood damage prevention ordinances, and other forms of development policies that restrict new development in flood hazard areas. Additional discussion of actions these communities have taken to reduce future flood vulnerability is provided in Section 6, the Capability Assessment.

In its June 2021 report entitled *The Impact of Climate Change on Virginia's Coastal Areas*, the Virginia Academy of Science, Engineering, and Medicine (VASEM), laid out the consequences of climate change for Virginians. VASEM is a nonprofit organization consisting of members of the National Academies of Science, Engineering, and Medicine who reside or work in Virginia as well as other Virginians who are leaders in these fields. The most immediate consequence of climate change is sea level rise, caused primarily by melting ice and glaciers and thermal expansion. Additional consequences related to flooding include more recurrent flooding (higher frequency of occurrence for damaging floods), extreme rainfall and inundation of septic systems. The report projects that, particularly in urban areas, recurrent flooding will have a disproportional impact on racial and ethnic minorities, the poor, the elderly, renters, non-native English speakers, and those with mobility challenges. Exposure to a growing number of flood-prone facilities regulated for toxic and hazardous substances as sea levels rise is another concern, particularly on the James River, between Richmond and Hampton Roads. Impacts in rural areas are more likely to be centered around soil quality, such as water-logged soils in flood-prone areas, increased salinity due to saltwater intrusion and septic system failures that affect public health.[3]

Increased levels of precipitation from storm events sometimes overwhelm existing municipal stormwater management systems in the Hampton Roads region, which can result in roadway flooding, safety and access concerns, and issues with water quality and treatment capacity. As sea levels rise, the ability of the existing stormwater management systems to collect, convey, treat, and discharge flow will be further reduced by higher water levels at outfall locations.
The average annual number of days with heavy precipitation is expected to increase in the future as a result of climate change. This increased precipitation will have an impact on the frequency of regional flooding, especially riverine flooding, but may also impact coastal flooding unless municipal stormwater systems are redesigned. Heavy precipitation events can easily overwhelm existing infrastructure, causing failure of stormwater culverts, bridge scour, and overland flooding affecting areas and structures that do not normally flood. Increased heavy precipitation can impact dams and, over time, influence flood frequency curves that are used for a variety of insurance, building safety and planning purposes.

According to 2022 data from the Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA)[4], under a moderate emissions scenario, Portsmouth can expect that for the period 2066 to 2095, the average number of days per year with rainfall greater than 1 inch will be 9.5 days, which is 20% more than in the period between 1976 and 2005. The same percentage increase is expected across the region. On the other hand, the number of days with rainfall greater than 3 inches is 0.4, 56% more than in 1976-2005 for Portsmouth. The predictions for days with this severe rainfall are not uniform across the region and range from a low of 35-percent increase in parts of Virginia Beach, to an 84-percent increase in western Isle of Wight County.

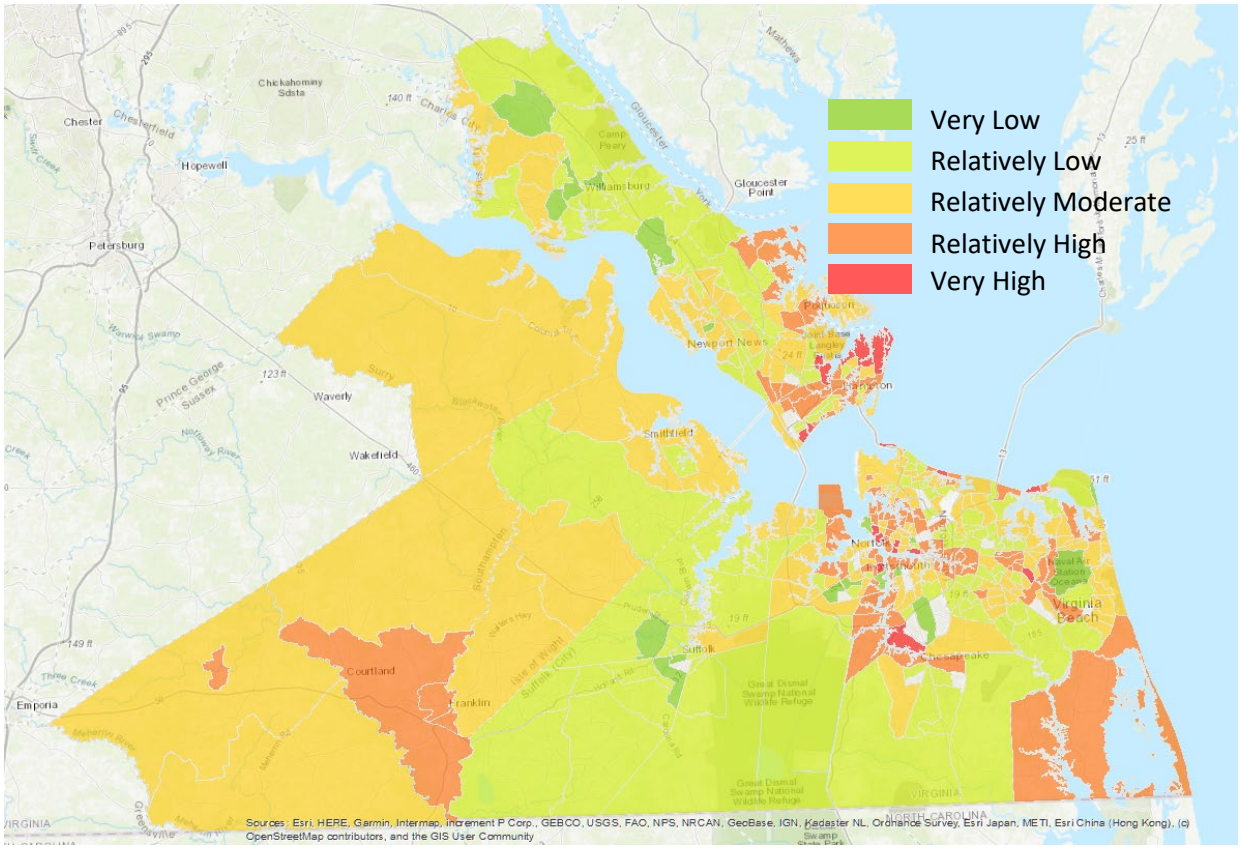
SOCIAL VULNERABILITY

Social vulnerability to both coastal and riverine flood (combined) for the Hampton Roads region is represented in **Figure 5.12**, categorized by Census tract. The map shows the NRI rating for flood risk is highest in the Franklin/Southampton County area, the lower Peninsula, Census tracts bordering the Elizabeth River in Portsmouth and Norfolk, and portions of central and southern Virginia Beach.

[3] *The Impact of Climate Change on Virginia's Coastal Areas*, the Virginia Academy of Science, Engineering, and Medicine, June 2021. Available online at: http://www.vasem.org/wp-content/uploads/2021/08/VASEM_VirginiasCoastalAreasReport_FINAL.pdf

[4] Mid-Atlantic Regional Integrated Sciences and Assessments: https://public.tableau.com/views/Climate_summary_rainfall_20181112_PUBS/3b?:embed=y&:toolbar=n&:embed_code_version=3&:loadOrderID=0&:display_count=y&:origin=viz_share_link

FIGURE 5.12: RIVERINE FLOODING, NRI RISK RATING



2021

Source: National Risk Index, 2021

FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM

ESTIMATES OF POTENTIAL LOSSES

Table 4.4 summarizes possible impacts to downstream structures and infrastructure in the event of dam failure. In the downstream inundation areas for all of Hampton Roads high hazard potential dams, the following impacts are possible:

2,798 homes;
136 roadways;
8 businesses;
3 schools;
4 parks;
4 utilities;
6 railroad segments; and,
9 downstream dams.

Potential damages from inundation of these structures and infrastructure have not been further quantified, but is an area of expected future study in the region.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

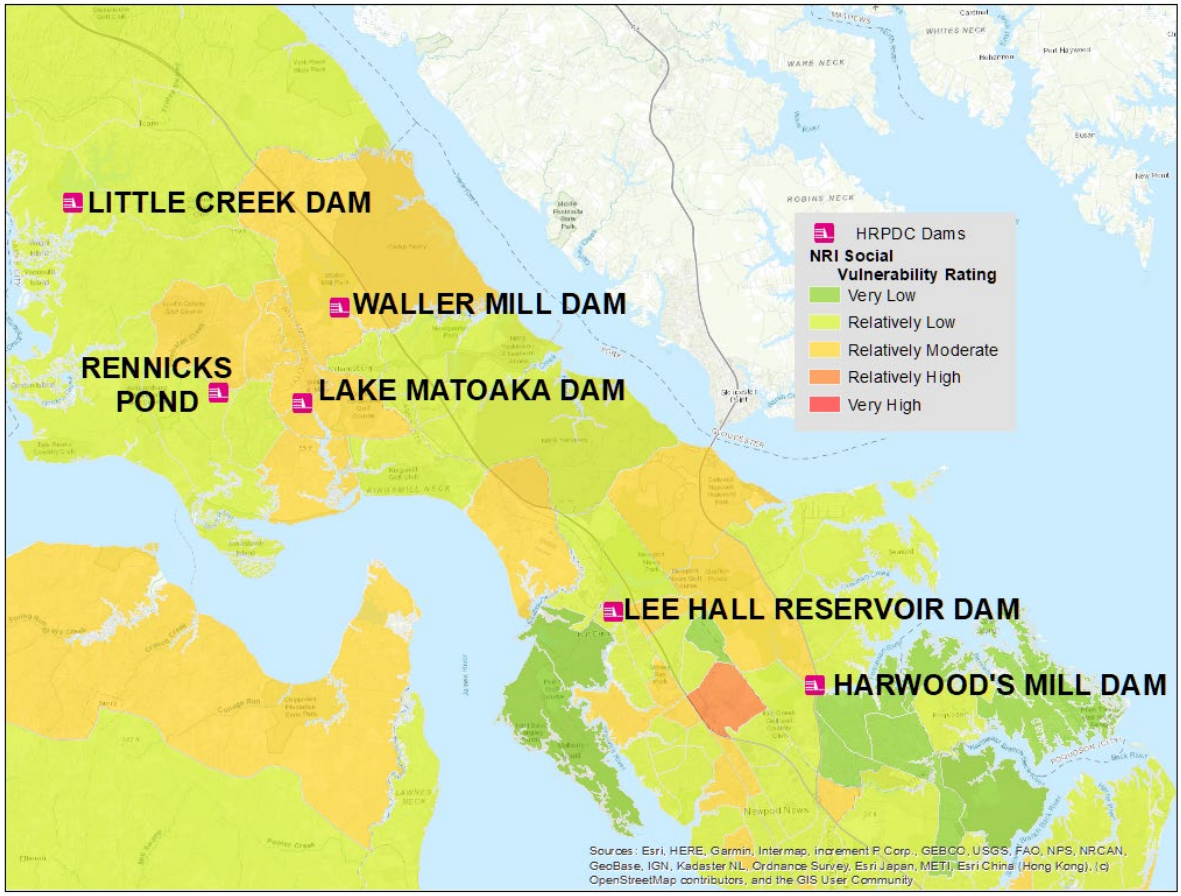
Based on historical experience and the fact that the dams in the study area are aging, precipitation patterns are increasingly more frequent and severe as a result of climate change, and the dams are categorized as High Hazard, there is a moderate probability of a future event involving a dam or levee failure in the study area. As climate change alters precipitation patterns, including frequency and quantity, the adequacy, safety and protection levels of all dams (not just high hazard potential dams) will need continuous evaluation.

SOCIAL VULNERABILITY

The locations of the study area high hazard potential dams were overlaid on the foundational social vulnerability map from the NRI. The analysis, as shown in **Figures 5.13 and 5.14**, indicates that 7 dams are located in areas of Relatively Moderate social vulnerability (no dams were in areas of Very High or Relatively High social vulnerability): Waller Mill Dam, Lake Matoaka Dam, Harwood's Mill Dam, B-1 Pond Dam, B-2 Pond Dam, ASB Pond Dam and C-Pond Dam. All other dams are in Relatively Low or Very Low areas of social vulnerability.

According to DCR, social vulnerability is a factor in assessing grant applications prepared by dam owners in Hampton Roads. Project engineers are also responsible for addressing impacts on historical and cultural impacts in accordance with state and federal regulations.

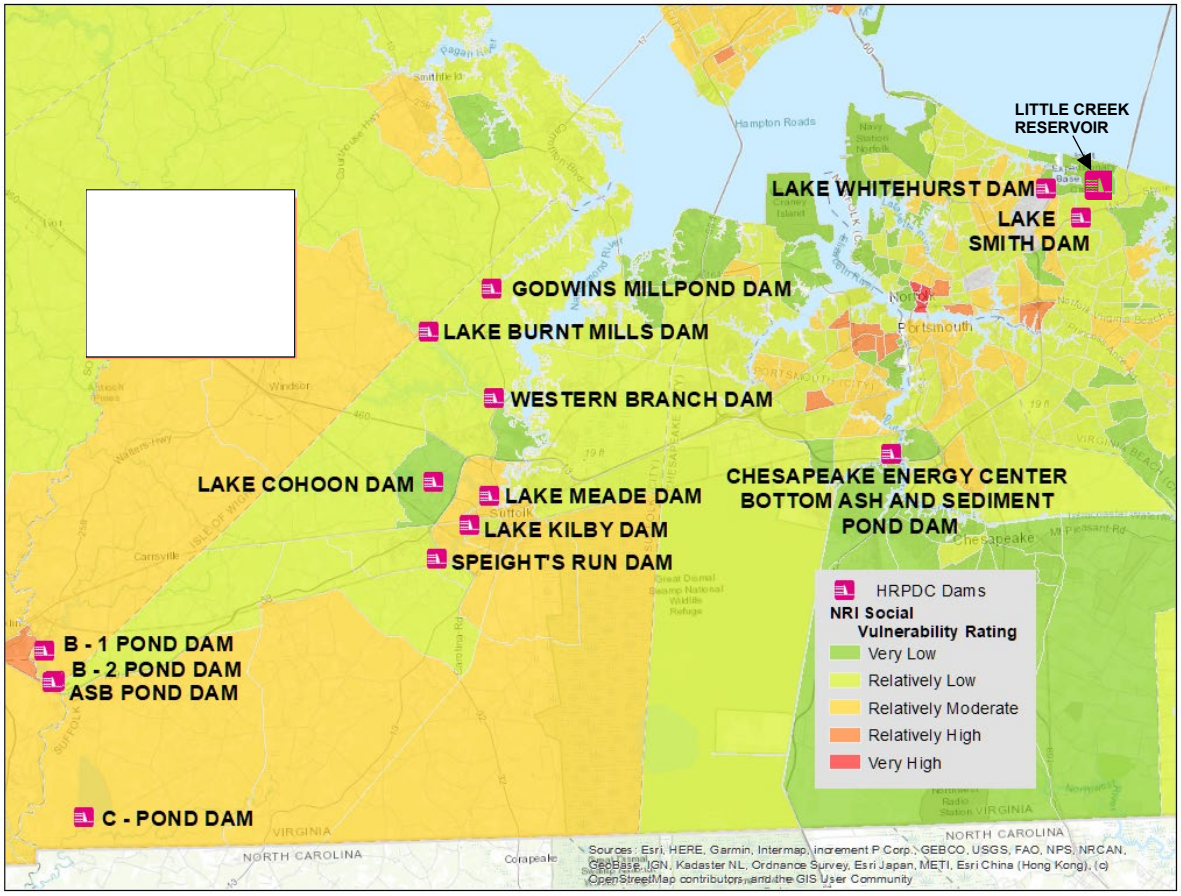
FIGURE 5.13: HIGH HAZARD POTENTIAL DAMS, PENINSULA



2021

Source: DCR, 2021

FIGURE 5.14: HIGH HAZARD POTENTIAL DAMS, SOUTHSIDE



2021

Source: DCR, 2021

SEA LEVEL RISE AND LAND SUBSIDENCE

Historical evidence shows that much of the Hampton Roads region is already experiencing some degree of sea level rise and land subsidence. As discussed in the *Hazard Identification and Analysis* section, data from Sewells Point at the Norfolk Naval Base indicate that sea level in the past 93 years has risen at a rate of approximately 4.73 millimeters per year and sea level rise at that rate is expected to continue and possibly accelerate. Vulnerability to sea level rise can be looked at in terms of economic losses resulting from future flood event damages, and by examining expectations for future land use and development patterns and highlighting what infrastructure and real estate will potentially be affected by rising tides. In both cases, this analysis assumes somewhat static conditions with regard to flood mitigation capabilities. A changing regulatory climate, development pressure, large-scale mitigation or resiliency projects, and changes in economic conditions or financial capabilities, for example, could dramatically affect the impact of sea level rise in the region. Additionally, HRSD's SWIFT program is an innovative water treatment project in eastern Virginia that is taking highly treated water that would otherwise be discharged into the region's waterways, and putting it through additional rounds of advanced water treatment. The SWIFT water is then added to the Potomac Aquifer and helping to slow or even revers the sinking of land due to groundwater withdrawals.

HRPDC has compiled a list of sea level rise viewing tools, some of which include data to help visualize the various types of risk posed by sea level rise and land subsidence:
Vulnerable Infrastructure - Buildings, roads, and critical facilities;
Societal Exposure - Demographic data summaries and socially vulnerable communities; or
Environmental Change - Marsh migration and shoreline condition.

ONLINE TOOLS	SEA LEVEL RISE SCENARIOS	INFRASTRUCTURE IMPACTS	SOCIETAL IMPACTS	ENVIRONMENTAL IMPACTS
ADAPT VIRGINIA INTERACTIVE MAP	Low, intermediate, and extreme scenarios for 2020-2100	✓	✓	✓
CCRFR SEA LEVEL RISE TOOL	NOAA Intermediate High Scenario for 2040, 2060, and 2080	✓	✗	✗
CLIMATE CENTRAL'S COASTAL RISK SCREENING TOOL	Map sea level rise by year (2030-2100) or water level.	✗	✗	✗
CLIMATE CENTRAL'S SURGING SEAS RISK FINDER	Map by water level for a specific city. Summary fact sheets and graphs available.	✓	✓	✗
NOAA COASTAL FLOOD EXPOSURE MAPPER	Map by water level. User can save and export maps.	✓	✓	✓
NOAA'S SEA LEVEL RISE VIEWER	Map by water level or local scenarios (2020-2100).	✗	✓	✓

Adapt Virginia Interactive Map (Virginia only)

CCRFR Sea Level Rise Tool (Virginia only)

Climate Central's Coastal Risk Screening Tool

Climate Central's Surging Seas Risk Finder

NOAA Coastal Flood Exposure Mapper

NOAA Sea Level Rise Viewer

ESTIMATES OF POTENTIAL LOSSES

Detailed economic loss estimates for long-term sea level rise and land subsidence are difficult to develop because the response of individual property owners and governmental entities to sea level rise is inherently unpredictable and variable over both time and space. Regional experience over the past 50 years indicates that shoreline protection measures will be reinforced to protect threatened structures, hindering the ability of wetlands and shorelines to adjust naturally as the water level rises. Therefore, models based on permanent inundation of developed areas, and which assume inundation means destruction of the built environment, can dramatically overstate losses.

In 2020, the City of Virginia Beach conducted a detailed analysis of annual average flood-related losses for current conditions, 1.5 feet of sea level rise in the 2040s, and 3 feet of sea level rise in the 2070s primarily using lowest floor elevations, HAZUS and depth-damage curves. Average annual losses today are estimated to be $26 million, and expected to be $77 million in the 2040s. In the 2070s, that loss estimate balloons to 12 times current conditions, at $329 million average annual losses.[5] Applying these ratios to Hampton Roads has some relevance due to similarities in the flood risks and growth patterns faced by the coastal communities, especially on the lower Peninsula and Southside areas. The current estimate of average annual flood losses in Hampton Roads as a result of this study is $44.2 million, which would translate into $130.8 million by the 2040s, and over $558.6 million annually by the 2070s. This is the average annual damage figure chosen as a basis for this plan analysis.

Different methodologies have produced additional predictions of the annualized flood damages in the future caused by sea level rise. The *Virginia Coastal Resilience Plan, Phase I, 2021*, estimates that statewide between 2020 and 2080, "the number of residential, public, and commercial buildings exposed to an extreme coastal flood is projected to increase by almost 150% from 140,000 to 340,000, while annualized flood damages increase by 1,300% from $0.4 to $5.1 billion."[6]

Another methodology for estimating average annual losses expected from sea level rise was supported by FEMA many years ago. The agency issued a report to Congress documenting the estimated impact of relative sea level rise on the Flood Insurance Rate Maps, *Projected Impact of Relative Sea Level Rise on the National Flood Insurance Program*, FEMA, October 1991, http://papers.risingsea.net/Flood-Insurance.html. The agency estimates that existing development in the coastal zone would experience a 36% to 58% increase in annual damages for a 1-foot rise in sea level by 2100, and a 102% to 200% increase resulting from a 3-foot rise by 2100. Applying these [albeit outdated] ratios to the current average annual flood losses, the result is $60-70 million from 1 foot sea level rise, increasing to $89-133 million with the expected 3-foot increase.

[5] *Coastal Flooding and Economic Loss Analysis: City of Virginia Beach, Virginia*. March 30, 2020. Available online at: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/20200330_FloodRiskAnalysis_Final_(2).pdf

[6] *Virginia Coastal Resilience Master Plan, Phase One,* December 2021. Summary available online at: https://www.dcr.virginia.gov/crmp/plan.

The lack of detailed elevation information for the existing pre-FIRM and post-FIRM building inventory in much of Hampton Roads further hinders efforts to calculate detailed future average annual flood damages using increasing 100-year flood elevations, especially outside of the current SFHA. For example, calculations of sea level rise losses may be supported by the argument that areas below a certain elevation will be permanently inundated and evacuated. The FEMA study assumes that the current elevation distribution of post-FIRM construction relative to the 100-year flood elevation holds steady for future construction, when in fact many communities in the region have already implemented and are enforcing freeboard requirements, and many base flood elevations recently changed as a result of a restudy of coastal areas. The obsolescence of buildings is not accounted for in the FEMA predictions; presumably, the number of pre-FIRM and post-FIRM buildings built to outmoded floodplain management standards should decline with time. Replacement structures must be in compliance with NFIP regulations in effect at the time of their construction, and are thus better protected from flood (and wind) damage. Some communities, such as Hampton, are also adopting requirements for freeboard outside of the SFHA.

Recent research in other regions is estimating the negative impact from flooding and sea level rise on gross domestic product. In other words, this research is attempting to estimate overall impacts to the economy rather than just accumulating damage or losses to affected structures, families and businesses. There may be applications for this research in the Hampton Roads region in the future.

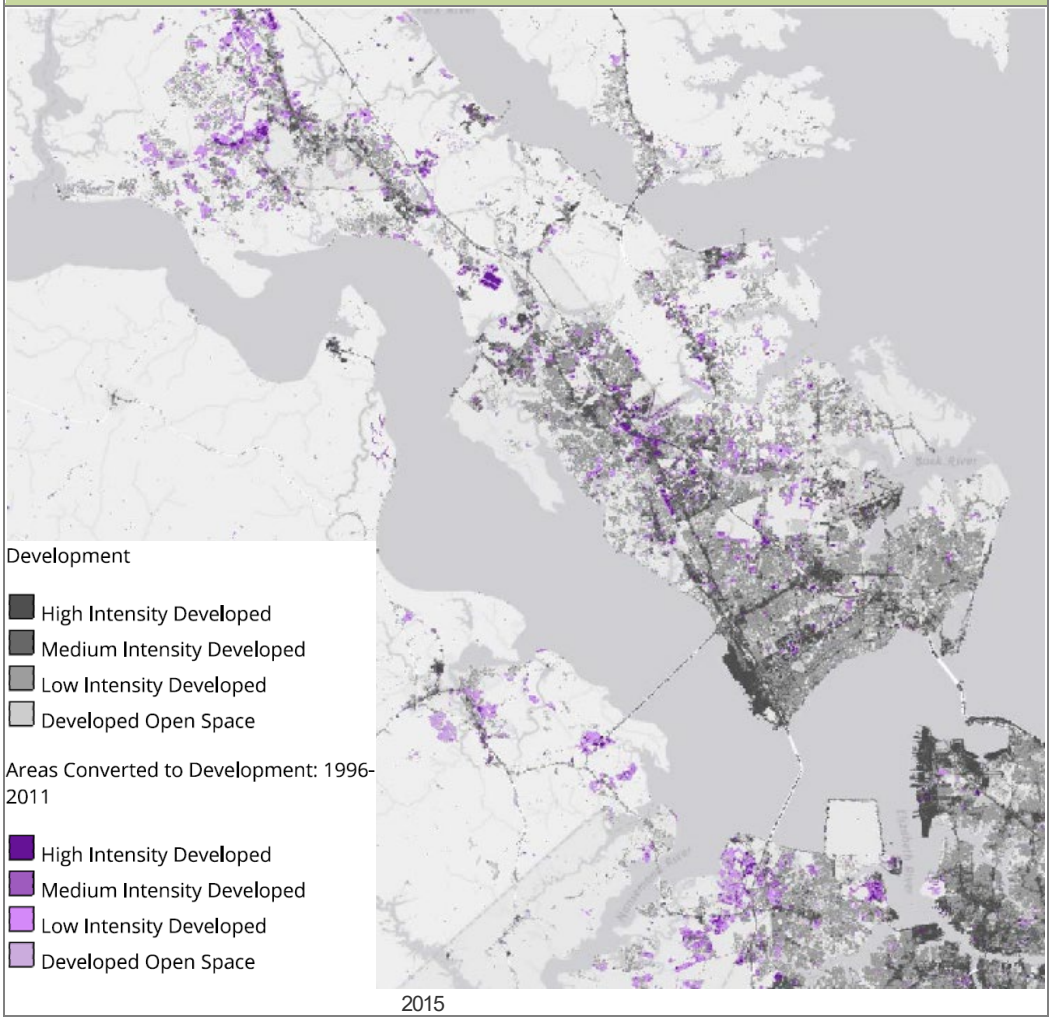
Communities in need of more detailed annualized estimates for the economic impacts of sea level rise in future scenarios, to include impacts to infrastructure and individual structures, must address three primary data needs:

1. Lowest floor elevations for all structures in and near the existing SFHA;
2. HAZUS Level 2 or Level 3 analysis for multi-frequency flood events and flood depths, with various scenarios for sea level rise, to provide sufficient results for annualization; and,
3. The functional, physical or economic obsolescence of existing development, and the variable requirements for flood-safe design for new construction.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

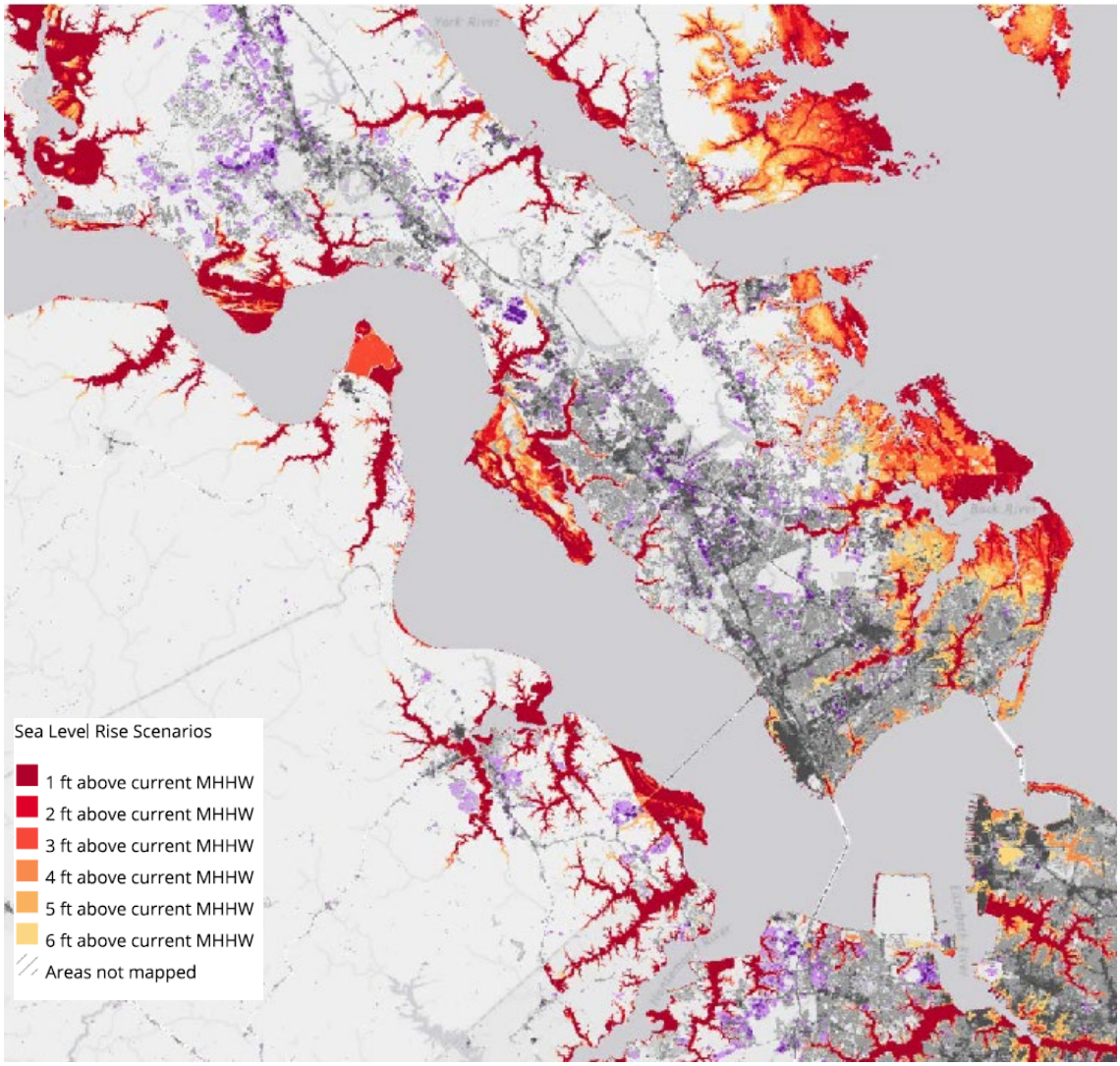
The NOAA Coastal Flood Exposure Mapper tool (http://www.coast.noaa.gov/floodexposure/#/map) uses recent land cover data to show where areas being developed may be impacted by varying levels of sea level rise. This tool can help provide planners with information needed to focus sea level rise mitigation efforts geographically. Summary maps are shown for each Hampton Roads subregion in **Figures 5.15 through 5.20**.

FIGURE 5.15: DEVELOPMENT PATTERNS, PENINSULA



Source: NOAA Coastal Flood Exposure Mapper

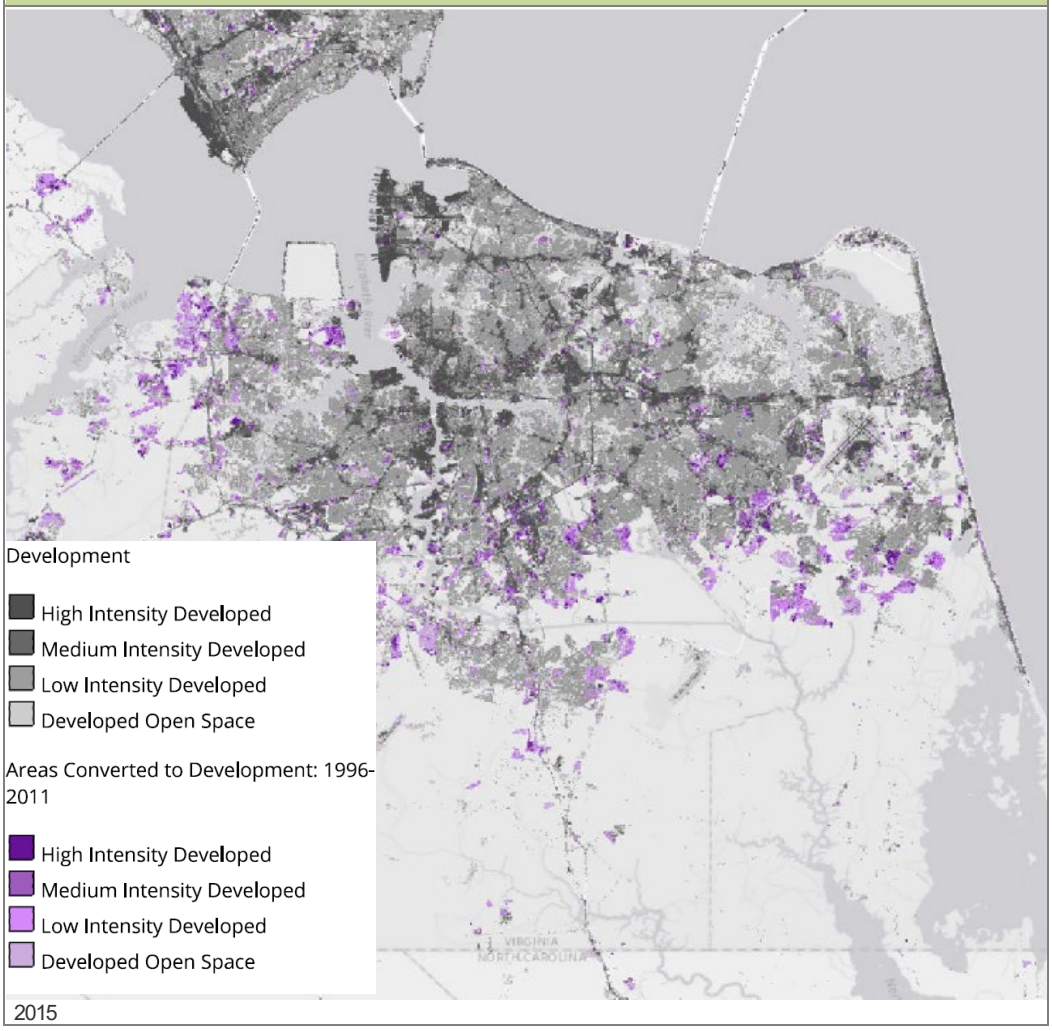
FIGURE 5.16: SEA LEVEL RISE SCENARIOS, PENINSULA



2015

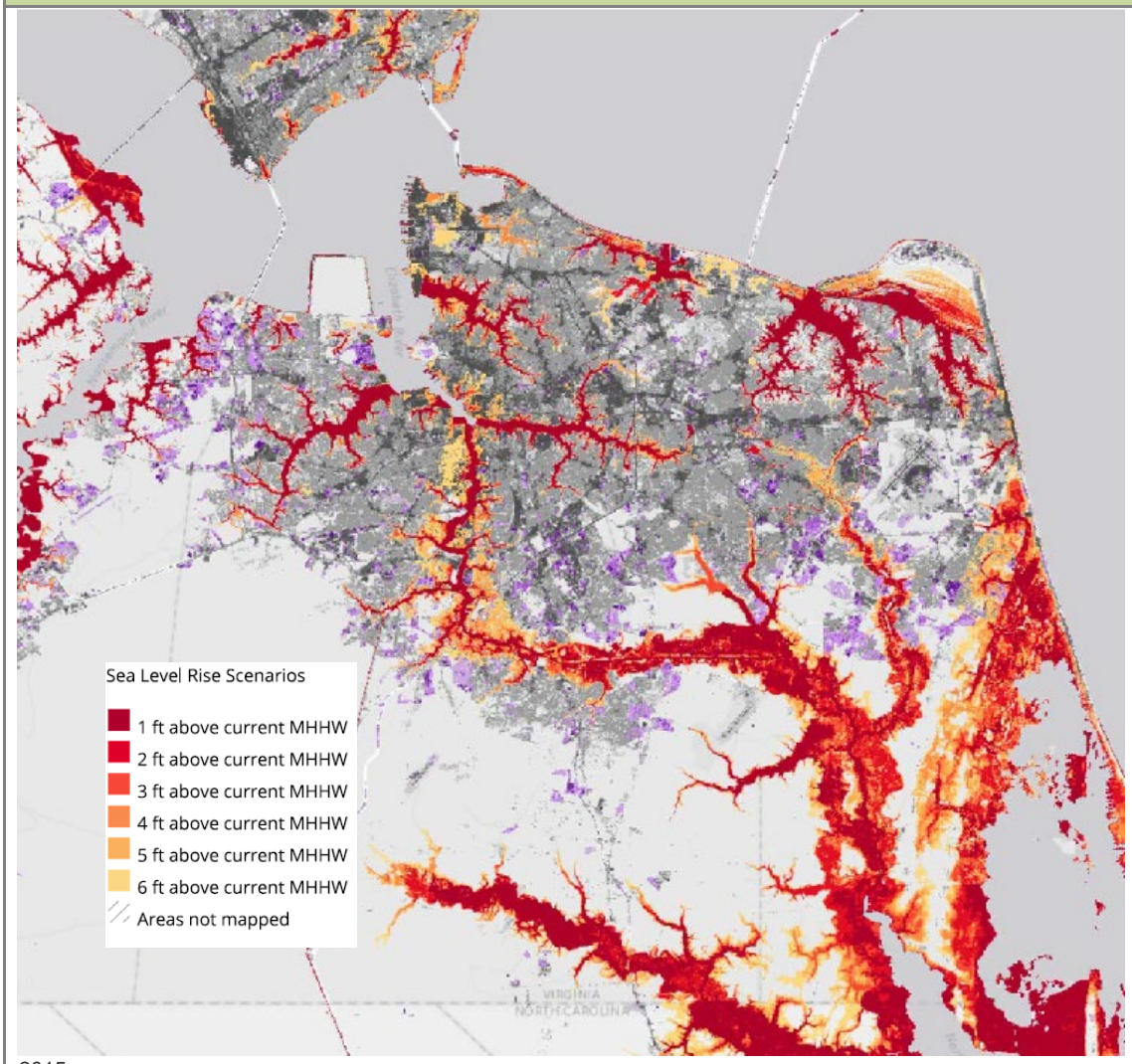
Source: NOAA Coastal Flood Exposure Mapper

FIGURE 5.17: DEVELOPMENT PATTERNS, SOUTHSIDE



Source: NOAA Coastal Flood Exposure Mapper

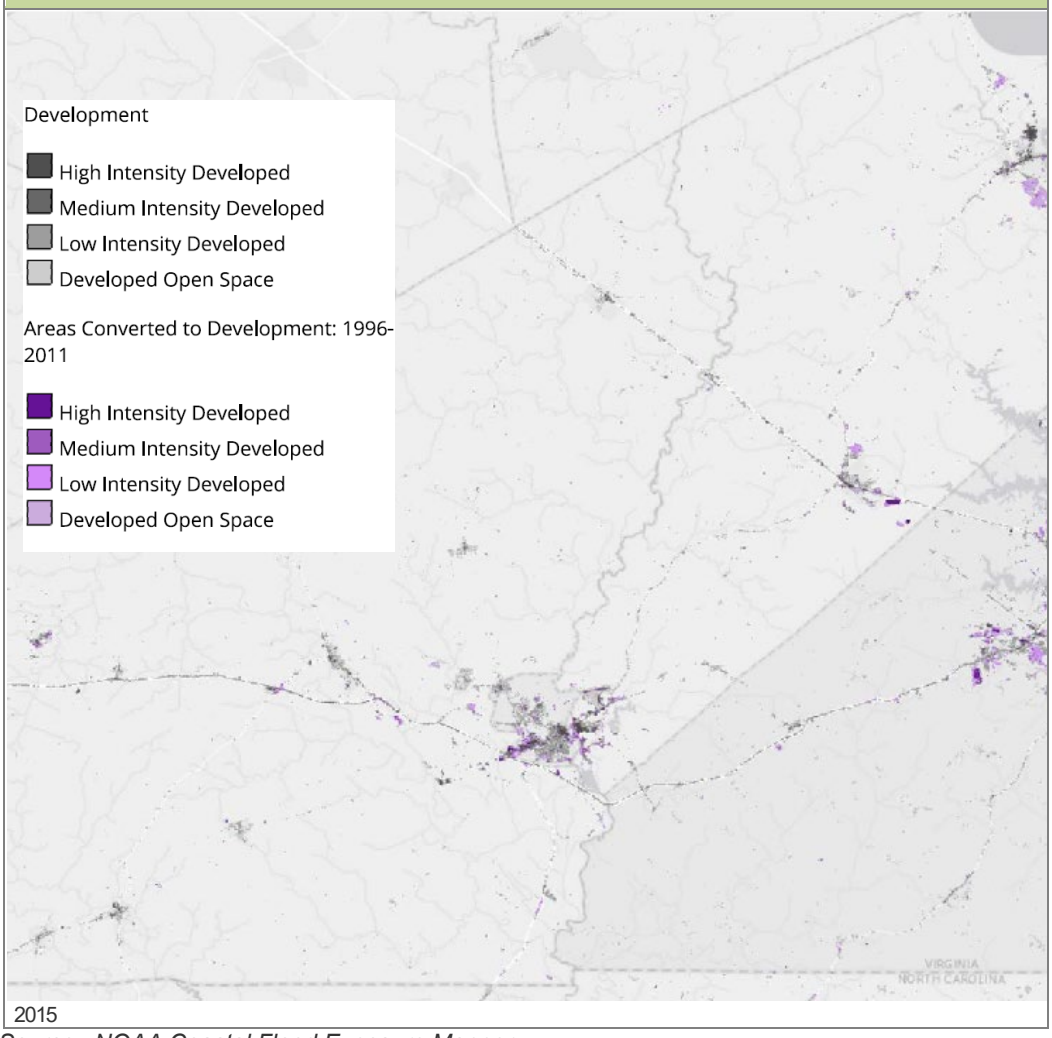
FIGURE 5.18: SEA LEVEL RISE SCENARIOS, SOUTHSIDE



2015

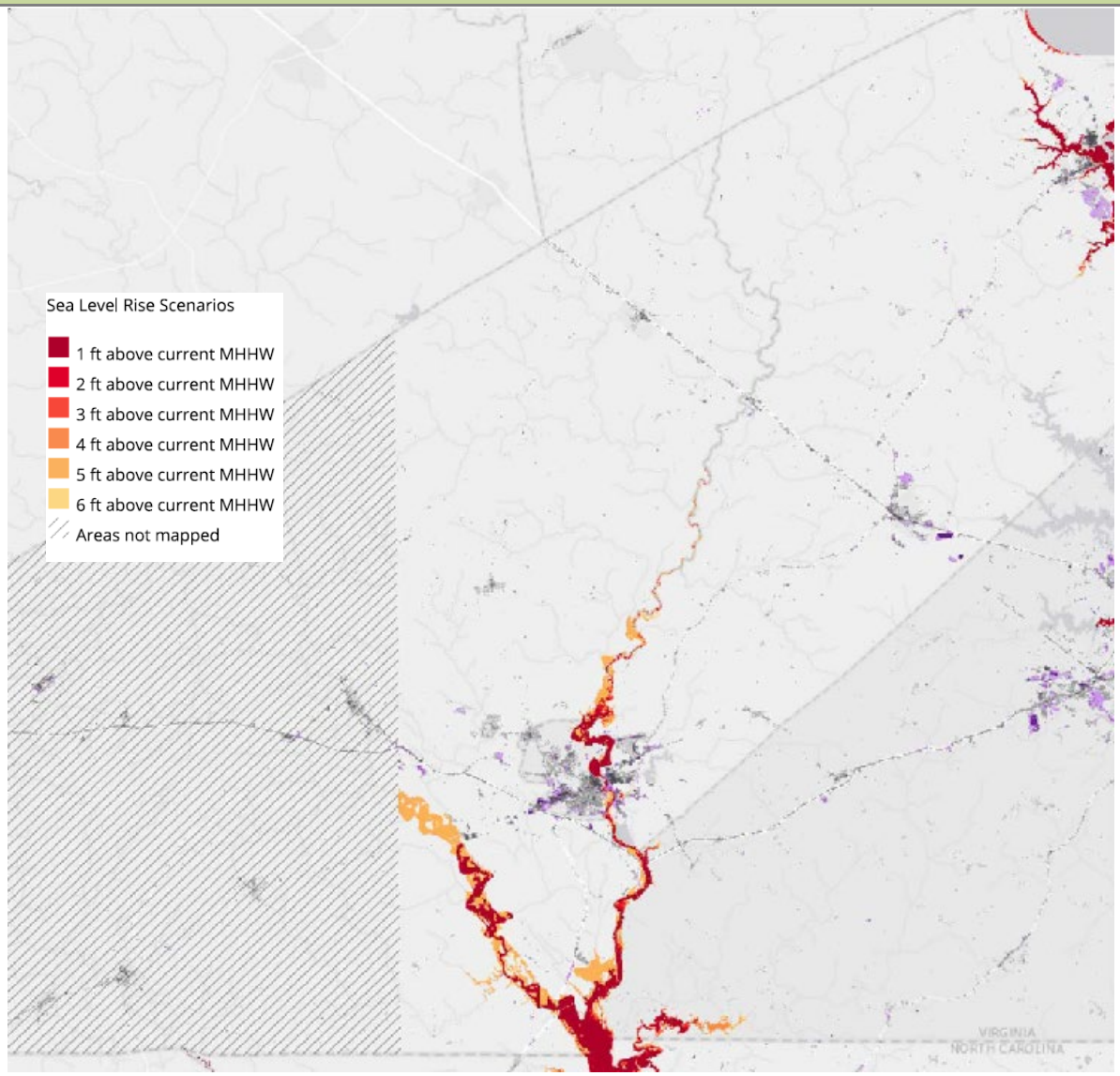
Source: NOAA Coastal Flood Exposure Mapper

FIGURE 5.19: DEVELOPMENT PATTERNS, WESTERN TIDEWATER



Source: NOAA Coastal Flood Exposure Mapper

FIGURE 5.20: SEA LEVEL RISE SCENARIOS, WESTERN TIDEWATER



Source: NOAA Coastal Flood Exposure Mapper

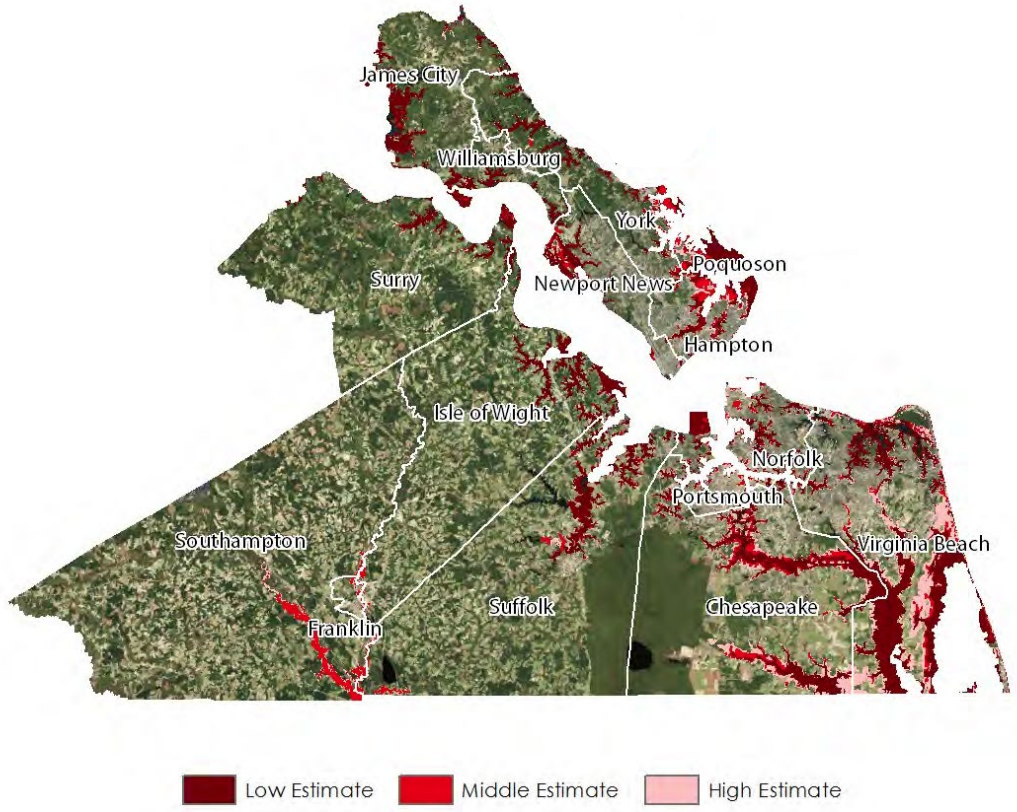
In a 2012 report entitled *Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia,* HRPDC compiled maps and data to document those areas of the region that are exposed to one meter of sea level rise above spring high tide **(Figure 5.21)**. **Table 5.8** summarizes the report's findings, which highlight over $8.7 billion of vulnerability or exposure in the built environment. Norfolk, Virginia Beach and Chesapeake are the Hampton Roads communities with the highest population exposed to sea level rise. Hampton is fourth on the list and even has a larger number of housing units exposed than Chesapeake. Poquoson is a smaller community, but with a very high percentage of its land area and population exposed, the City must deal with the increasing vulnerability as frequency of damaging flooding increases. The exposure to sea level rise is lowest in the western part of the study area, including Southampton County and Franklin, where sea level rise may cause some moderate changes in river levels, but is not expected to have the dramatic impacts on homes, roads and businesses that it will in the eastern portion of the study area.

TABLE 5.8: EXPOSURE TO ONE METER SEA LEVEL RISE ABOVE SPRING HIGH TIDE (MIDDLE ESTIMATE)

SUBREGION	COMMUNITY	LAND AREA (square miles)	POPULATION	HOUSING UNITS	ROADS (total miles)	BUSINESSES
Peninsula	Hampton	12.6	14,066	6,011	97.0	263
	Newport News	9.5	4,321	1,896	8.3	28
	Poquoson	11.8	6,770	2,597	38.7	115
	Williamsburg	0.2	275	137	0.1	0
	James City County	14.9	1,796	835	4.5	12
	York County	11.0	5,483	2,195	34.6	64
Southside	Norfolk	6.5	24,715	8,955	75.5	532
	Portsmouth	7.0	4,655	2,089	17.5	127
	Suffolk	14.4	4,691	1,715	4.7	21
	Virginia Beach	58.0	21,160	10,051	66.9	389
	Chesapeake	32.4	15,983	5,731	65.2	380
Western Tidewater	Isle of Wight County	13.4	3,046	1,263	2.0	16
	Franklin	0.6	74	33	0.1	0
	Southampton County	7.8	149	64	2.0	1
	Surry County	5.4	107	59	1.3	0
TOTALS		**206**	**107,291**	**43,631**	**418**	**1,948**

Source: *Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia.* HRPDC, July 2012.

FIGURE 5.21: AREAS EXPOSED TO ONE METER OF SEA LEVEL RISE ABOVE SPRING HIGH TIDE



Disclaimer: This map is for informational purposes only. Areas depicted as vulnerable are based on estimates only and should not be construed as being in imminent danger of inundation. The analysis depicted does not account for flood protection or control infrastructure. This map should not be used in place of official FEMA flood insurance rate maps. Users agree to hold harmless and blameless the Hampton Roads Planning District Commission and its representatives and its agents for any liability associated with the use of this map.

2012

Source: Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia. HRPDC, July 2012.

SOCIAL VULNERABILITY

The National Risk Index does not include a risk or vulnerability analysis specific to sea level rise or land subsidence. In 2018, Virginia Beach conducted a very detailed analysis of socially vulnerable demographic groups using 2010 Census data, population projections, population distribution, as well as current and future 100-year floodplains, to more accurately assess the number of people at risk under current and future sea level rise scenarios. The conclusion was that the elderly population of Virginia Beach experiences a marginally disproportionate risk to coastal flood hazards, and that for every 1.5 feet of sea level rise, the percentage of people at risk to coastal flooding will double from present conditions. Currently, 6.5% of the population is at risk; with 1.5 feet of sea level rise, 12.5% of the population will be at risk; and with 3 feet of sea level rise, approximately 26-percent of the population will be at risk. Other demographic groups were not shown to have a disproportionate risk to coastal flood hazards.[7] The detailed study methodology used in Virginia Beach represents a possible methodology for additional study of social vulnerability to sea level

[7] *Demographic and Population Vulnerability Analysis: City of Virginia Beach, Virginia*, September 13, 2018. Accessed online at: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/new%20PWCN-15-0014_WO12B_SocialVulnerability_Final_20180913.pdf

rise in all of Hampton Roads. Study of patterns of flood insurance coverage and other mitigation techniques could be incorporated into the analysis. The Virginia Beach results and conclusions may not necessarily apply broadly across the region due to variation in development patterns and population change; however, the disproportionate impact on the elderly compared to other vulnerable groups included in the analysis (people of color, children under five years old, institutionalized people, people with limited English proficiency, people with limited income, and people with disabilities) is noteworthy for mitigation planning purposes.

TROPICAL/COASTAL STORM

Historical evidence shows that Hampton Roads is vulnerable to damaging storm-force winds, whether associated with coastal storms like nor'easters, or tropical storms such as hurricanes. As discussed in detail in the *Hazard Identification and Analysis* section, 76 hurricanes and tropical storms have passed within 75 miles of the region since 1851. This equates to a 45-percent annual chance that a storm will similarly impact the region.

ESTIMATES OF POTENTIAL LOSSES

Detailed loss estimates for the wind damage associated with the tropical storm hazard were developed based on probabilistic scenarios using Hazus (Level 1 analysis). **Table 5.9** shows estimates of potential building damage for the 100-year return period, and annualized total losses. In summary, the region may be susceptible to an estimated total of approximately $1.65 billion in building damages from a 100-year wind event.

TABLE 5.9: ESTIMATES OF POTENTIAL BUILDING DAMAGE – WIND ONLY

SUBREGION	COMMUNITY	BUILDING DAMAGE	CONTENTS & INVENTORY DAMAGE	TOTAL*	ANNUALIZED TOTAL LOSSES
Peninsula	Hampton	$91,781,000	$42,021,000	$138,514,000	$7,265,000
	Newport News	$53,985,000	$10,663,000	$68,841,000	$5,035,000
	Poquoson	$9,575,000	$3,971,000	$13,874,000	$670,000
	Williamsburg	$1,366,000	$392,000	$1,766,000	$236,000
	James City County	$10,477,000	$3,944,000	$14,428,000	$1,841,000
	York County	$35,966,000	$18,024,000	$55,067,000	$2,997,000
Southside	Norfolk	$168,291,000	$28,515,000	$213,399,000	$10,494,000
	Portsmouth	$48,722,000	$8,960,000	$61,573,000	$3,824,000
	Suffolk	$23,969,000	$6,293,000	$31,191,000	$3,031,000
	Virginia Beach	$579,495,000	$190,242,000	$815,974,000	$37,078,000
	Chesapeake	$160,748,000	$55,549,000	$224,879,000	$12,459,000
Western Tidewater	Isle of Wight County	$8,008,000	$2,592,000	$10,789,000	$1,174,000
	Franklin	$381,000	$110,000	$491,000	$207,000
	Southampton County	$650,000	$268,000	$919,000	$437,000
	Surry County	$332,000	$142,000	$474,000	$165,000
Totals		**$1,193,746,000**	**$371,686,000**	**$1,652,179,000**	**$86,913,000**

* Also includes income losses from relocation, lost wages, and lost rental income.
Source: Hazus

Based on the data in Table 5.9, Virginia Beach, Chesapeake and Norfolk have the highest annualized total losses from wind associated with a 100-year wind event. These communities are also the most vulnerable for flood, so these 3 communities are considered the most vulnerable to the combined wind and flooding effects of Tropical Storms. Hampton and Newport News are also very vulnerable to wind effects from the 100-year wind event. Franklin, Williamsburg, Surry County and Southampton County are significantly further inland and are less likely to experience the devastating impacts of the remainder of Hampton Roads. Franklin has annualized wind-related damages of only $207,000; a small portion of the $37 million calculated for Virginia Beach.

Hazus was also used to produce building damage estimates based on percentage of damage (by damage state) for the 100-year return period (**Table 5.10**).

TABLE 5.10: NUMBER OF BUILDINGS DAMAGED, BY DAMAGE STATE[8], 100-YEAR WIND EVENT

OCCUPANCY TYPE	MINOR	MODERATE	SEVERE	DESTRUCTION
Residential	29,180	3,407	70	68
Commercial	1,214	204	20	0
Industrial	307	45	8	0
Other	287	36	5	1
TOTAL	**30,988**	**3,692**	**103**	**69**

Source: Hazus

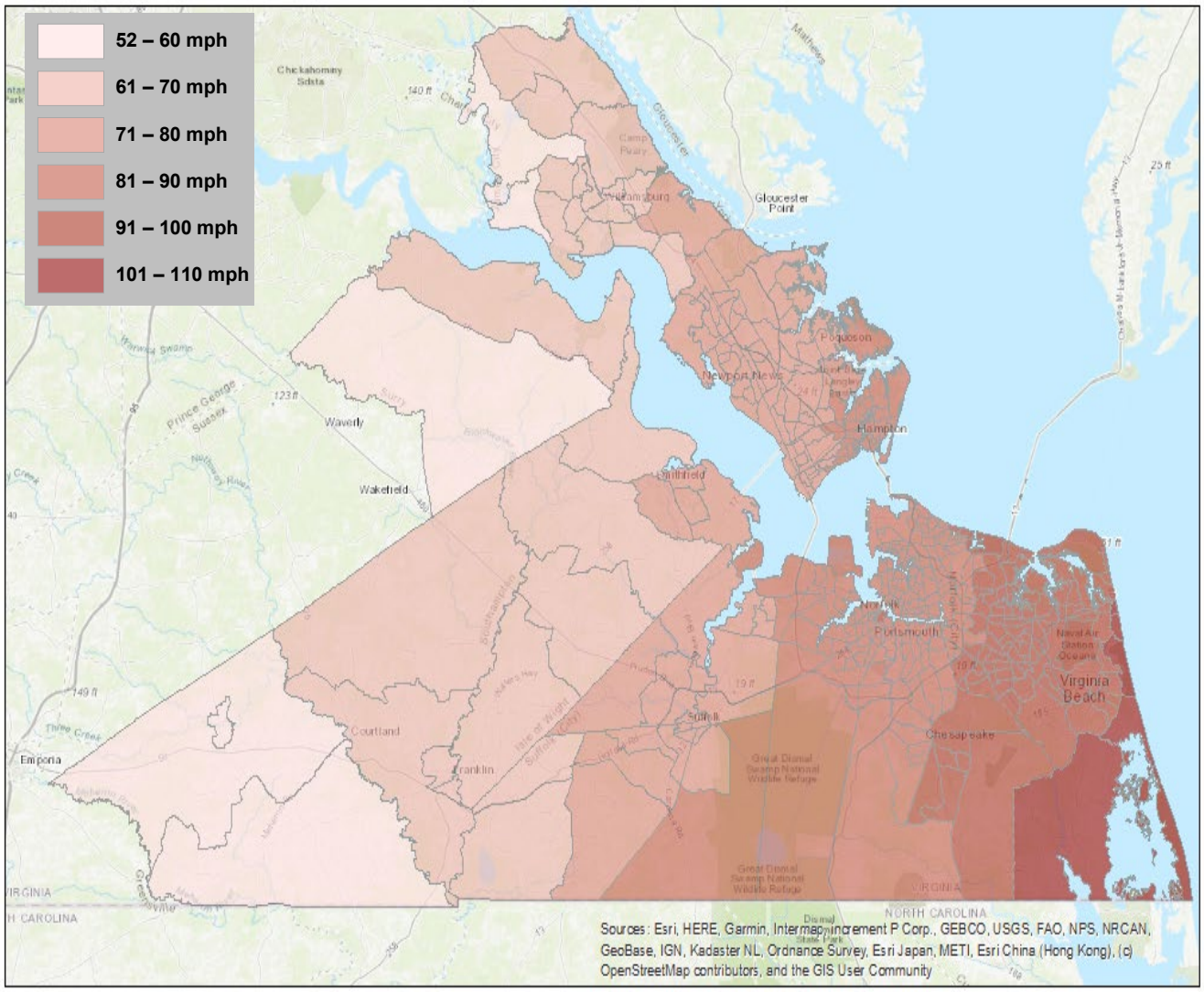
FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

The type of building construction has a significant impact on potential damages from high wind events in the future, as type of construction is also a key factor in determining the life of a structure. Basic building types in declining order of wind vulnerability are manufactured, non-engineered wood, non-engineered masonry, lightly engineered and fully engineered buildings. According to the HAZUS study, the primary construction type in the study area is wood framed (61 percent), varying from single story to multiple stories, although some masonry and steel properties are present as well. With the prevalence of non-engineered, wood-framed structures throughout the Hampton Roads region, a majority of structures in the area could be classified as having a high level of vulnerability to damages due to a high wind event in the future. Using HAZUS, an analysis of the damage caused by a 100-year frequency wind event indicates that 22,632 wood-framed structures would have minor, moderate, severe or destruction damage, while 10,346 masonry structures would have minor, moderate, severe or destruction damage.
All future structures built in the Hampton Roads region will likely be exposed to hurricane and tropical storm-force winds and may also experience damage not accounted for in the loss estimates presented in this section, with the highest vulnerability in structures near the Atlantic coast as shown in **Figure 5.22**, which show vulnerability to 100-year peak gusts by Census tract for the region. The State's Uniform Statewide Building Code continues to reduce vulnerability of newly constructed buildings to the wind hazard.

The VASEM 2021 report concludes that the research on climate change impacts in the study region is conflicted regarding increased frequency of Atlantic Coast hurricanes. However, the report indicates consensus among the researchers that there will be an increase in average cyclone intensity, precipitation rates, and the number of strong storms. Strong storms combined with sea level rise are particularly alarming for the eastern region of the study area. Even in rural areas in the western portion of the study area, increasing storm intensity can damage crops and soil in addition to vulnerable agricultural structures.

[8] For detailed definitions of the four damage states, please refer to the HAZUS-MH User Manual for the Hurricane Model.

FIGURE 5.22: 100-YEAR RETURN PERIOD PEAK GUST (MPH) BY CENSUS TRACT



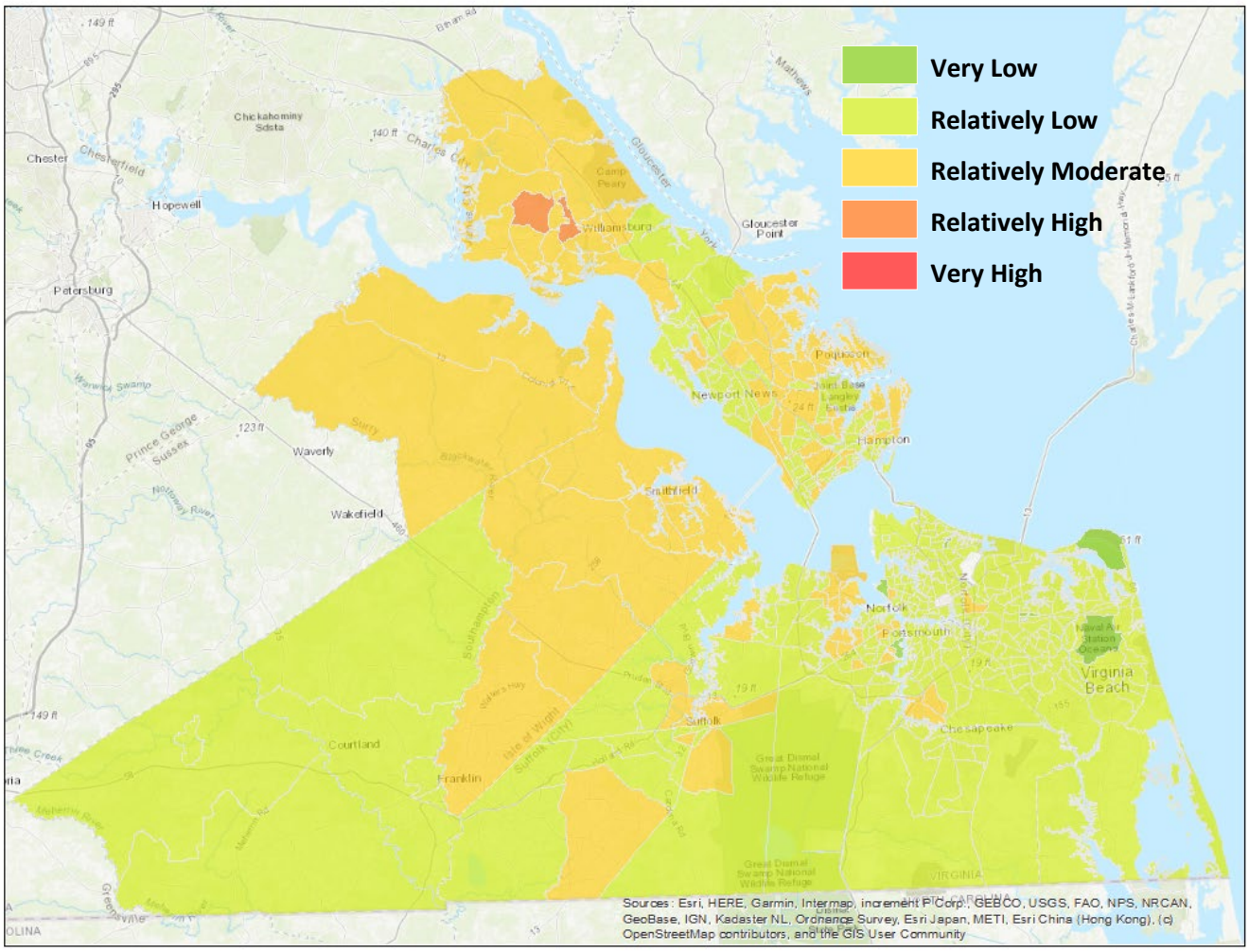
2021

Source: Hazus

SOCIAL VULNERABILITY

The NRI hurricane risk ratings by Census tract, which include a factor for social vulnerability, are shown in **Figure 5.23**. Most of the southern portion of the study area is shown as having low risk, while much of the Peninsula, Surry County and Isle of Wight County have relatively moderate risk. The Williamsburg area is shown as having relatively high social vulnerability to hurricane. This rating seems out of sync with local experience, and may be a result of the lower reported occurrences of hurricane damage in the NCEI database. When compared to the NRI hurricane risk ratings for North Carolina tracts just south of the state line, the Virginia ratings are remarkably lower.

FIGURE 5.23: NATIONAL RISK INDEX, HURRICANE RISK RATING



2021

Source: National Risk Index, 2021

LANDSLIDE/COASTAL EROSION

As documented in the *Hazard Identification and Analysis* section, the Hampton Roads region is vulnerable to the long term effects of both landslide and coastal erosion. Coastal erosion remains a significant hazard of concern that must continue to be addressed through sustained shoreline management practices. To date, existing strategies for shoreline hardening and the implementation of numerous replenishment projects have been successful in minimizing major coastal erosion losses within parts of the planning region.

ESTIMATES OF POTENTIAL LOSSES

It is difficult to determine the amount of property or the number of structures that are vulnerable to the erosion or landslide hazard. The jurisdictions in the region have demonstrated, through past projects such as the Virginia Beach Erosion Control and Hurricane Protection Project that they are willing to take on projects to protect coastal residences and commercial buildings in the hazard zone. Landslides are a much less frequent historical occurrence and are typically addressed by the landowner with little government involvement.

The Comprehensive Coastal Inventory Program (CCI) at VIMS has created a GIS shoreline database to develop revised Shoreline Situation Reports (SSR) for cities and counties in the region. SSRs were developed by VIMS in the 1970s, and are available online at: http://ccrm.vims.edu/gis_data_maps/index.html. These reports have been the foundation for shoreline management planning in the region for more than 30 years. CCI has developed new protocols for collecting, disseminating, and reporting data relevant to shoreline management issues today. New SSRs are currently available online at: http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/. Southampton County and Franklin are not included in the Chesapeake Bay Shoreline Inventory project.

The data inventory developed for the new SSRs is based on a three-tiered shoreline assessment approach. In most cases this assessment characterizes conditions that can be observed from high resolution imagery. A small boat navigating along the shoreline was used to verify the remotely sensed data and collect features that could not be ascertained from the imagery. The three tiered shoreline assessment approach divides the shore zone into three regions: 1) the immediate riparian zone, evaluated for land use; 2) the bank, evaluated for height, stability, cover and natural protection; and 3) the shoreline, describing the presence of shoreline structures for shore protection and recreational purposes. Final prepared maps are available online at the site noted above. Although the maps alone do not indicate potential loss from erosion, they provide areas for future study and indicate where shoreline structure protection is currently in place to protect against coastal erosion.

Figure 5.24 provides a sample of the maps available in the SSR for the City of Hampton.

The Atlantic Ocean shorelines in Virginia Beach and Norfolk are the most vulnerable areas of Hampton Roads with regard to coastal erosion. The fetch for tropical storms and nor'easters is sufficient to create wind-driven waves that cause significant damage on a regular basis. The Chesapeake Bay shorelines of Hampton, Poquoson and Norfolk are also susceptible to wind-driven wave action that causes coastal shoreline erosion. The James River and York River are deep and wide enough to cause some shoreline erosion in Suffolk, Isle of Wight County, Newport News, York County, Surry County and James City County. Riverine erosion in Franklin and Southampton County, while not as dangerous to people and homes, creates limited vulnerability to infrastructure and the built environment.

FIGURE 5.24: BANK CONDITIONS, HAMPTON RIVER

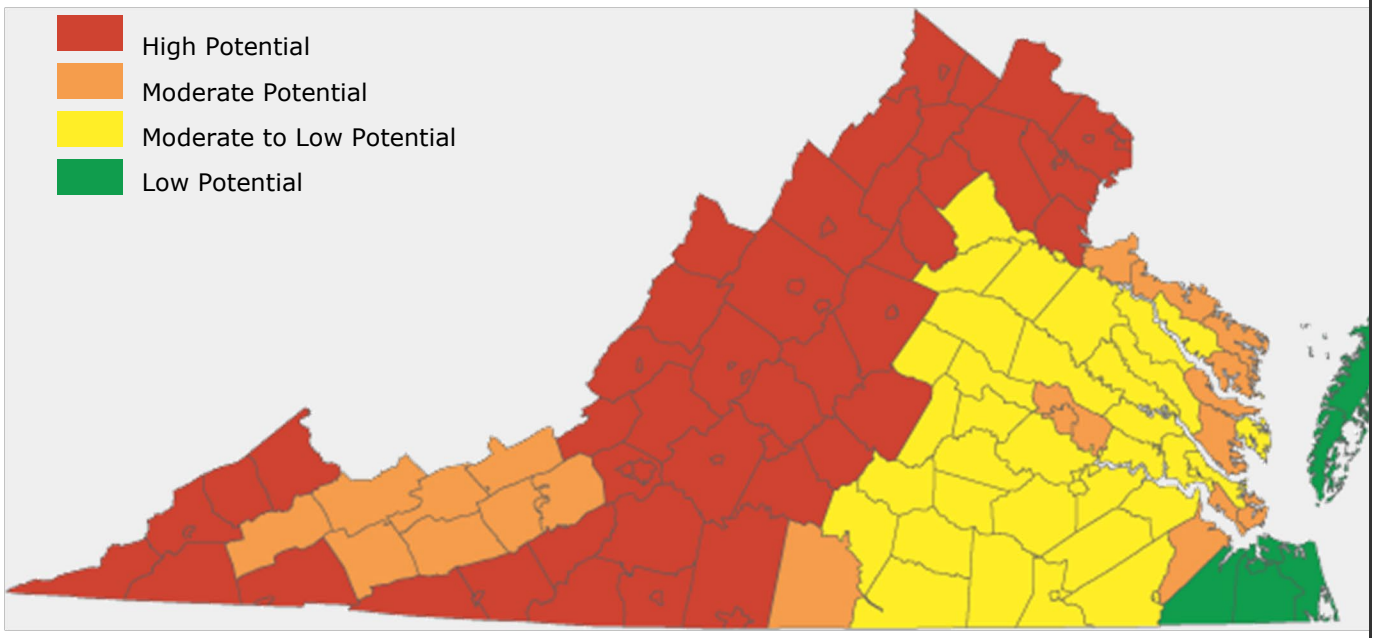


2021

Source: VIMS CCI

Landslide events in the region are considered a moderate- to low-probability event, with very localized impacts when and where they occur. Virginia Department of Energy provided the map in **Figure 5.25** that shows counties in Virginia and related susceptibility to landslides. Because damages are rarely quantified or are extremely limited in nature, average annual damages from landslides are not very useful. Occurrence intervals are similarly flawed because of the short period of record. Figure 5.25, however, indicates that the region's highest relative vulnerability is in in Isle of Wight, Newport News, Hampton, and Poquoson, perhaps due to the unconsolidated soils in the area.

FIGURE 5.25: SUSCEPTIBILITY TO LANDSLIDES BY VIRGINIA COUNTY/CITY



2021

Source: Virginia Department of Energy

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Generally speaking, future vulnerability to both landslide and coastal erosion will depend greatly on appropriate local site planning and permitting, as well as each community's approach to sea level rise and associated flooding problems. Planned mapping regarding landslide risk, if appropriately shared with local land use planners and incorporated into site planning and stormwater regulations, may reduce the incidence of landslides that affect structures in the future.

The Commonwealth's Stormwater Management program and enabling statutes help to manage future land use, and reduce stream channel erosion, water pollution, depletion of groundwater resources and more frequent localized flooding to protect property value and natural resources throughout the region. While waves are the primary force in determining the prevailing shoreline processes in the short-term of months or individual storms, sea level rise is the primary driver of shoreline change over the long-term. Documented sea level rise in the study area is expected to accelerate and will continue to impact shoreline morphology in the future.

Current building code requirements restrict fill materials used to fill a building site prior to new construction. But homes built on debris fill, or on oversteepened slopes (such as along a river bluff) may be more vulnerable to landslides in the future, especially on or near slopes near the contact between the Yorktown and Eastover convergence. The Virginia Department of Energy is interested in identifying at-risk areas in the region.

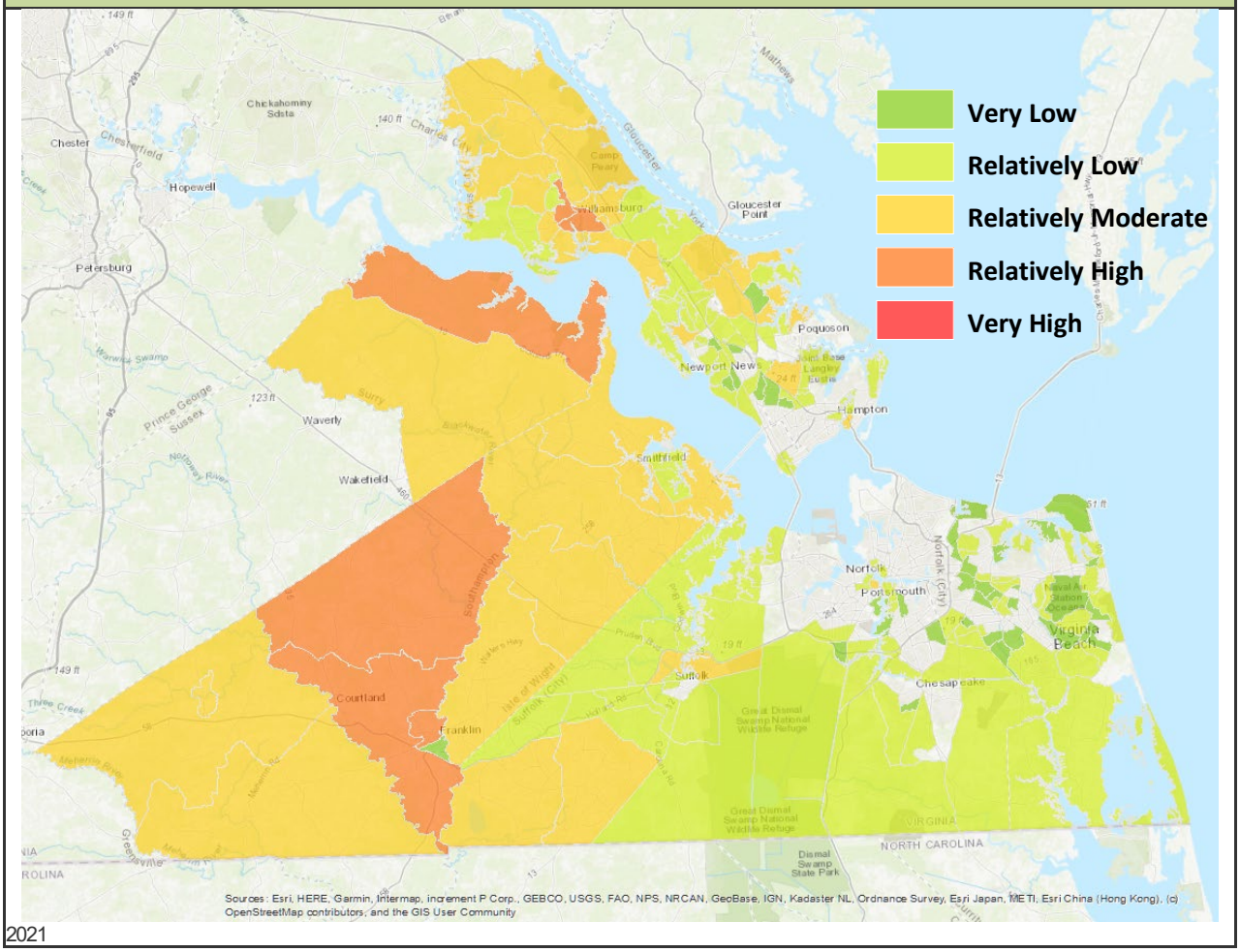
Climate change has the potential to worsen the risk associated with landslides in the study area. Precipitation patterns are expected to become more intense, prolonged and frequent as a result of a warming climate. There is a risk that these precipitation events could destabilize fragile slopes in the region, leading to more frequent and damaging landslides.

SOCIAL VULNERABILITY

Any measurement of social vulnerability to shoreline or coastal erosion requires considerably more knowledge about the location of vulnerable structures in each locality. Mitigation Action MH-4 in the *2018 Commonwealth of Virginia Hazard Mitigation Plan* proposes VDEM involvement in assisting localities, state agencies, and PDCs with identification of vulnerable structures and application for funding to implement soil stabilization projects to reduce risk to structures or infrastructure from erosion. Future revisions to the plan may be able to more precisely define socially vulnerable areas of the study region for shoreline or coastal erosion using information developed under this or a similar effort.

The region's NRI risk ratings for landslide are shown in **Figure 5.26**. The USGS Landslide Hazard Map was used as an input for hazard susceptibility, creating a raster that classified all of the conterminous United States as having either "some" or "negligible" landslide susceptibility based on slope and relief. This method may not adequately capture the unique geological conditions that are suspected as contributors to landslides in the study region. Nevertheless, the vulnerability shown in Figure 5.26 is a starting point for discussions regarding factors that could affect a household's vulnerability to landslide.

FIGURE 5.26: NATIONAL RISK INDEX RATING, LANDSLIDE



2021

Source: NRI, 2021

TORNADO

Historical evidence shows that the Hampton Roads region is vulnerable to tornado activity, which is often associated with other severe weather events such as thunderstorm or tropical cyclone activity.

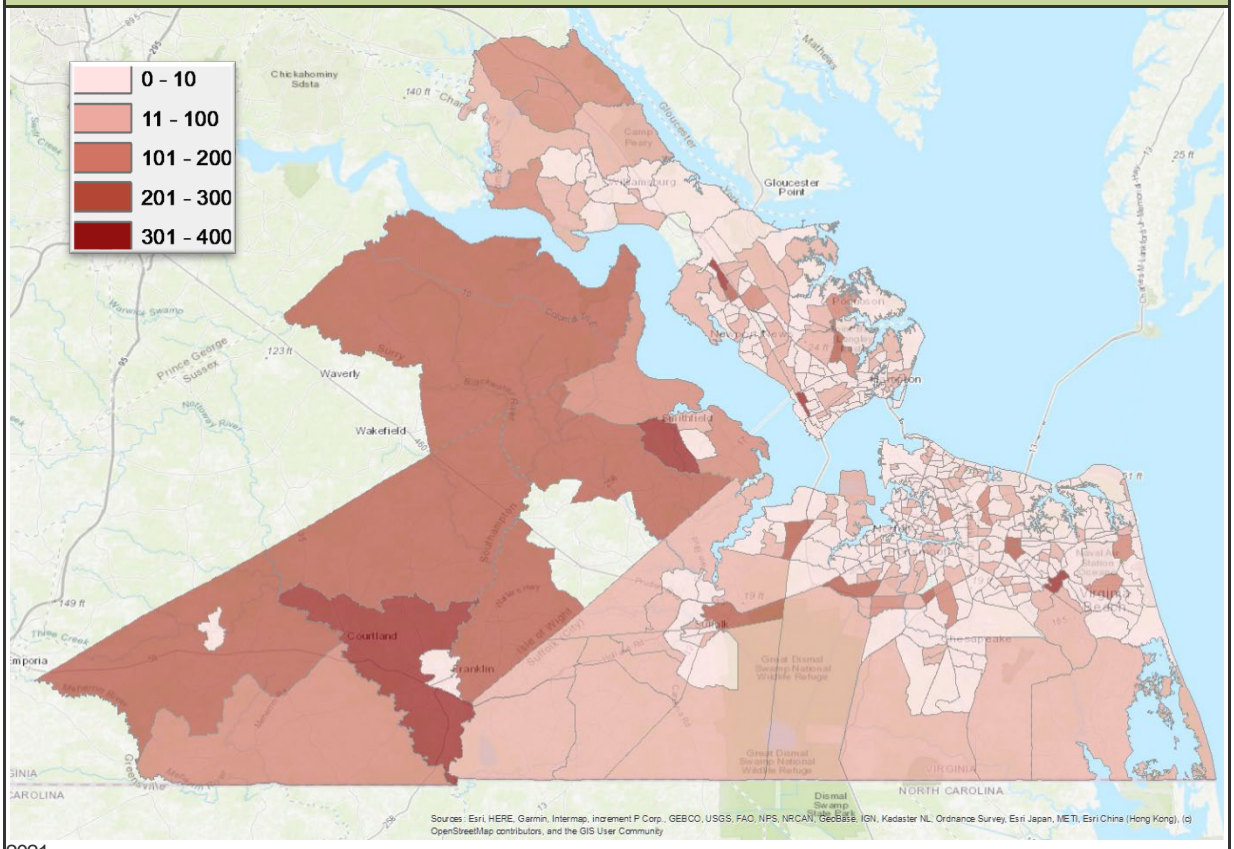
ESTIMATES OF POTENTIAL LOSSES

Because it cannot be predicted where a tornado may strike, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $204 billion for all buildings and contents within the region is considered to be exposed and could potentially be impacted on some level by the tornado hazard.

Low-intensity tornadoes may not completely destroy a well-constructed building, although even the most well-constructed buildings are vulnerable to the effects of a more intense (F2 or higher) tornado. The statewide building code provides a reasonable level of protection for newly constructed buildings, while structures built before the code went into effect are most vulnerable to damage.

Because manufactured homes are particularly vulnerable to damage from tornadoes, HAZUS was used to show geographic concentrations of manufactured homes in the study area. **Figure 5.27** is a map showing the number of manufactured homes by Census tract from the 2010 Census data generated by HAZUS.

FIGURE 5.27: NUMBER OF MANUFACTURED HOMES BY CENSUS TRACT



2021

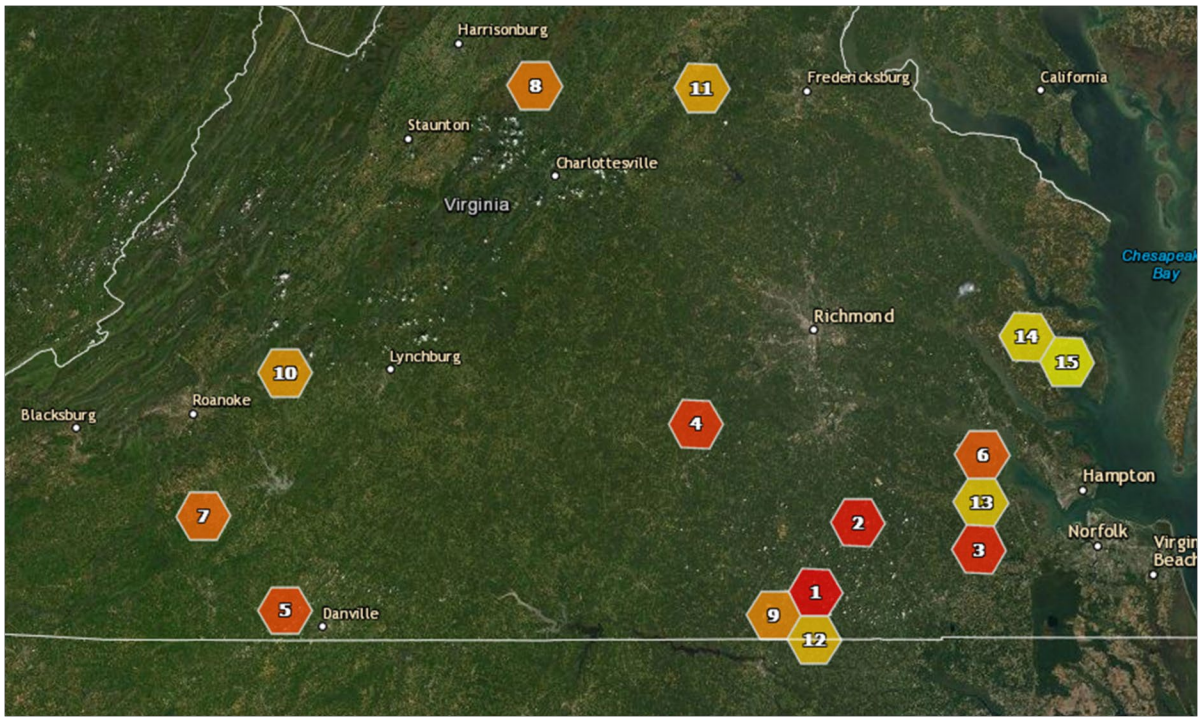
Source: Hazus and 2010 U.S. Census

Based on historic property damages for the 26-year period between 1995 and 2021 as shown in *Section 4, Hazard Identification and Risk Analysis*, there were 77 tornado events with an annualized loss estimate of $24.3 million and annual probability of 3.0% percent.

While Figure 4.18, Historical Tornado Hazard Frequency, and Figure 5.27, Number of Manufactured Homes by Census Tract, are useful for seeing where tornadoes have historically struck and where they could potentially damage a specific type of structure, the figures do not show measured differences in vulnerability among study area communities. Because tornadoes are driven by larger scale air masses and storm systems and these storm systems affect the Hampton Roads region uniformly, the region's vulnerability to tornadoes is quite uniform. The population concentrations in the urbanized areas of the Peninsula and Southside Hampton Roads may experience more damage as a result of a similar event in the more rural areas of Southampton County or Isle of Wight County, for example, but the vulnerability to tornado strike is uniform throughout the study area.

Researchers at Old Dominion University who have been researching spatial variability and trends in tornado occurrence in the Commonwealth, overlaid areas of increased tornado activity with the highest percentage of manufactured homes in the state, based on data from the 2014-2018 American Community Survey. Based on their analysis, there are several areas that have experienced an increased trend in number of tornadoes since 1950, and which have a high concentration of mobile homes, including specific areas in: Surry County and Isle of Wight County. **Figure 5.28** from the ODU study shows these areas in more detail.

FIGURE 5.28: VIRGINIA TORNADO MOBILE HOME RISK INDEX



Source: Old Dominion University web page, accessed online 2021 at: https://odu-gis.maps.arcgis.com/apps/Cascade/index.html?appid=723e660c2c09447fa8a57d3186dc8d2a

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

All future structures built in Hampton Roads are likely to be exposed to the tornado hazard. The link between changing climate and tornado severity and frequency is currently unclear. One problem is that long-term trends are difficult to determine, as records only go back to the 1950s. Another issue is that as population centers have grown and shifted over time, the reporting of tornadoes has been inconsistent.

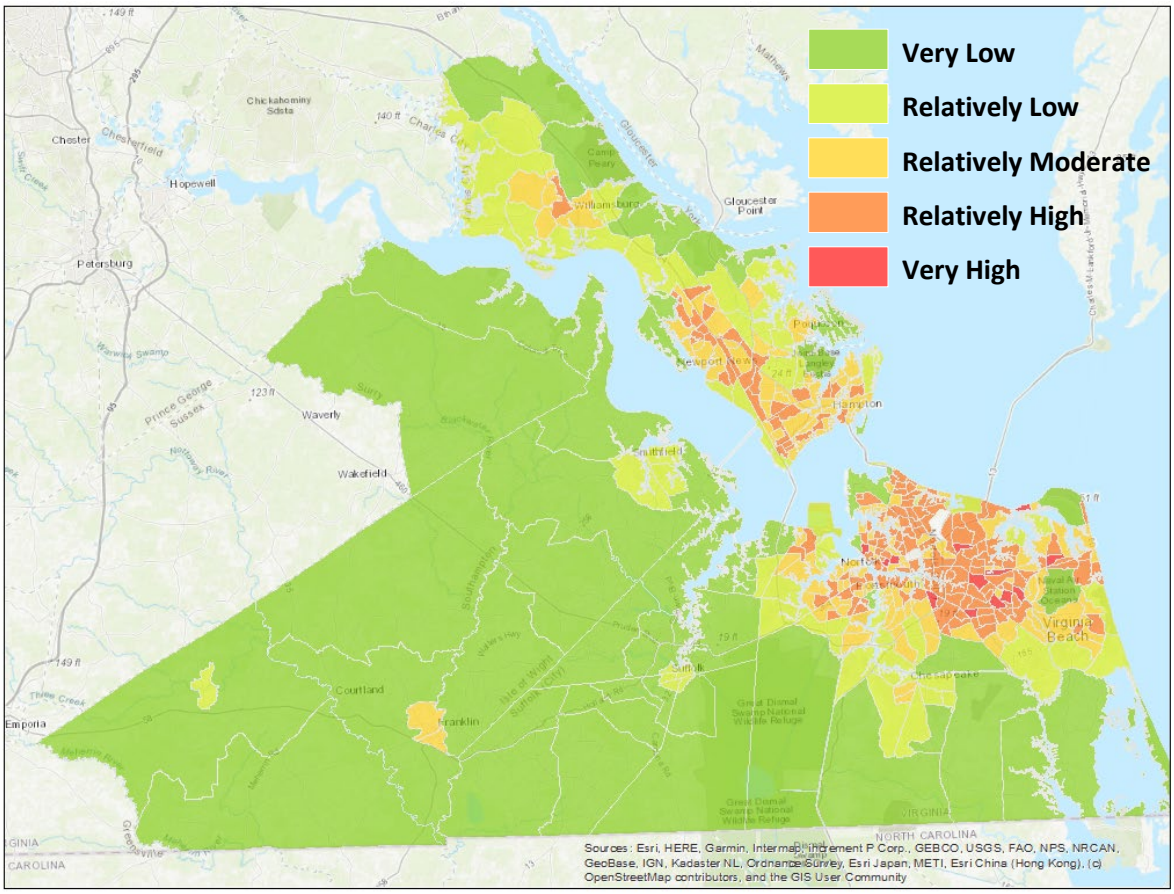
Also, improved observation technology (such a Doppler radar) allows for detection of events that was not possible in earlier years.

Researchers are working to better understand how the fundamental elements required for tornado formation – atmospheric instability and wind shear – interacts with changing climate conditions. Researchers expect that a warmer, wetter climate will allow for more frequent atmospheric instability. However, it is also possible that a warmer climate will dampen the probability of wind shear. Recent trends observed in the Midwest are inconclusive. A changing climate change could also shift the traditional timing or expected locations for tornadoes and have less impact on the total number of tornado occurrences.

SOCIAL VULNERABILITY

The NRI risk ratings for tornadoes are shown in **Figure 5.29** by Census tract. Despite the higher numbers of manufactured homes in the rural, southwestern portions of the study area, the damage history and built infrastructure exposure in the urbanized areas of the lower Peninsula and Southside are likely culprits in the rating disparity.

FIGURE 5.29: NATIONAL RISK INDEX RATING, TORNADO



2021

Source: National Risk Index, 2021

WINTER STORM

Historical evidence shows that the Hampton Roads region is vulnerable to winter storm activity and the wind-related impacts of nor'easters, including heavy snow, ice, extreme cold, freezing rain, and sleet.

ESTIMATES OF POTENTIAL LOSSES

Because winter storms typically affect large areas beyond county and municipal boundaries, it is not possible to map geographic locations at specific risk from this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $204 billion for all buildings and contents within the region is considered to be exposed and could potentially be impacted by the winter storm hazard. Based on historic property damages for the past 25 years (1996 to 2021), an annualized loss estimate of $805,800 and annual probability of 112% was generated for the winter storm hazard. Potential losses may be inflated by factors such as the costs associated with the removal of snow from roadways, debris clean-up, indirect losses from power outages, and the tendency of the NCEI data to combine metropolitan regional damages. Per the data in Table 4.13, no damages were reported for any of the NCEI database storms noted since the previous plan. Failure to report damages can significantly skew the data results.

Structures built prior to Virginia's statewide building code are somewhat more vulnerable to damage from severe winter storms where snow and ice may accumulate on rooftops, especially if snow loads were not accounted for in the original structure design. Because manufactured or mobile homes are also very susceptible to damage of roof collapse or additional damage due to their design features, HAZUS was used to show geographic concentrations of manufactured homes in the study area. **Figure 5.27** is a map showing manufactured homes by Census tract from the 2010 Census data generated by HAZUS.

Due to the consistency in the study area's basic geographic characteristics, winter storms can be expected to affect Hampton Roads' communities in a similar way. However, warm ocean currents offshore of Virginia Beach can occasionally diminish the effects of winter storms on the communities adjacent to larger bodies of water, including Virginia Beach, Norfolk, Hampton, and Poquoson. Temperature differences of a few degrees in these eastern communities can cause faster melting of snow and ice, and may result in a "snow line" that bisects the study area into areas of snow versus areas of rain associated with eastward moving systems. Such differences can result in dramatically different storm impacts in the study area.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Winter storms remain a likely occurrence for the region. Because of the geographic location, all future structures built in Hampton Roads are likely to be exposed to the winter storm hazard and may experience damage. The *2018 Commonwealth of Virginia Hazard Mitigation Plan* suggests that the southern and southeastern portions of the state are likely to receive significant winter weather approximately once a decade. Local zoning and comprehensive plans are not focused on winter storm planning in the study area, although Emergency Operations Plans typically contain appropriate response actions.

As the earth's climate changes, heavy seasonal snow years have begun to occur with greater frequency. According to NCEI, the frequency of extreme snowstorms in the eastern US has increased over the past century, with approximately twice as many extreme snowstorms occurring in the last half of the 20th century as in the first half. Conditions that influence snowstorm severity including warmer ocean surface temperatures in the Atlantic. These increased temperatures can lead to exceptionally high amounts of moisture feeding into a storm and contribute to storm intensification.

Global ocean surface temperatures have increased at a rate of +.18 degrees Fahrenheit each decade since 1950. Natural variability can affect surface ocean temperatures, but as global surface temperatures increase, the temperature is higher at any time than it would have been if the climate were not changing.

Some research has shown that increasing ocean surface temperature and reductions in Arctic sea ice may produce atmospheric circulation patterns that are favorable for winter storm development in the eastern United States. Notably, a greater prevalence of high pressure blocking patterns over the North Atlantic that result in cold outbreaks in the eastern U.S., along with slow moving systems can further exacerbate the longevity and severity of a snowstorm.

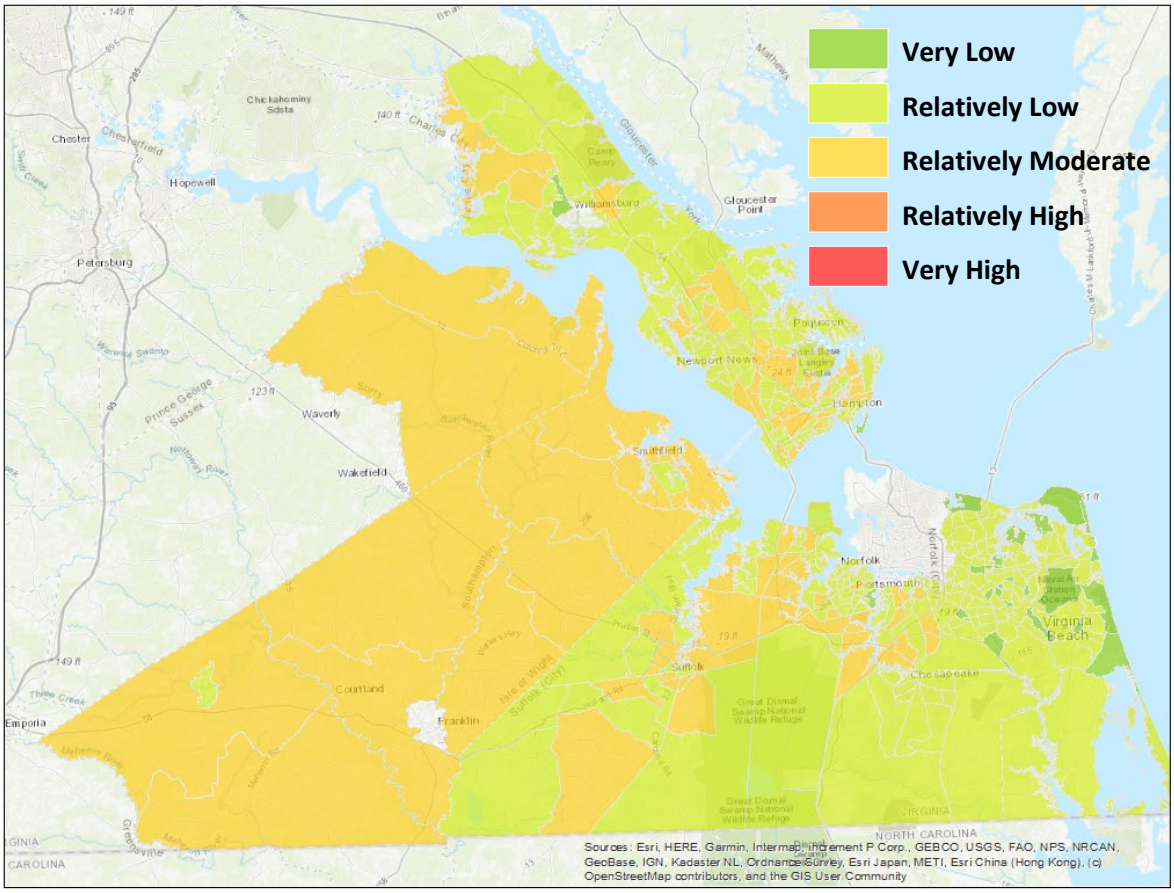
Studies have shown that natural variability associated with El Nino conditions has a strong relationship and influence on the incidence of severe snowstorms in the eastern U.S. An analysis of 100 storms in six regions east of the Rocky Mountains found that severe snowstorms are approximately twice as likely to occur in the eastern U.S. – north and south – during years when a moderate to strong El Nino is present as compared to years when more neutral conditions are present.

SOCIAL VULNERABILITY

The NRI risk ratings for winter weather are shown in **Figure 5.30** by Census tract. Most of the more populous regions of Hampton Roads are rated as Relatively Low, with some moderate areas found in Isle of Wight, Surry and Southampton counties, and portions of Suffolk. Technical documentation for the NRI indicates that the Iowa Environmental Mesonet data were used for tallying the number of historical occurrences; however, the historic loss ratios were derived from NCEI data which show relatively low dollar value losses for the region. Only four events in the past 25 years have associated damages in the NCEI database.

Severe winter weather can be problematic for socially vulnerable populations, especially people living in substandard housing or without alternative arrangements when power goes down. Transportation impacts are especially severe when vulnerable people rely on public transportation and those routes are interrupted by snow or ice accumulation. Populations with medical disabilities, many who require power to run oxygen supplies for example, are also vulnerable, as are elderly people who have less ability to adjust their living arrangements when winter storms affect the region.

FIGURE 5.30: NATIONAL RISK INDEX RATING, WINTER STORM



2021

Source: NRI 2021

EARTHQUAKE

The annual probability of an earthquake epicenter within 65 miles of Hampton Roads is estimated at less than 1% based on historical data. While the probability of an earthquake occurrence is relatively low, moderate losses, should a significant earthquake event occur, are possible.

ESTIMATES OF POTENTIAL LOSSES

Table 5.11 provides generalized building damage estimates by jurisdiction for the 1,000-year return period based on probabilistic scenarios using Hazus.

TABLE 5.11: ESTIMATES OF POTENTIAL BUILDING DAMAGE – EARTHQUAKE WITH 1,000-YEAR RETURN PERIOD

SUBREGION	COMMUNITY	BUILDING DAMAGE	NON-STRUCTURAL, CONTENTS & INVENTORY DAMAGE	TOTAL*
Peninsula	Hampton	$5,837,000	$14,560,000	$27,791,000
	Newport News	$7,525,000	$19,330,000	$37,344,000
	Poquoson	$643,000	$1,496,000	$2,695,000
	Williamsburg	$732,000	$2,019,000	$4,036,000
	James City County	$4,401,000	$11,077,000	$19,876,000
	York County	$3,446,000	$8,297,000	$15,185,000
Southside	Norfolk	$9,116,000	$21,526,000	$43,354,000
	Portsmouth	$2,851,000	$6,197,000	$13,391,000
	Suffolk	$3,451,000	$7,805,000	$14,954,000
	Virginia Beach	$16,885,000	$36,962,000	$73,951,000
	Chesapeake	$9,320,000	$20,815,000	$40,140,000
Western Tidewater	Isle of Wight County	$1,689,000	$3,932,000	$7,364,000
	Franklin	$325,000	$827,000	$1,701,000
	Southampton County	$825,000	$1,943,000	$3,676,000
	Surry County	$342,000	$843,000	$1,577,000
Totals		**$67,387,000**	**$15,7928,000**	**$307,034,000**

* Also includes income losses from relocation, lost wages, and lost rental income.
Source: Hazus

Hazus (Level 1 analysis) was also used to produce building damage estimates based on percentage of damage (by damage state) for the 1,000-year return period (**Table 5.12**). According to the Hazus model assumptions, there should be no building damage from the 100-year earthquake event.

TABLE 5.12: ESTIMATES OF POTENTIAL BUILDINGS DAMAGED BY DAMAGE STATE[9]– EARTHQUAKE WITH 1,000-YEAR RETURN PERIOD			
SLIGHT	MODERATE	EXTENSIVE	COMPLETE
11,994	3,487	428	39

Source: Hazus

Due to the relative consistency in the topography, geographic characteristics and soils of the study area, earthquakes are expected to affect the Hampton Roads region communities in a similar manner, with damages proportional to the inventory of structures and infrastructure.

Average Annual Losses from earthquake in Hampton Roads total an estimated $1.1 million, with Norfolk and Virginia Beach having the highest annual loss estimates. Average annual losses are equal to or less than $10,000 per year in Poquoson, Franklin, and Surry County.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

All future structures built in Hampton Roads will be vulnerable to seismic events to a limited degree, and may also experience damage not accounted for in the estimated losses presented in this section.

While scientists have observed some correlation between climate change on rising temperatures, melting glaciers and isostatic rebound, a causal connection to subsequent earthquakes is less documented, especially for the eastern United States. Earthquakes and weather have a few possible correlations that are still under investigation and should be considered more theoretical than scientific:

1. glacier melt and isostatic rebound causing earthquakes;
2. changing surface stress loads from increased surface water causing microseismicity or tiny earthquakes with magnitudes less than zero, and changes in water quantity stored in large dams inducing seismicity;
3. longer duration droughts and/or groundwater withdrawals that change stress loads on the Earth's crust causing earthquakes; and,
4. injection wells that lubricate faults and induce seismicity.[10]

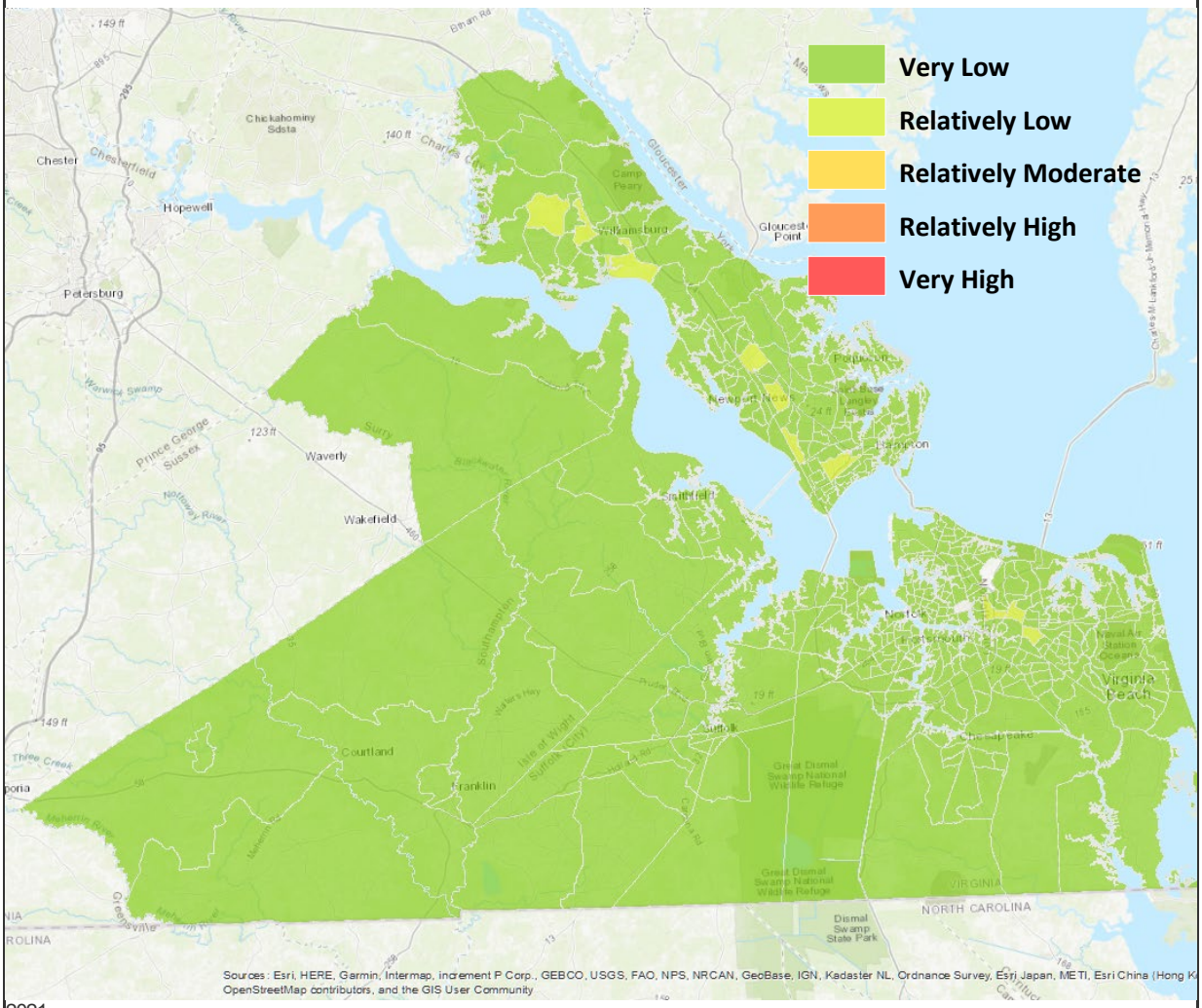
SOCIAL VULNERABILITY

The NRI risk ratings for earthquake are shown in **Figure 5.31** by Census tract. The map reflects the history of earthquakes in Virginia, with few damages and very low risk throughout the Hampton Roads region.

[9] For more detailed description of the four damage states, please refer to the *HAZUS-MH User Manual* for the Earthquake Model.

[10] Buis, Alan. NASA: Global Climate Change: Vital Signs of the Planet. *Can Climate Affect Earthquakes, or are the Connections Shaky?* Feature dated October 29, 2019, accessed online at: https://climate.nasa.gov/news/2926/can-climate-affect-earthquakes-or-are-the-connections-shaky/

FIGURE 5.31: NATIONAL RISK INDEX RATING, EARTHQUAKE



2021

Source: NRI 2021

WILDFIRE

Historical data indicate that the Hampton Roads region of Virginia is vulnerable to wildfire, particularly in the western portion of the study area. Figure 4.24 provides a graphical overview of wildfire vulnerability in the region.

ESTIMATES OF POTENTIAL LOSSES

As shown in the *Hazard Identification and Analysis* section, VDOF documented an average of 24 wildfire events per year between 2002 and 2020, with total property damages of $663,550 reported for the 433 events between 2002 and 2020. Average losses for state-response wildfires in the region are, therefore, estimated to be $36,860 each year.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

In cities and counties throughout the U.S., population concentration increase has resulted in rapid development in the outlying metropolitan areas and in rural areas, both of which are areas already occupied by dense forests. Wildfire risk can increase when new developments are built in close proximity to large and dense stands of forest. Wildland Urban Interface (WUI) risk is not limited to new developments in large natural areas. Occasionally, forest and brushlands can grow up over time and engulf previously developed areas. Regardless of how the risk arises, the WUI creates an environment in which fire can move readily between structural and vegetative fuels. Expansion of the WUI over time has increased the likelihood that wildfires will threaten structures and people.

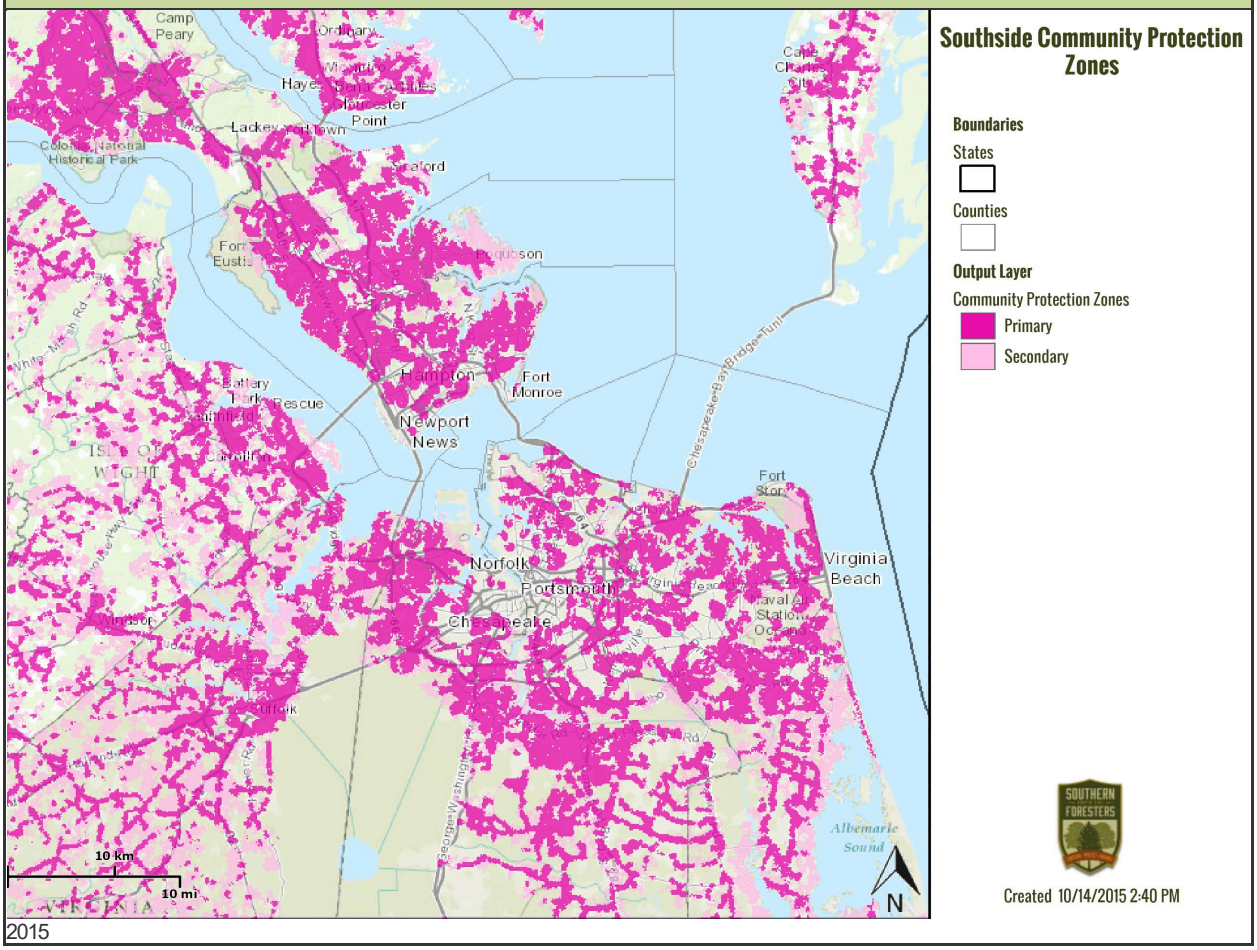
The Southern Group of State Foresters has created an online portal for wildfire risk assessment at http://www.southernwildfirerisk.com/map/index/public. The portal provides mapping to help determine future vulnerability to WUI fire in Hampton Roads and to provide planners a sense of where fire mitigation should be focused for the best reduction in vulnerability. Community Protection Zones (CPZs) with both primary and secondary levels of importance are depicted in **Figures 5.32 through 5.34**. The zones are based on an analysis of the “Where People Live” housing density data and surrounding fire behavior potential. Primary CPZs reflect areas with a predefined housing density appropriate to the region. Rate of Spread data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance. This is referred to as the Secondary CPZ.

The online portal for wildfire risk assessment also allows users to highlight a neighborhood or street and determine the wildfire characteristics of that area, such as the Wildfire Urban Interface Risk Index, the wildfire ignition density and the fire intensity scale.

The CPZs in the Hampton Roads area, where wildfire vulnerability is highest, are clustered in the lower Peninsula (Hampton, Newport News and Poquoson), James City County, Suffolk, and north Chesapeake. There are sporadic pockets of vulnerability scattered through Surry County, eastern Isle of Wight County, parts of Virginia Beach, Norfolk and Portsmouth that make these areas perhaps slightly less vulnerable. The Great Dismal Swamp is not mapped as part of this effort as it is Federal land, but there is also high risk of wildfire in that region actively managed by the Great Dismal Swamp Fire Program.

The region is expected to continue to incur wildfires, particularly during extended periods of dry and windy weather. The region’s zoning ordinances do not generally guide new development away from the Wildland Urban Interface, but the wildfire threat is not as severe as in the western United States.

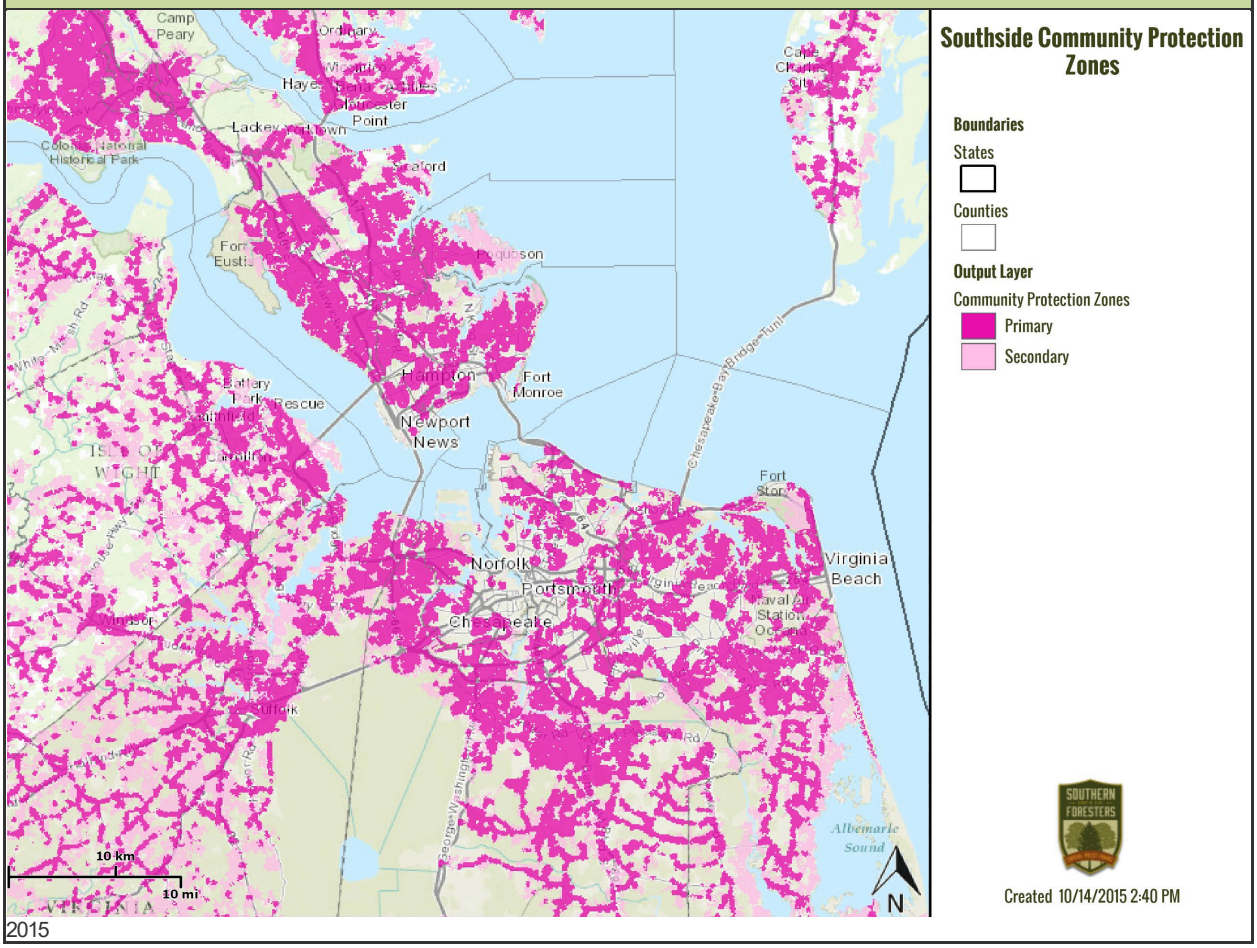
FIGURE 5.32: COMMUNITY PROTECTION ZONES FOR WILDFIRE, PENINSULA



2015

Source: Southern Group of State Foresters

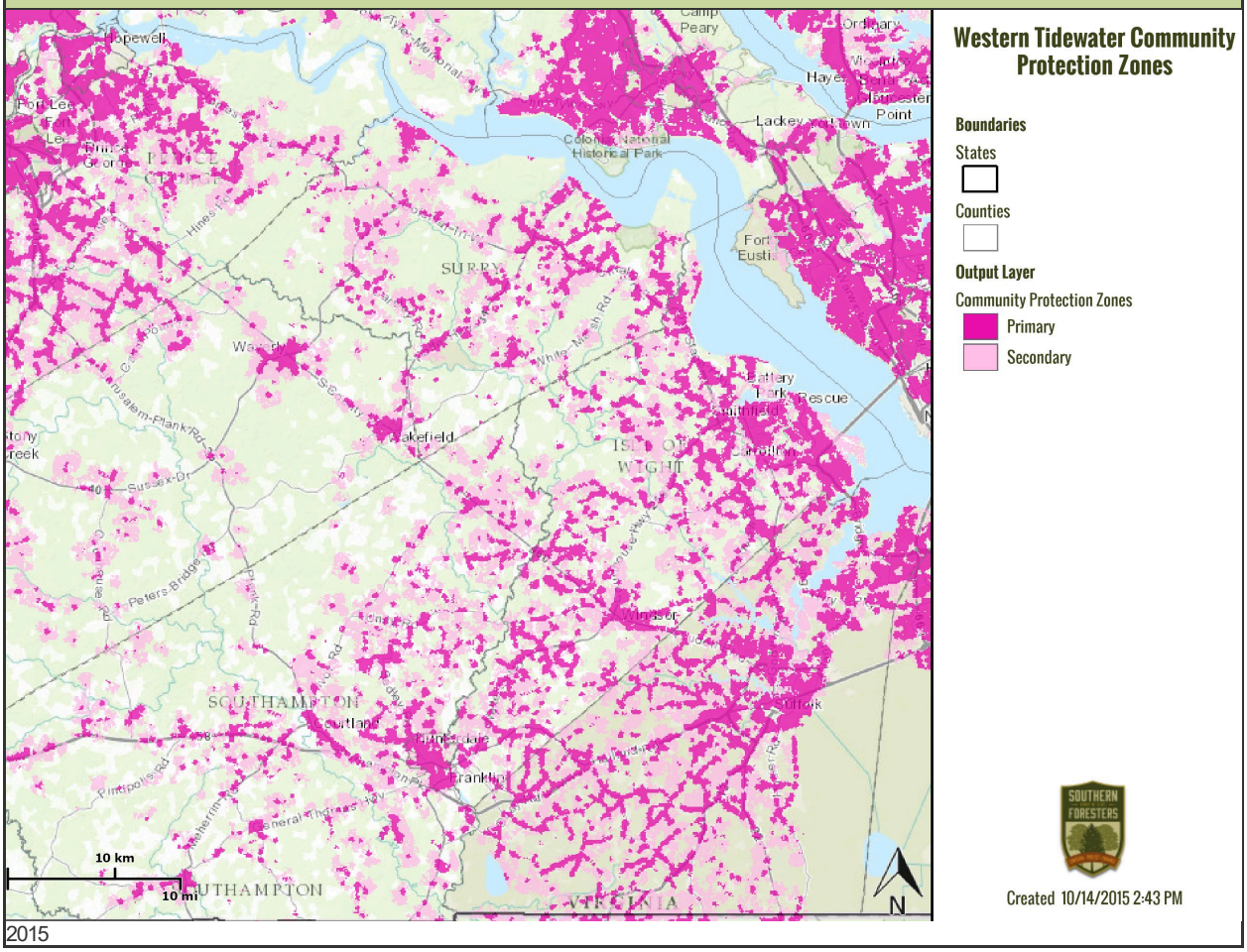
FIGURE 5.33: COMMUNITY PROTECTION ZONES FOR WILDFIRE, SOUTHSIDE



2015

Source: Southern Group of State Foresters

FIGURE 5.34: COMMUNITY PROTECTION ZONES FOR WILDFIRE, WESTERN TIDEWATER



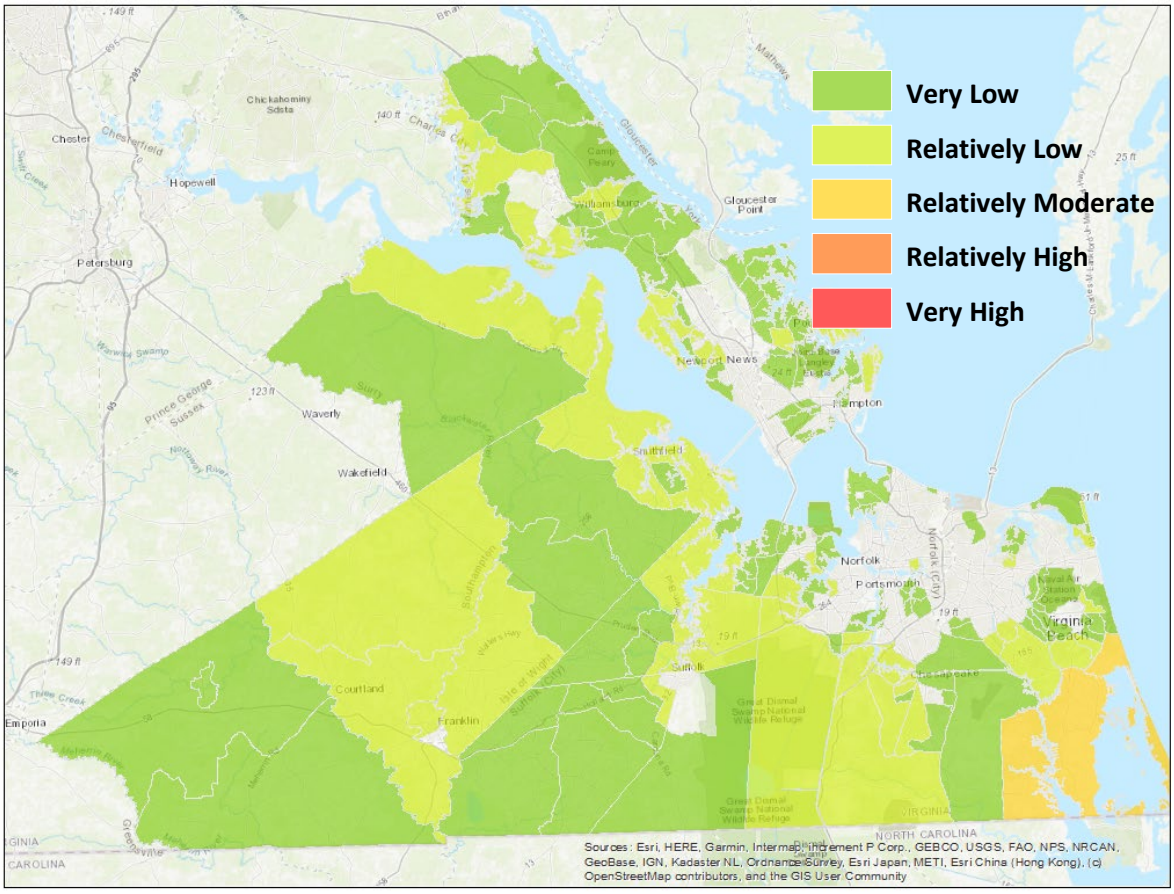
Source: Southern Group of State Foresters

Climate change increases the risk of the hot, dry weather that is likely to fuel wildfires. Also, because climate change is also a factor in higher intensity windstorms, there is a likelihood of increased fuel for wildfire when downed trees from storms are not removed. For site specific information on historic wildfire ignition density, property owners and planners can visit: www.southernwildfirerisk.com.

SOCIAL VULNERABILITY

The NRI risk ratings for wildfire are shown in **Figure 5.35**. The risk ratings are relative to the rest of the United States and the damage history upon which the ratings are built is simply not as substantial as many parts of the country. Although most of the region is rated low, there is one pocket of relatively moderate risk in the southeastern part of Virginia Beach.

FIGURE 5.35: NATIONAL RISK INDEX RATING, WILDFIRE



2021

Source: NRI 2021

DROUGHT

Droughts can impact natural systems and the ability of cities, towns and neighborhoods to function effectively. Specific impacts may include a reduction in the production of food grains and other crops, the size and quality of livestock and fish, available forage for livestock and wildlife, and the availability of water supplies needed by communities and industry. As evidenced by previous occurrences, the Hampton Roads region is vulnerable to the drought hazard.

ESTIMATES OF POTENTIAL LOSSES

While drought impacts agricultural, recreational, and manufacturing industries, estimating losses to the built environment is difficult because drought causes little documented physical damage to the built environment. In 2006, this plan included an annualized drought loss estimate of $2,215,839 for Isle of Wight County, Suffolk and Virginia Beach; however, the methodology regarding how this loss estimate was developed is not clear. Annualized damages appear to have been based on changes in total harvested cropland; however, losses in harvested cropland or the market value of crops cannot be attributed entirely to drought or other weather-related conditions, especially in rural parts of the planning area that are rapidly developing. Data on drought damages from the NCEI are incomplete and, when available, apply to a very large area including jurisdictions outside of the planning region. As a result, the estimation of annualized damages due to drought has been discontinued in plan updates.

Table 5.13 provides a time series of data regarding the total harvested cropland, irrigated land, market value of crops, and percent of non-irrigated land from 2002, 2007 and 2012. Due to a lack of agricultural information, data for many of the cities and towns are not provided.

TABLE 5.13: AGRICULTURAL DATA RELATED TO DROUGHT VULNERABILITY				
	2002	2007	2012	2017
JURISDICTION	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)
James City County	5,258	2,367	2,698	318
York County	211	Withheld	Withheld	55
Suffolk	53,954	51,203	49,693	56,270
Virginia Beach	21,609	20,258	20,814	16,476
Chesapeake	53,188	41,391	36,269	31,592
Isle of Wight County	49,373	48,230	47,868	48,833
Southampton County	83,449	79,449	87,902	91,803
Surry County	35,265	26,526	30,238	23,844
TOTAL	**302,307**	**269,424**	**275,482**	**269,191**

Source: U.S. Department of Agriculture Census

The geography of the study area makes the Hampton Roads region uniformly vulnerable to the effects of drought. However, the impacts would vary across the region based on land use, with impacts to agriculture and the agricultural economy primarily in Surry and Southampton counties, as well as James City County, York County, Suffolk, Virginia Beach, Chesapeake, and Isle of Wight County. Social impacts to water utility customers in the cities of Hampton Roads would be more likely during a chronic, prolonged drought that results in water restrictions.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

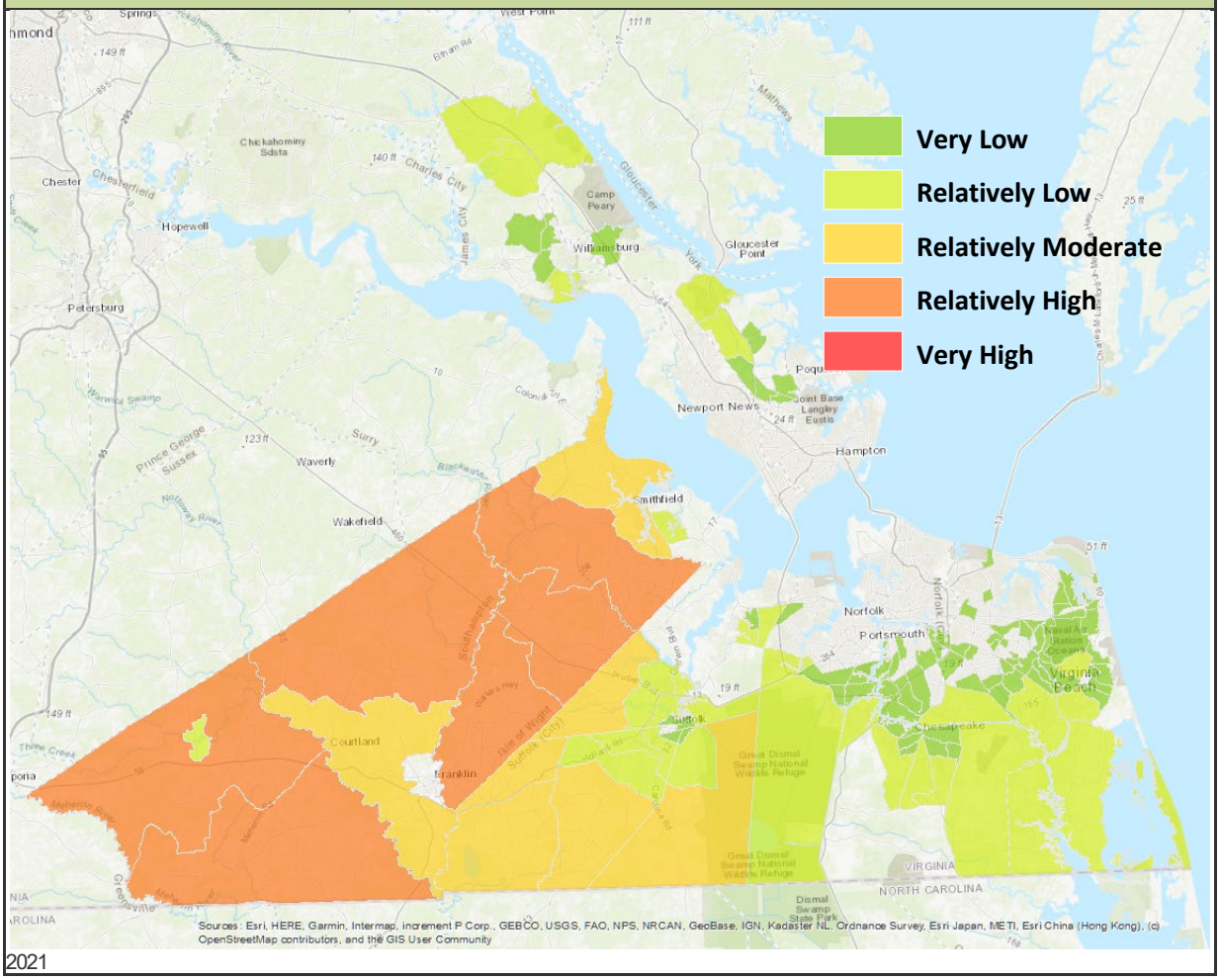
According to the USDA Agriculture Census data from 2002 through 2017, the total harvested cropland in Hampton Roads farming communities decreased 11-percent from 2002 to 2007, and then increased and held somewhat steady. This is consistent with the area's largest farming county, Southampton County, which experienced a decrease of 4-percent in the first period and an increase of 10-percent in the middle period, but has now increased to pre-2002 levels. These rates may be indicative of past and future changes in land use which may be peripherally related to long-term drought conditions, although the long period between data collection and relatively short period of record makes it difficult to draw useful conclusions.

The VASEM 2021 report predicts that as this century comes to a close, agriculture will be impacted by climate change with more intense precipitation and also longer periods of drought. The cumulative effect will particularly be bad for crops near the warm end of their geographic range.

SOCIAL VULNERABILITY

The NRI risk ratings for drought are shown in **Figure 5.36**. Historical occurrence data were taken from the University of Nebraska-Lincoln National Drought Mitigation Center, U.S. Drought Monitor. The period of record was January 2000 to December 2017. Large portions of Southampton County and Suffolk appear to be the most socially vulnerable to the impacts of drought.

FIGURE 5.36: NATIONAL RISK INDEX RATING, DROUGHT



2021

Source: NRI 2021

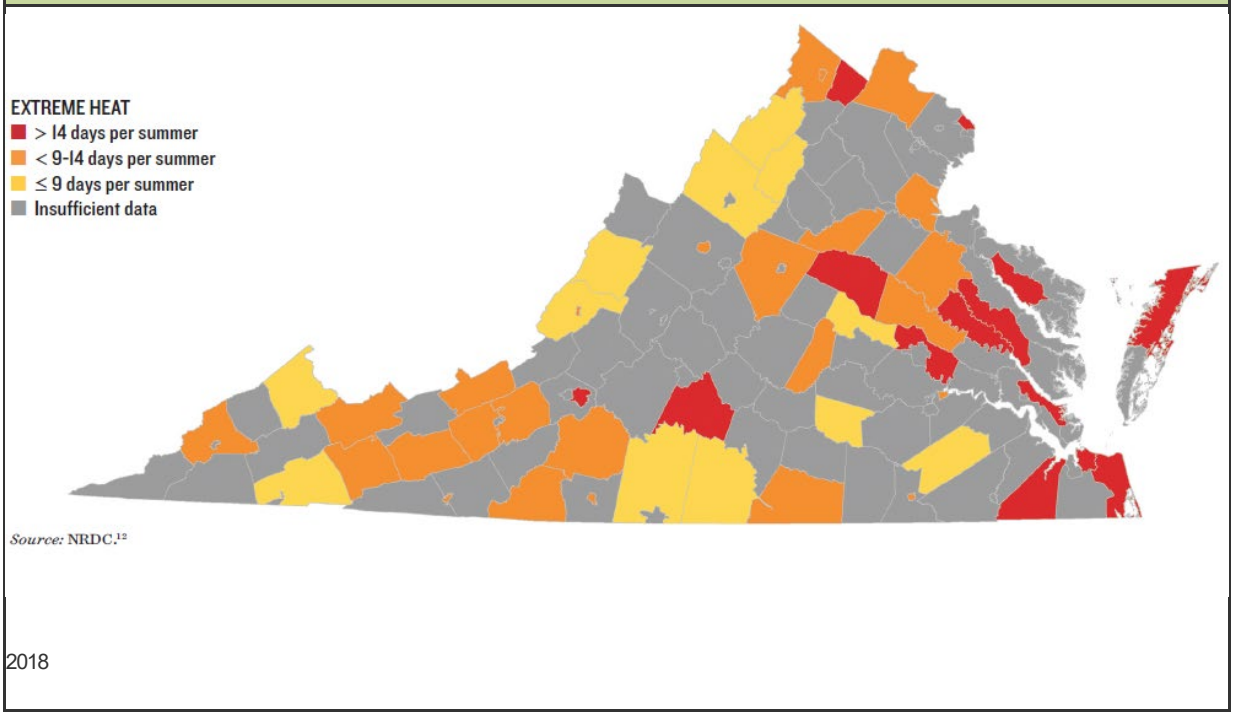
EXTREME HEAT

ESTIMATE OF POTENTIAL LOSSES

Based on the previous historical occurrences, annualized losses to the built environment are considered to be negligible (less than $1,000). Loss of human life or health impacts are a greater concern with extreme heat than is property damage, although extreme heat can exacerbate droughts, contribute to conditions that fuel wildfire, and cause road pavement to buckle.

An examination of vulnerability to extreme heat by jurisdiction necessitates the use of data other than NCEI data, which are incomplete. **Figure 5.37** shows the average number of extreme summer heat days per year in Virginia, by county, between 2007 and 2016, from an NRDC report on *Climate Change and Health in Virginia*. While the data are insufficient in much of the study area, a definite exposure to extreme heat for Virginia Beach, Suffolk and York County is evident.

FIGURE 5.37: AVERAGE NUMBER OF EXTREME SUMMER HEAT DAYS PER YEAR IN VIRGINIA

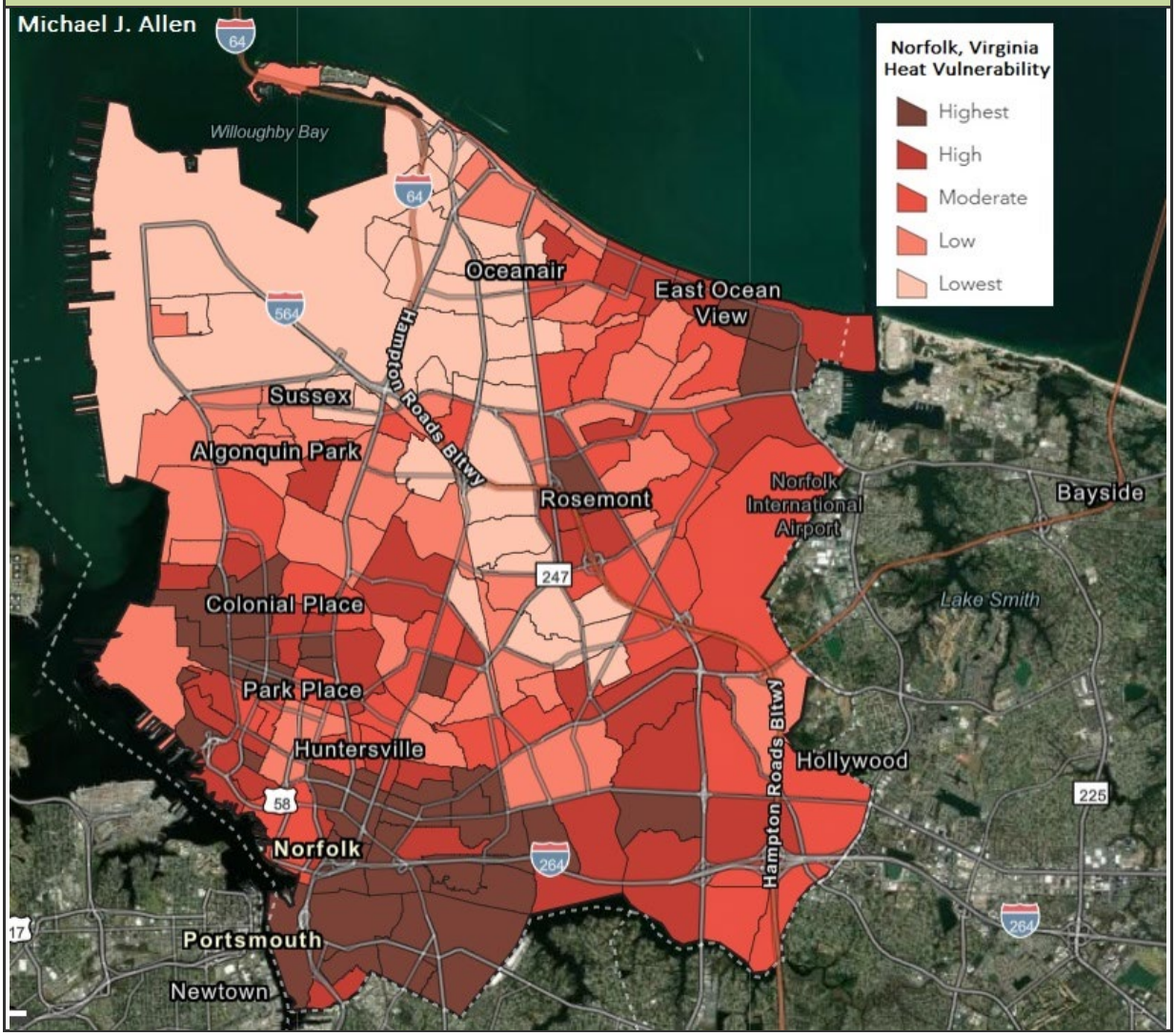


Source: NRDC: Climate Change and Health in Virginia, Issue Brief, April 2018. Accessed online: https://www.nrdc.org/sites/default/files/climate-change-health-impacts-virginia-ib.pdf

A heat mapping project in Norfolk in July, 2019, provides some insights to variability in risk to extreme heat for that particular city. By combining data on single day temperatures, land cover and poverty, researchers put together a far more detailed heat vulnerability map (**Figure 5.38**) that may be useful for future planning and research efforts on the geographic variability in risk to this hazard.[11] Land cover and tree cover at a neighborhood scale are important factors in determining vulnerability.

[11] Allen, Michael. *Norfolk Heat Vulnerability Story Map, 2021* accessed online at: https://storymaps.arcgis.com/stories/7cde13a422504a0682ec9c2deb18c4b6

FIGURE 5.38: NORFOLK HEAT VULNERABILITY



Source: Michael Allen, *Norfolk Heat Vulnerability Story Map* accessed 2021 online at: https://storymaps.arcgis.com/stories/7cde13a422504a0682ec9c2deb18c4b6

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

The risk of heat-related illnesses and deaths in Virginia will grow as climate change fuels more intense and frequent heat waves. While long-term trends at individual sites in Hampton Roads, such as airports, are useful for observing regional temperature change, students at Virginia Wesleyan in Virginia Beach are part of a statewide effort to more accurately map and distinguish urban heat islands and their evolving impact, similar to the Norfolk effort described above. On the hottest days of the year, students drive along predetermined routes at three different times of day to capture temperature and humidity data using sensors attached to car windows. The data will help link city planning decisions past and future, such as where trees and green spaces are required, to real results on the ground.

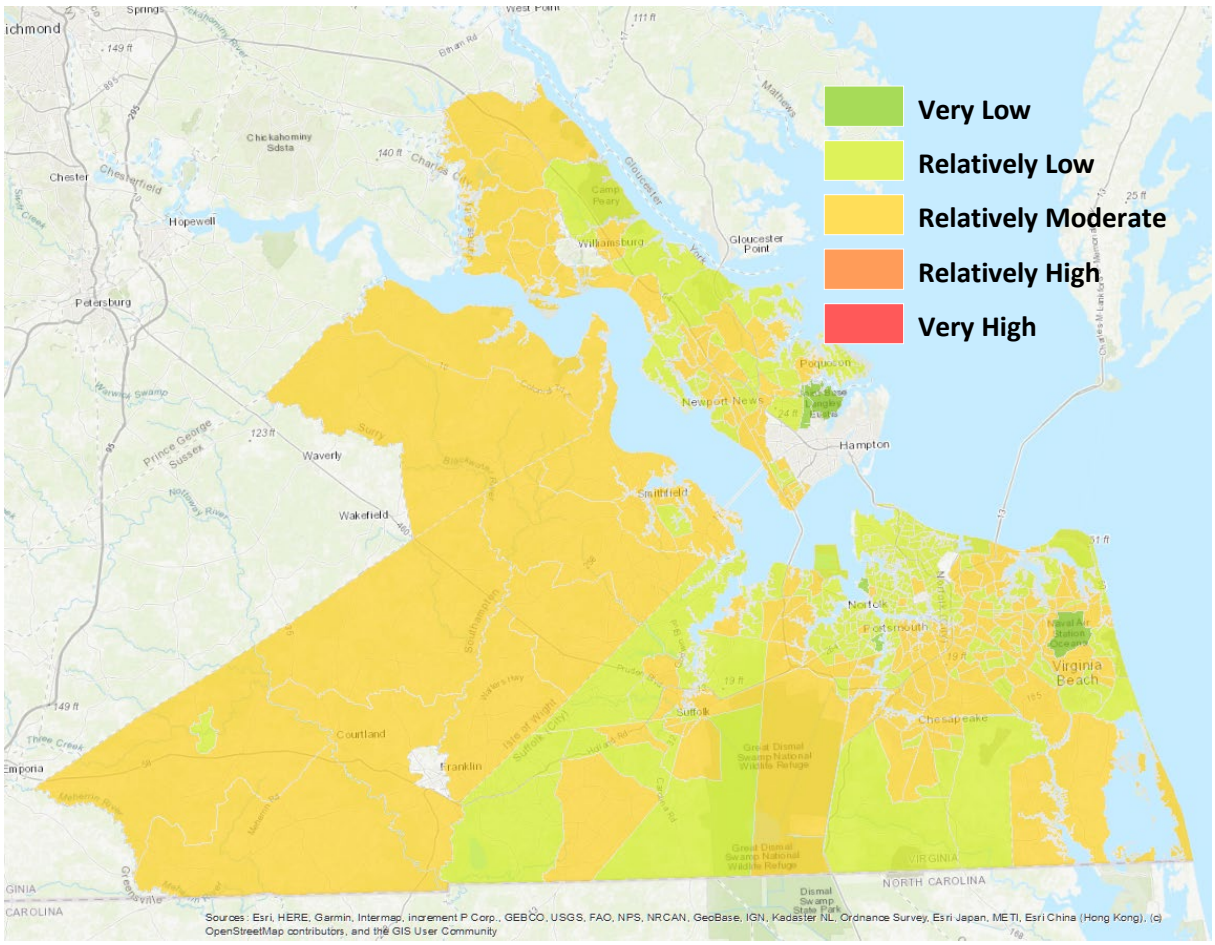
All future structures built in the Hampton Roads region will be exposed to extreme heat. Information gleaned from research such as the mapping in Norfolk and Virginia Beach will help inform future planning regulations and design guidelines, including passive cooling solutions for buildings and neighborhoods, that can improve energy efficiency, cooling and health outcomes from extreme heat events. Examples include

cool roofs and reflective cool walls for buildings, cool corridors in neighborhoods where trees and concrete rather than asphalt prevent heat buildup, and positioning buildings to shade common pedestrian routes.

SOCIAL VULNERABILITY

The main concern in periods of extreme heat is the potential public health impact, such as heat exhaustion or heat stroke. Individuals of concern include those living in residences without air conditioning, or in areas where electric service is unavailable due to system-wide blackouts. The elderly, small children, the chronically ill, livestock and pets are most vulnerable to extreme heat. **Figure 5.39** shows the relative risk from heat waves based on the National Risk Index data.

FIGURE 5.39: NATIONAL RISK INDEX RATING, HEAT WAVE



2021

Source: NRI 2021

HAZARDOUS MATERIALS INCIDENTS

ESTIMATES OF POTENTIAL LOSSES

Based on information provided in the *Hazard Identification and Analysis* section, the Hampton Roads region experiences an average of 26 hazardous materials incidents per year with only minor damages (generally less than $10,000 per year) reported. **Table 5.14** shows hazardous materials incidents from 1998 to 2021 in Hampton Roads region (according to the U.S. Department of Transportation) that contribute to an annualized loss estimate of $67,500 from highway incidents.

TABLE 5.14: ANNUALIZED LOSSES FOR HAZARDOUS MATERIALS INCIDENTS

SUBREGION	COMMUNITY	NUMBER OF EVENTS	PROPERTY DAMAGE	AVERAGE ANNUAL NUMBER OF EVENTS	ANNUALIZED LOSS
Peninsula	Hampton	26	$9,454	1.13	$411
	Newport News	44	$5,058	1.91	$220
	Poquoson	0	$0	0.00	$0
	Williamsburg	3	$6,845	0.13	$298
	James City County	0	$0	0.00	$0
	York County	2	$0	0.09	$0
Southside	Norfolk	118	$425,847	5.13	$18,515
	Portsmouth	52	$148,234	2.26	$6,445
	Suffolk	15	$343,678	0.65	$14,943
	Virginia Beach	210	$78,807	9.13	$3,426
	Chesapeake	113	$292,360	4.91	$12,711
Western Tidewater	Isle of Wight County	0	$0	0.00	$0
	Franklin	8	$3,688	0.35	$160
	Southampton County	2	$10,706	0.09	$465
	Surry County	2	$7,550	0.09	$328

U.S. Department of Transportation, 2021

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future land use and zoning of structural development as discussed in previous subsections are expected to have less impact on future vulnerability than mitigation. Protection of human life through administration of proper emergency notification and evacuation planning with regard to potential hazardous material incidents are critical elements in reducing real-time vulnerability before, during and after events.

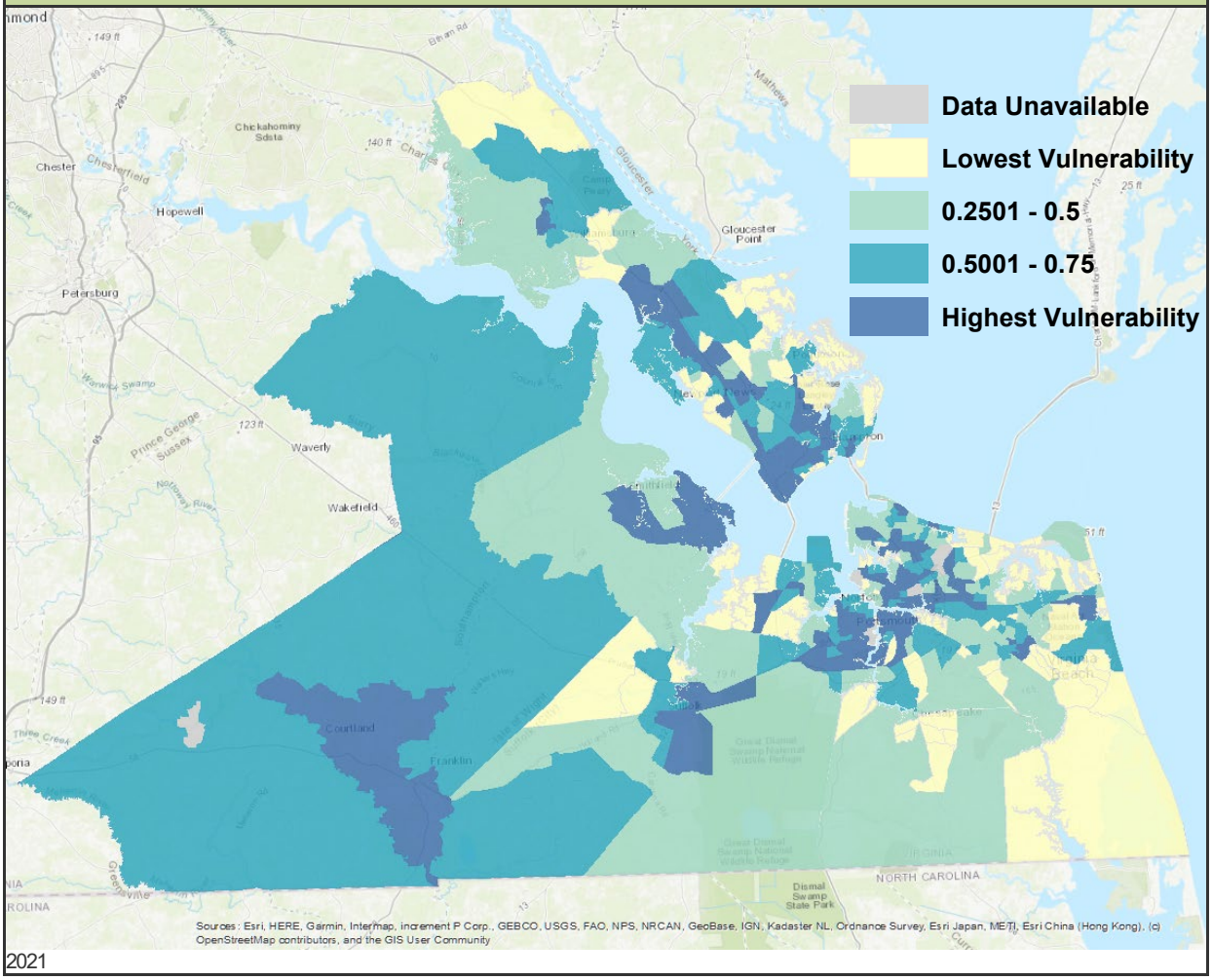
Climate change impacts are limited with hazardous materials incidents. Higher frequency of extreme weather events such as winter storms or tropical storms may increase the overall number of rail and highway accidents, which could naturally lead to an increase in events involving hazardous materials. Extreme heat and wildfire events brought about by higher temperatures could conceivably increase incidents involving flammable materials.

SOCIAL VULNERABILITY

The CDC Agency for Toxic Substances and Disease Registry (ATSDR) created a Social Vulnerability Index geared toward preparing for and responding to exposure to dangerous chemicals (and other natural hazards, as well). This index is better suited to examining the social vulnerability related to hazardous materials incidents, although many of the inputs are the same as the NRI. Overall vulnerability for this index is based on: socioeconomic status (below poverty, unemployed, income, no high school diploma); household composition and disability (aged 65 or older, aged 17 or younger, civilian with disability, single-parent households); minority status and language; and housing type and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

The ATSDR map provided in **Figure 5.40** shows the highest social vulnerability to hazardous materials incidents, is in the east end of Newport News, eastern Surry County, a corridor in Southampton County, and pockets in Suffolk, Chesapeake, Portsmouth, Norfolk and Virginia Beach.

FIGURE 5.40: CENTERS FOR DISEASE AND PREVENTION, SOCIAL VULNERABILITY INDEX



Source: CDC/ATSDR Social Vulnerability Index 2018 Database, Virginia.

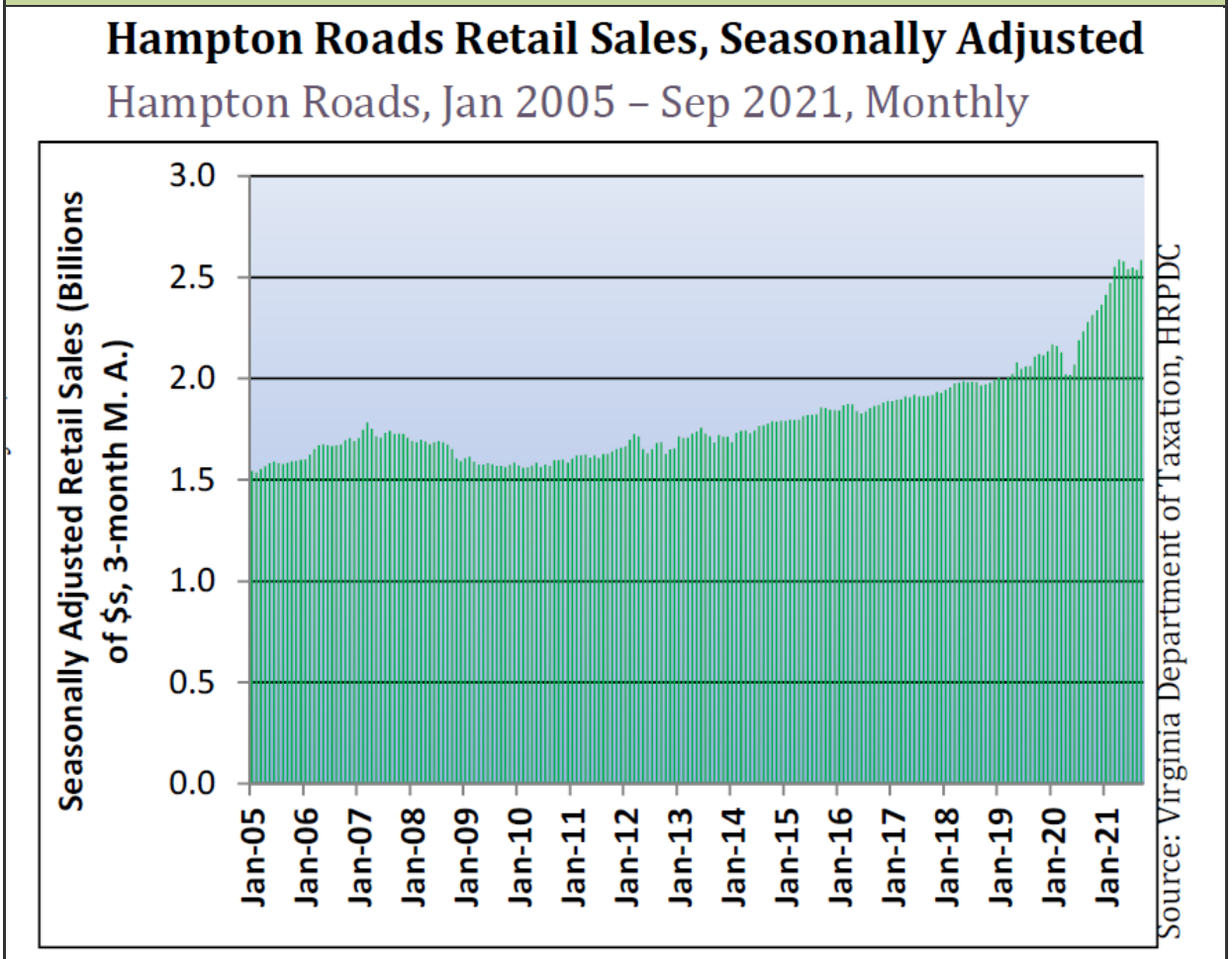
PANDEMIC FLU OR COMMUNICABLE DISEASE

ESTIMATES OF POTENTIAL LOSSES

An outbreak of widespread disease burdens local medical facilities in terms of capacity for treatment, the region's health departments, emergency responders and other essential workers with additional staff responsibilities, but would not be expected to damage the built environment or community infrastructure in any significant way. Experience with COVID-19 has shown that economic impacts and job losses may affect almost every aspect of the economy, and the number of people remaining at home for work and schooling can dramatically impact the demand for childcare services and other support service industries. These impacts are expected to be temporary, unique to COVID-19, and may be further ameliorated by Federal stimulus dollars distributed as a result of a public health disaster, and eviction prohibitions issued at various government levels.

HRPDC has monitored how COVID-19 has impacted local transportation volume, employment, unemployment claims, retail sales, home prices and rent rates, and other economic indicators throughout the pandemic. A full writeup is prepared each month in the *Hampton Roads Economic Monthly*, gaging various metrics of the economy; these reports are available at: https://www.hrpdcva.gov/departments/economics. **Figures 5.41** through **5.43** graphically show the most recent impacts to Hampton Roads retail sales, unemployment rate and the number of homes sold, representing just a snapshot of the potential losses and the local recovery. Additional analysis once conditions return to a more normal, pre-pandemic status may be able to quantify the losses due to pandemic.

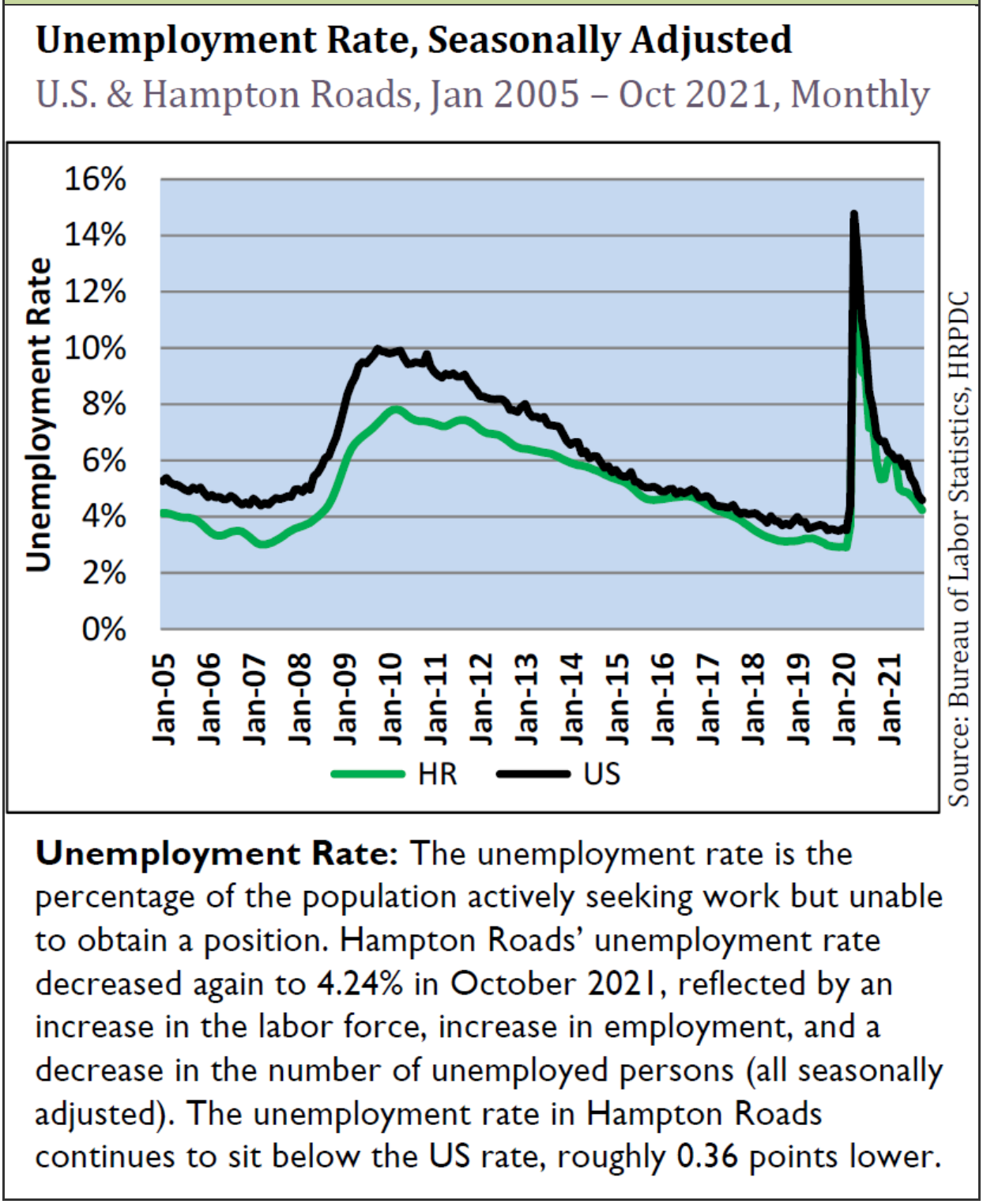
FIGURE 5.41: HAMPTON ROADS RETAIL SALES



Retail Sales: Retail sales in Hampton Roads, as measured by the 1% local option sales tax, serve as an indicator for consumption in the region. When seasonally adjusted and averaged over 3 months, September shows an increase in retail sales after several months of declines. Unadjusted, Sept 2021 posted a 19% increase from September 2020 (when the rise in retail sales was in full swing after the initial shock of the pandemic wore off), and a nearly 30% increase from Sept 2019. In other words, retails sales are continuing to rise long-term as consumers are still spending more on goods than pre-pandemic.

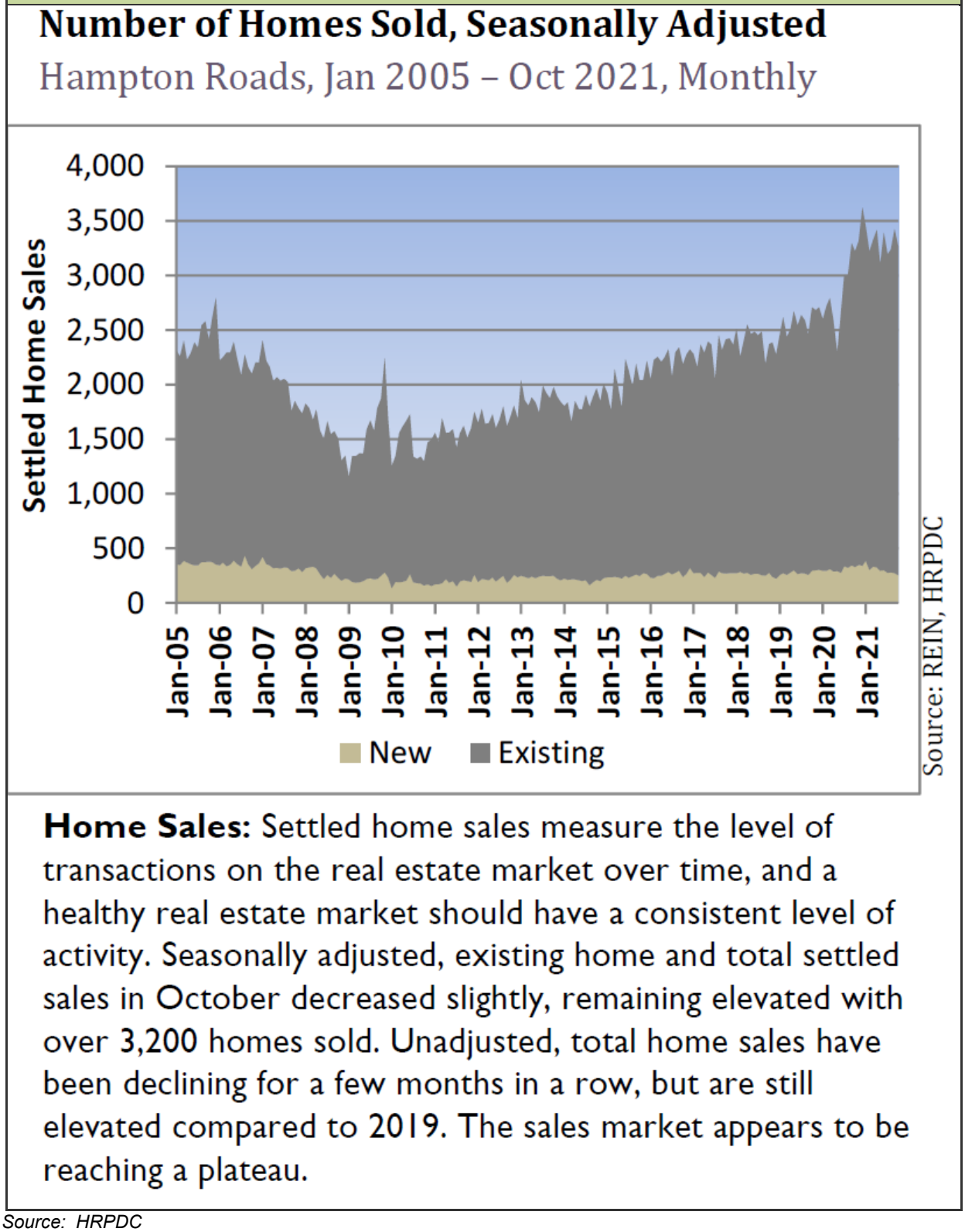
Source: HRPDC

FIGURE 5.42: HAMPTON ROADS UNEMPLOYMENT RATE



Source: HRPDC

FIGURE 5.43: HAMPTON ROADS NUMBER OF HOMES SOLD



Source: HRPDC

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future land use is expected to have less impact on future vulnerability to pandemic flu or communicable disease than the protection of public health through dissemination of proper individual protection measures, emergency notification with regard to flu or disease outbreak and effective vaccines.

Many causes of climate change also increase risk of pandemic, including deforestation, loss of habitat and loss of species. Warming temperatures and increasingly severe rainfall patterns make conditions better for Lyme disease, waterborne diseases and mosquito-borne diseases.

SOCIAL VULNERABILITY

Analysis of the impacts of COVID-19 on populations of varying economic, social and ethnic backgrounds is ongoing at the time of this study. Understanding how the virus spread requires examination of the specific geographic circumstances of where people are *required* to travel. Social isolation was quickly recognized as a critical element in managing the spread, but isolation is not an option for many essential workers who are critical to the healthcare system, food supply chain and transportation systems. There are clear divides in the region's communities regarding who can work from home and who is required to go out in public. COVID-19 clearly did not affect everyone equally. The Virginia Center for Inclusive Communities (https://inclusiveva.org/covid19/) noted the following disparities:

- older adults were more susceptible to the virus itself, leading to large numbers of socially isolated seniors;
- school closures led to food insecurity, disparities in technology and internet access, and a need for special services for students with disabilities and students learning English;
- persons with pre-existing conditions but less access to high quality, preventive healthcare were more susceptible to the virus;
- small businesses with existing banking relationships had better access to State and Federal financial assistance, especially during the early part of 2020;
- inequities related to transportation access impacted how the virus affected individuals;
- and violence against intimate partners, Asians, Islamics and others increased during the pandemic.

Fortunately, as of February 2021, at least seven different vaccines were being administered to the most vulnerable populations throughout the world. Three primary vaccines were being used in Virginia, and by January 31, 2022, over 6.7 million Virginians had received at least one dose, 5.87 million were fully vaccinated, and over 2.4 million had also received a third booster dose.[12]

As COVID-19 demonstrated, the nature and characteristics of a virus, such as how it is transmitted and who is most likely to suffer from severe symptoms, affects the populations most likely to be impacted. Social vulnerability can be influenced by financial health, physical health, mental health and other aspects of where and how a person lives. Similarly, access to virus testing, healthcare for those who contract the virus, and access to medications and vaccinations are all components in an assessment of social vulnerability to each virus and such assessment is difficult to manage while resources are committed to managing an ongoing virus. Communication and outreach to socially vulnerable groups is a key mitigation measure for lessening the impact of viruses that unequally impact demographic groups.

[12] Virginia Department of Health COVID-19 Vaccine Dashboard accessed online at: https://www.vdh.virginia.gov/coronavirus/covid-19-vaccine-summary/

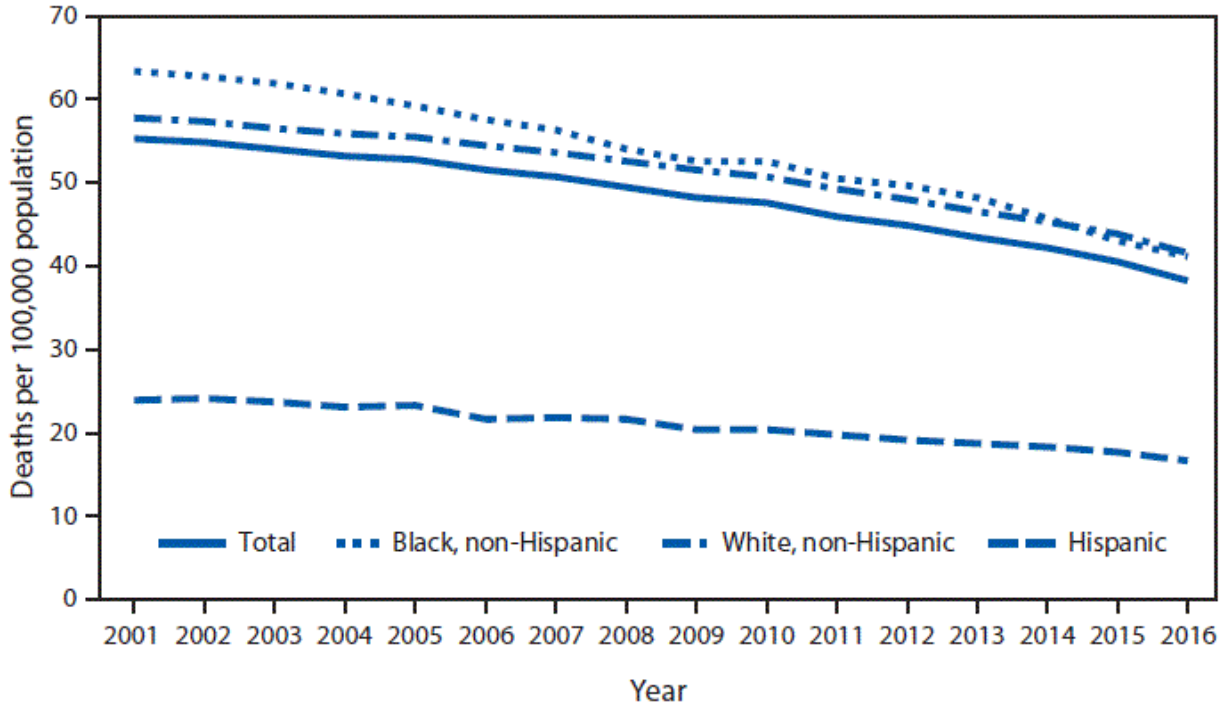
RADON EXPOSURE

ESTIMATES OF POTENTIAL LOSSES

Radon testing in Virginia has been sporadic and not necessarily reported to any single data repository. Thus, the only way to know if any structure or group of structures has a radon problem is to test. Testing of residential structures is easy and inexpensive. Low-cost test kits are available through the mail and at home improvement stores. Qualified testers can also do long-term residential testing and set up systems for testing larger non-residential buildings. Mitigation or treatment of structures with high radon concentrations is also possible, relatively inexpensive and can be very effective if done properly. Testing is most important for structures in the red or orange zones indicated in Figure 4.35, and especially important for structures in which inhabitants spend their time in parts of the structure below ground or in contact with the ground. Future updates to this plan may include identification of specific structure types, for example structures with basements, in any higher radon potential areas to further define vulnerability, especially if the EPA's 1993 map of radon zones is updated based on more testing or other new scientific information.

Unlike many other hazards in this plan, structures are not physically damaged by radon exposure; instead, human lives are directly at risk. CDC QuickStats show that death rates from lung cancer declined between 2001 and 2016. While this stand-alone graph does not attribute the decline in lung cancer deaths to a specific cause, nor does it show the percentage of deaths attributed to radon exposure, the death rates by race/ethnicity provide evidence that there are racial/ethnic disparities in death from lung cancer (see **Figure 5.44**). During this period, the lung cancer death rates for the total population (deaths per 100,000 population) declined from 55.3 to 38.3, as well as for each racial/ethnic group shown. The death rate for the non-Hispanic Black population decreased from 63.3 to 41.2, for the non-Hispanic white population from 57.7 to 41.5, and for the Hispanic population from 23.9 to 16.6. Throughout this period, the Hispanic population had the lowest death rate.

FIGURE 5.44: AGE-ADJUSTED DEATH RATES FROM LUNG CANCER, BY RACE/ETHNICITY, UNITED STATES, 2001-2016



* Deaths per 100,000 population age-adjusted to the 2000 U.S. standard population.

Source: Centers for Disease Control and Prevention, accessed online 4/22/22 at: https://www.cdc.gov/mmwr/volumes/67/wr/mm6730a8.htm

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

According to Memorial Sloan Kettering Cancer Center, major scientific organizations believe that radon contributes to approximately 12% of lung cancers annually in the United States. It is the second leading cause of lung cancer. With 5,820 new cases of lung and bronchus cancer expected in Virginia in 2021, this translates into approximately 700 of those new cases being caused by radon exposure.

Radon levels are very localized and additional testing is needed to verify EPA zones for the study area. There are no federal or state laws that require radon testing prior to a real estate transaction, but some contracts do include radon testing or mitigation contingency clauses, typically at the request of the buyer.

Virginia Code at Section 15.2-2280 gives all red zone (Zone 1) counties and cities the option of requiring passive radon resistant construction features; however, there are no Zone 1 communities in the study area for this plan.

In 1993 the Virginia General Assembly passed legislation that requires all schools in the Commonwealth to be tested for radon after July 1, 1994, and includes any new school buildings and additions built after that date. Each school is required to maintain files of their radon test results.

In the early 1990s the Virginia Department of Education purchased long-term radon test kits that were used to test all Virginia public school K-12 classrooms that were in contact with the ground at that time. Long-term tests are generally more accurate than short term tests because they sample anywhere from 90 to 365 days. Short term tests usually sample for only 2 to 7 days. Since radon levels can fluctuate over time, the longer the test duration, the more accurate the results will be. The EPA school testing protocol recommends testing during the heating season which runs roughly from late October through the end of March. A VDH review of the original testing data from the long-term tests done at that time indicated that some of these test results were not valid or usable due to:

- School classrooms not being identified on the test report;
- Testing periods that were outside of the preferred heating season; and
- Improper testing of unoccupied areas such as boiler and storage rooms.

In general, radon test results for the vast majority of school classrooms in Virginia are below the EPA action level of 4.0 pCi/L for indoor air. For the few classrooms that have shown elevated radon levels, the problem was usually solved by making adjustments to the school's HVAC system. However, in some cases the HVAC adjustments did not work and a radon mitigation system was installed to reduce the radon to acceptable levels. Future updates to this plan may include evaluation of school data for study area schools, as available. Calls to VDH regarding availability of the data for the purposes of this plan were not returned.

With regard to future climate change, changes in the environment and human behavior may alter the risks associated with radon for individual buildings. According to the EPA, the primary factors that influence radon entry into buildings include: 1) radon content of the soil; 2) pressure differential between the interior of a structure and the soil; 3) air exchange rate for the building; 4) moisture content surrounding the structure; and 5) presence and size of entry pathways. Climate change can affect these same factors and, therefore, may cause direct or indirect changes in indoor air quality within a structure. In addition, certain changing human behavioral factors driven by climate change may further impact air quality. Examples of how climate change may impact indoor air quality include:

- Increased Air Conditioning and Decreased Fan Usage: air conditioning used as a result of rising temperatures contributes to "closed house conditions" and reduced stratification of radon between floors;

- Activity Patterns and Spatial Radon Variation: rising outdoor temperatures may result in increased use of basements where radon concentrations are generally higher;

- Weatherization and Energy Efficiency: although undetermined, tightening structures for energy efficiency may increase radon concentrations for structures with indoor radon sources;

- Weather-Related Influences: increased wind can change pressure differentials between structure levels and the outside, and increased precipitation rates or totals may change hydrologic conditions causing a rise in the water table and force vapors from the vadose zone, or unsaturated zone, into a less dense media, such as a basement.

- High Density Housing: concrete construction used in high density housing (constructed to reduce greenhouse emissions) may be an increasing source of elevated radon exposure for some occupants.

SOCIAL VULNERABILITY

The CDC ATSDR created a Social Vulnerability Index geared toward preparing for and responding to exposure to dangerous chemicals (and other natural hazards, as well). This index is better suited to examining the social vulnerability related to hazardous materials incidents, although many of the inputs are the same as the NRI. Overall vulnerability for this index is based on: socioeconomic status (below poverty, unemployed, income, no high school diploma); household composition and disability (aged 65 or older,

aged 17 or younger, civilian with disability, single-parent households); minority status and language; and housing type and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

The ATSDR map provided above in **Figure 5.40** shows the highest social vulnerability to radon exposure, is in the east end of Newport News, eastern Surry County, a corridor in Southampton County, and pockets in Suffolk, Chesapeake, Portsmouth, Norfolk and Virginia Beach. Perhaps once more information is collected regarding the underlying geology of the region and the relationship to radon, this map can be further refined in the future to more accurately isolate the social vulnerability to radon. Structure-specific data regarding age and existence of basements could also be incorporated to further enhance the analysis.

CONCLUSIONS ON HAZARD RISK

The risk and vulnerability assessment performed for the Hampton Roads region provides significant findings that allow committee members to prioritize hazard risks and proposed hazard mitigation strategies and actions. Prior to assigning conclusive risk levels for each hazard, the committee reviewed the results of the assessments shown in the following tables.

Damages and frequency information from the risk and vulnerability assessments are summarized in **Table 5.15**. This table provides a quantitative assessment of existing data for the hazards, recognizing that some hazards are not readily assessed, nor are the assessments truly comparable.

TABLE 5.15: SUMMARY OF QUANTITATIVE ASSESSMENT

HAZARD	AVERAGE ANNUAL ESTIMATED LOSSES
Sea Level Rise and Land Subsidence	$130.8 million by 2040
Tropical/Coastal Storm	$86,913,000
Flooding	$44,261,400
Tornado	$24,265,000
Earthquake	$1,119,000
Winter Storm	$805,000
Hazardous Materials Incident	$67,500
Wildfire	$36,900
Extreme Heat	Negligible*
Flooding Due to Impoundment/High Hazard Dam	Not quantified
Landslide/Coastal Erosion	Not quantified
Radon Exposure	Not quantified
Pandemic Flu or Communicable Disease	Not quantified
Drought	Not quantified

*Extreme heat event impacts are believed underreported by NCEI data.

Risk level ranking was based on historical and anecdotal data, as well as input from committee members. This ranking was done collaboratively in Workshop #1 for each hazard, using the matrix shown in **Figure 5.45**. Each hazard was discussed and analyzed based on the participants' knowledge about consequences and likelihood. This risk scoring approach is a simplified method for estimating risk that is easy to understand, based on a method developed for the Australian Institute for Disaster Resilience (AIDR)[13]. Scores from likelihood and consequence are then multiplied to provide a risk score, as shown in **Table 5.16**. Flooding and Impoundment Failure/High Hazard Dam were grouped for simplicity's sake.

[13] AIDR. (2015). *Handbook 10: National Emergency Risk Assessment Guidelines*. 2nd Edition. Australian Institute for Disaster Resilience, Australian Government Attorney-General's Department.

FIGURE 5.45: AIDR RISK RANKING FOR EACH HAZARD

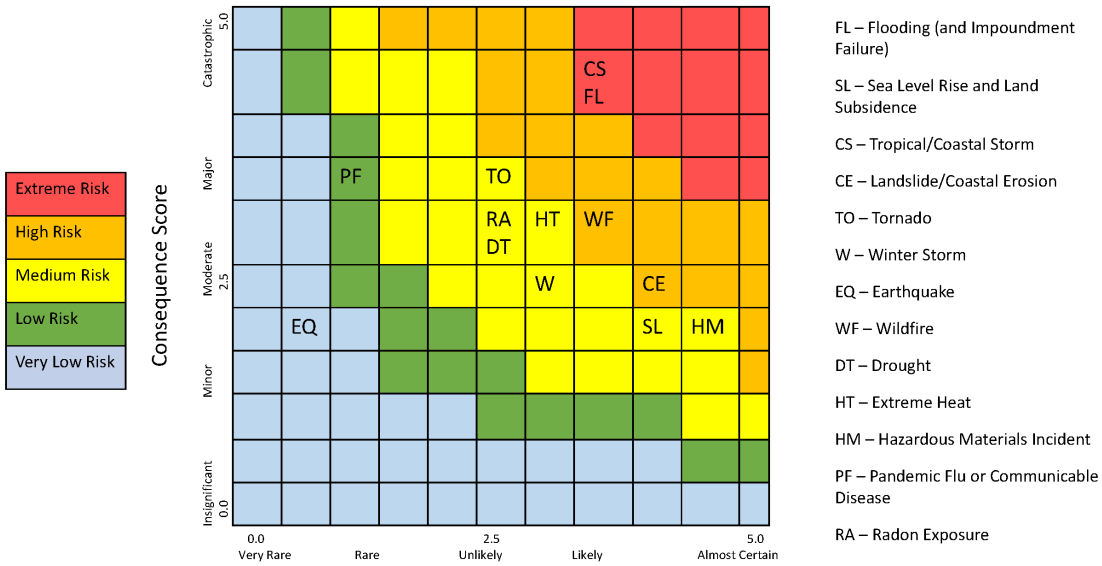


TABLE 5.16: AIDR RISK SCORES FOR EACH HAZARD

Hazard	Risk Score	Risk Description
Flooding	15.75	Extreme
Coastal/Tropical Storm	15.75	Extreme
Wildfire	10.5	High
Landslide/Coastal Erosion	10	High
Hazardous Materials Incident	9	Medium
Tornado	8.75	Medium
Extreme Heat	9	Medium
Sea Level Rise	8	Medium
Radon Exposure	7.5	Medium
Drought	7.5	Medium
Winter Storm	7.5	Medium
Pandemic Flu or Communicable Disease	3.5	Low
Earthquake	1	Very Low

The conclusions drawn from the assessments, combined with an examination of the rankings in the 2017 plan, as well as final determinations and discussion with committee members, were inserted into three categories for a final summary of hazard risk for the region based on High, Moderate, Low, or Negligible designations (**Table 5.17**). Although some hazards are classified as posing Low or Negligible risk and the impacts to infrastructure are limited, their occurrence and damages are still possible in the region.

TABLE 5.17: CONCLUSIONS ON HAZARD RISK FOR HAMPTON ROADS	
CRITICAL HAZARD - HIGH RISK	FLOODING TROPICAL/COASTAL STORM SEA LEVEL RISE AND LAND SUBSIDENCE
CRITICAL HAZARD - MODERATE RISK	WINTER STORM TORNADO HAZARDOUS MATERIALS INCIDENT
NONCRITICAL HAZARD - LOW RISK	EARTHQUAKE WILDFIRE FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM PANDEMIC FLU/COMMUNICABLE DISEASE RADON EXPOSURE
NEGLIGIBLE	EXTREME HEAT LANDSLIDE/SHORELINE EROSION DROUGHT

CAPABILITY ASSESSMENT

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2022 UPDATE

Section 6 was updated to combine capabilities of all communities based on the existing plans and updated information collected from interviews, phone calls, and committee work during the update process. The following major changes were incorporated:

1) All tables were updated to reflect new information;
2) Mitigation actions completed by communities and their methods of integrating hazard mitigation principles across plans and departments was updated and summarized;
3) Surry County and towns were appended to the section where necessary, and,
4) A brief section detailing regional capabilities and the Commonwealth's resiliency efforts was updated.

INTRODUCTION

This section of the Plan discusses the capability of Hampton Roads communities with regard to hazard mitigation activities, and consists of the following four subsections:

- WHAT IS A CAPABILITY ASSESSMENT?
- CONDUCTING THE CAPABILITY ASSESSMENT
- CAPABILITY ASSESSMENT FINDINGS
- INTEGRATING MITIGATION INTO COMMUNITY LIFE

WHAT IS A CAPABILITY ASSESSMENT?

The purpose of conducting a capability assessment is to confirm that the community's resulting mitigation strategy is based on the principles found in (or missing from) existing authorities, policies, programs, and resources, and based on the community's ability to expand and improve these existing tools. This planning process strives to establish goals, objectives, and actions that are feasible, based on an understanding of the organizational capacity of the departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be

implemented over time given a local government's planning and regulatory framework, level of administrative and technical support, level of fiscal resources, and current political climate.

Careful examination of local capabilities helps detect existing gaps, shortfalls, or weaknesses within ongoing government activities that could hinder proposed mitigation activities or exacerbate hazard vulnerability. A capability assessment highlights positive mitigation measures already in place or being implemented at the local and regional levels, which should continue to be supported and enhanced through future mitigation efforts.

CONDUCTING THE CAPABILITY ASSESSMENT

In order to inventory and analyze Hampton Roads' community capabilities, the planning committee and consultant requested information on a variety of "capability indicators" such as existing local plans, policies, programs, or ordinances that may reduce, or in some circumstances, increase the community's hazard vulnerability. The matrix of capability indicators has been built by the consultant over several years of gathering capability information, and on review of numerous documents relating to factors that impact community capability. Other indicators included information related to each community's fiscal, administrative and technical capabilities such as access to local budgetary and personnel resources necessary to implement mitigation measures. Identified gaps, weaknesses, or conflicts can be recast as opportunities to implement specific mitigation actions.

For the 2022 update, the planning committee was asked to review and provide feedback on: the existing plan's capability assessment, and a presentation at the second meeting of the planning subcommittee. The presentation included information on possible new mitigation actions, and other relevant regional and state capabilities. This section has been updated based on feedback from these reviews and discussions during the Committee meetings as well as in person meetings conducted with many of the communities toward the end of the planning process.

CAPABILITY ASSESSMENT FINDINGS

PLANNING AND REGULATORY CAPABILITY

Planning and regulatory capability is based on the implementation of plans, ordinances and programs that demonstrate each local jurisdiction's commitment to guiding and managing growth, including reconstruction following a disaster. Examples include emergency response, mitigation and recovery planning, comprehensive land use planning, transportation planning, and capital improvements planning. Additional examples include the enforcement of zoning or subdivision ordinances and building codes. These planning initiatives present significant opportunities to integrate hazard mitigation principles and practices into the local decision making process.

This assessment is designed to provide a general overview of the key planning and regulatory tools in place or under development in Hampton Roads, along with their potential effect on hazard loss reduction. This information will help identify opportunities to address existing gaps, weaknesses or conflicts in the hazard mitigation strategy.

Table 6.1 provides a summary of the relevant local plans, ordinances, and programs already in place or under development. A checkmark (✓) indicates that the item is currently in place and being implemented. A "C" indicates that the item is in place for a town but is maintained and administered by the County.

TABLE 6.1: RELEVANT PLANS, ORDINANCES, AND PROGRAMS

COMMUNITY	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Program	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evacuation Plan	Disaster Recovery Plan	Capital Improvements Plan	Economic Development Program	Historic Preservation Plan	Flood Damage Prevention Ordinance (feet freeboard)	Zoning Ordinance	Subdivision Ordinance	Unified Development Ordinance	Post-disaster Redevelopment Plan	Building and Fire Code	NFIP	NFIP Community Rating System
PENINSULA																						
Hampton	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓(3)	✓	✓			✓	✓	✓
Newport News	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓(2)	✓	✓			✓	✓	✓
Poquoson	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓			✓(3)	✓	✓			✓	✓	✓
Williamsburg	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓			✓	✓	
James City County	✓	✓			✓	✓	✓	✓	✓	✓		✓			✓(2)	✓	✓			✓	✓	✓
York County	✓	✓			✓	✓	✓	✓	✓	✓		✓			✓(3)	✓	✓			✓	✓	✓
SOUTHSIDE																						
Norfolk	✓	✓			✓	✓	✓	✓		✓		✓		✓	✓(3)	✓	✓			✓	✓	✓
Portsmouth	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓(3)	✓	✓			✓	✓	✓
Suffolk	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓			✓	✓	
Virginia Beach	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓(2)	✓	✓			✓	✓	✓
Chesapeake	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓(1.5)	✓	✓			✓	✓	✓
WESTERN TIDEWATER																						
Isle of Wight County	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓(1.5)	✓	✓			✓	✓	
Smithfield	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
Windsor	✓	✓			✓		✓	✓		✓		✓			✓	✓	✓			✓	✓	
Franklin	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓(2)	✓	✓		✓	✓	✓	✓
Southampton County	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓			✓(1.5)	✓	✓			✓	✓	
Boykins	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Branchville	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Capron	✓	✓			✓	C	C	C	C	✓			✓			✓	✓			✓		
Courtland	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Ivor	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Newsoms	✓	✓			✓	C	C	C	C	✓			✓			✓	✓			✓		
Surry County	✓	✓			✓	✓		✓		✓		✓	✓	✓	✓	✓	✓			✓	✓	
Claremont	✓	✓			✓	C		C		✓					✓	✓	✓			✓	✓	
Dendron	✓	✓			✓	C		C		✓						✓	✓			✓		

Emergency Management

Hazard mitigation is one of four primary phases of emergency management. The three other phases include preparedness, response, and recovery. Each phase is interconnected with hazard mitigation as **Figure 6.1** suggests. Opportunities to reduce potential losses through mitigation practices are ideally implemented before a disaster strikes. Examples include the acquisition or elevation of flood-prone structures or the enforcement of regulatory policies that limit or prevent construction in known hazard areas. The post-disaster environment provides an important "window of opportunity" to implement hazard mitigation projects and policies. During this time period, federal disaster assistance, such as the Hazard Mitigation Grant Program (HMGP), may be available. In addition, elected officials and disaster victims may be more willing to implement mitigation measures in order to avoid similar events in the future.

FIGURE 6.1: FOUR PHASES OF EMERGENCY MANAGEMENT



Source: Federal Emergency Management Agency

Planning for each phase is a critical part of a comprehensive emergency management program and key to the successful implementation of hazard mitigation actions.

Hazard Mitigation Plan: A hazard mitigation plan represents a community's blueprint for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment and mitigation strategy.

Disaster Recovery Plan: A disaster recovery plan guides the physical, social, environmental, and economic recovery and reconstruction process following a disaster. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing

on opportunities to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

- Virginia Department of Emergency Management (VDEM) assists local governments with plan development and revisions by offering the following services:
  - Issuing update notification at both 1 year and 6 months;
  - Conducting a plan review, as requested;
  - Facilitating plan review meetings; and,
  - Developing plan templates through collaboration with local partners.
- In December 2015, VDEM released *2015 Report on the Status of Emergency Response Plans and Preparedness Efforts in the Commonwealth*. According to the report, 98-percent of Virginia localities have current local emergency operations plans. Virginia was accredited for the third time in a row by the Emergency Management Assessment Program. Recommendations from the report included implementing statewide disaster planning software to digitize all EOPs to increase efficiency and coordination between agencies and localities and using common operating picture tools to provide situational awareness to state leaders in real-time.
- Emergency Managers for each city and county were included in preparation of the MAP because their knowledge of their jurisdiction's EOP and its strengths and weaknesses is a valuable component of this planning process.

Continuity of Operations Plan (COOP): A continuity of operations plan establishes a clear chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster. Many Emergency Managers in communities without comprehensive COOPs for all internal agencies were interested in supplementing their existing EOP or existing COOP with additional planning and this insight was included in the MAP planning process.

Radiological Emergency Plan: A radiological emergency plan delineates roles and responsibilities for assigned personnel and the means to deploy resources in the event of a radiological accident.

- The Virginia plan for radiological emergencies is available online at: https://www.nrc.gov/docs/ML0834/ML083470907.pdf.

SARA Title III Emergency Response Plan: A SARA Title III Emergency Response Plan outlines the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. These plans are required by federal law under Title III of the Superfund Amendments and Re-authorization Act (SARA), and the Emergency Planning and Community Right-to-Know Act (EPCRA).

General Planning

The implementation of hazard mitigation activities involves departments and individuals in a broad range of professions. Stakeholders may include local planners, public works officials, economic development specialists, and others. Concurrent local planning efforts can complement hazard mitigation goals even though they are not designed as such.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. Typically, a comprehensive plan is comprised of demographic conditions, land use patterns, transportation elements and proposed community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can serve as a far reaching, long-term risk reduction tool.

- Virginia law requires that all communities have a comprehensive land use plan and that it be updated every five years.
- As indicated in Sections 2 and 3, the comprehensive plans for each of the counties and cities involved in this planning process were relied upon for three planning stages: 1) updating the community profile; 2) comprehensive plan goals and objectives were reviewed during the updating of this plan's goals and objectives; and 3) each comprehensive plan was reviewed by the consultant prior to the in-person meetings to identify mitigation plan conflicts or areas of potential integration/coordination. This process helps make sure that the comprehensive plans and the hazard mitigation plan are in parallel.

Capital Improvements Plan (CIP): A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism to guide future development away from identified hazard areas, or to fix infrastructure problems that contribute to hazard-related damage. Limiting public investment in hazardous areas is one of the most effective long-term mitigation actions available to local governments. Jurisdictions with CIPs were able to pull projects from the CIP that reflect the goals and objectives of mitigation planning, and vice versa. CIPs often include more detail on projects costs, allowing the hazard mitigation plan actions to be described in more detail. In this way, the community CIPs and hazard mitigation plan share similar projects.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards to include the identification of the most effective way to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards or are within a historic district that cannot be easily relocated out of harm's way.

Zoning Ordinances: Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the public health, safety and welfare. Since zoning regulations enable municipal governments to limit the type and density of development, it can serve as a powerful tool when applied in identified hazard areas.

- The Virginia General Assembly enacted the Chesapeake Bay Preservation Act in 1988, requiring local governments statewide to include water quality protection measures in their zoning and subdivision ordinances and in their comprehensive plans. Although the Act was developed with the intent of improving water quality throughout Virginia, the regulations have the additional benefit of controlling or restricting development in floodplain areas. The CBPA Overlay District consists of three components: Resource Protection Area (RPA) that includes a 100 foot RPA buffer, a Resource Management Area (RMA), and the Intensely Developed Areas (IDA). The lands that make up Chesapeake Bay Preservation Areas are those that have the potential to impact floodplains and water quality most directly. Generally, there are two main types of land features: those that protect and benefit water quality (RPAs); and those that, without proper management, have the potential to damage water quality (RMAs). Areas with intensive waterfront industrial land uses and activities are categorized as IDAs.
- Floodplain management ordinances in Virginia communities are commonly administered as zoning overlay districts in the community zoning ordinance.
- Zoning ordinance floodplain management overlay district regulations were reviewed by the consultant prior to in person meetings with the jurisdictions. The review helped identify areas of potential improvement to the ordinances.

Subdivision Ordinances: A subdivision ordinance regulates development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development. For the 2017 update to this plan, the consultant reviewed subdivision ordinances and recommended potential areas of improvement related to hazard mitigation.

Building Codes, Permitting and Inspections: Building codes regulate design and construction standards. Permits are issued and work is inspected on new construction and building alterations. Permitting and inspection processes both before and after a disaster can affect the level of hazard risk faced by a community.

- Under Virginia Law the Department of Housing and Community Development (DHCD) has authority to promulgate building regulations and a regulatory process for development and adoption of a statewide mandatory mini/maxi construction code that all 167 units of local government (counties and incorporated cities) must adopt and implement. The Virginia Uniform Statewide Building Code (USBC) is administered by the Virginia Board of Housing and Community Development and regulates construction and maintenance of buildings and structures. Effective July 1, 2021, Virginia adopted the 2018 I-codes as referenced in the Virginia Construction Code Part 1, the 2018 Statewide Fire Prevention Code; and the 2017 National Electrical Code. Implementation for state colleges and universities is the responsibility of the Virginia General Services Department. The State Fire Marshal within DHCD is responsible for statewide implementation of the Fire Code unless localities elect to adopt this code at the local level. Localities can and do adopt the Property Maintenance Code, which is within the scope of the statewide code. Enforcement of the USBC is the responsibility of the local government's building inspections department. Many of the towns in the study area rely upon the county building department for code-related functions.
- The consultant for this plan update reviewed Appendix F of the International Codes related to radon control. This appendix was discussed with the communities for this update to determine if any communities were interested in enforcing Appendix F in view of the HIRA information regarding Radon Exposure risk.

Resiliency Planning: In 2021, the Commonwealth worked with 2,000 stakeholders to build the *Coastal Resilience Master Plan*. This plan documents which land is exposed to coastal flooding hazards now and into the future, as well as the impacts of future flooding scenarios on coastal Virginia's community resources and manmade and natural infrastructure.

The Master Plan concluded that between 2020 and 2080:

- the number of residents living in homes exposed to extreme coastal flooding is projected to grow from approximately 360,000 to 943,000, an increase of 160%;
- the number of residential, public, and commercial buildings exposed to an extreme coastal flood is projected to increase by almost 150%, from 140,000 to 340,000, while annualized flood damages increase by 1,300% from $0.4 to $5.1 billion;
- the number of miles of roadways exposed to chronic coastal flooding is projected to increase from 1,000 to nearly 3,800 miles, an increase of nearly 280%; and
- an estimated 170,000 acres, or 89%, of existing tidal wetlands and 3,800 acres, or 38%, of existing dunes and beaches may be permanently inundated, effectively lost to open water.

The Commonwealth intends to develop successive updates of the Master Plan on at least a five-year cycle, managed by the Department of Conservation and Recreation in consultation with the Chief Resilience Officer, the Special Assistant to the Governor for Coastal Adaptation and Protection, and the Technical Advisory Committee.

The next phase of the Master Plan anticipated by 2024, will aim to address recommendations of the Technical Advisory Committee to broaden the analysis of natural hazards by including rainfall-driven, riverine, and compound flooding, expand and improve the inventory of resilience projects by continuing to add efforts and working with project owners to better understand the benefits of projects, and extend this critical work beyond the coastal region to encompass statewide resilience needs.

Projects identified in the Master Plan must go through a specified resiliency planning process to be funded through the Community Flood Preparedness Fund (CFPF), also launched in 2021. Many communities in Hampton Roads have begun the planning process, and consequently, those communities were able to incorporate many of their projects into the hazard mitigation plan, as well. CFPF is a

statewide program maintained by the Department of Conservation and Recreation that fills pressing needs by prioritizing low-income communities and provides a permanent funding stream to finance flooding resilience projects, studies, and capacity building initiatives. The Regional Greenhouse Gas Initiative (RGGI) is an initiative made up of eleven states that aims to reduce greenhouse gas emissions. RGGI holds carbon dioxide auctions, which will fund the Virginia CFPF.

Radon Exposure Remediation:
The Code of Virginia requires that Radon testers and mitigators be currently certified by either the National Radon Proficiency Program or the National Radon Safety Board. The program is administered by Virginia Department of Health, Office of Radiological Health, Indoor Radon Program.

- In 1993 the Virginia General Assembly passed legislation that requires all schools in the Commonwealth to be tested for radon after July 1, 1994, and also any new school buildings or additions built after that date. Each school is required to maintain files of their radon test results.
- Upon request, the Department's Radon Coordinator can present a course on radon for real estate transactions in Virginia. This information was reviewed and incorporated into the HIRA and the public meeting presentations on radon provided during this update process.
- The department has a limited supply of radon test devices that are distributed annually, free upon request.

Floodplain Management

The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary but is promoted by FEMA as a crucial means to implement and sustain an effective hazard mitigation program.

In order to join the NFIP, a community must adopt flood damage prevention ordinance development standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings be protected from damage by the 100-year flood, and that new floodplain development does not aggravate existing flood problems or increase damage to other properties.

Another key service provided by the NFIP is the identification of flood hazard areas. FIRMs are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community.

Detailed information on each community's NFIP participation history and current map status is provided in Sections 5 and 6; **Table 5.3** summarizes NFIP participation for Hampton Roads communities, along with general NFIP policy data, while **Tables 5.4** and **5.5** provide the repetitive flood losses; and **Table 6.1** provides information on freeboard requirements. Each of the communities that participates in the NFIP has designated a floodplain manager in their floodplain management ordinance and each community in the NFIP has created a very specific Mitigation Action in the Mitigation Action Plan in Section 7 that addresses actions they will consider in the near-term to address their commitment to continuing their participation in the NFIP. Noteworthy accomplishments in floodplain management are also found at the end of this section, broken out by community. **Table 6.2** provides additional summary information on how the NFIP is managed in each of the participating communities in Hampton Roads and notes specific actions or programs of interest in each community, especially with regard to their flood ordinances.

Effective January 1, 2022, a new flood disclosure requirement of Virginia Code Section 55.1-708.2, requires that an owner of residential real property who knows that the dwelling unit is a repetitive risk loss structure must disclose such fact to the purchaser. A "repetitive risk loss structure" is defined as a property for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program within any rolling 10-year period since 1978. The law further requires that the owner of a property subject to the disclosure requirement must provide notification to the purchaser of any disclosure before the ratification of a contract.

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES

SUBREGION	COMMUNITY	Designated Floodplain Manager/Agency	CFM on Staff?	Notes on Floodplain Management Ordinance and Administration
Peninsula	Hampton	Zoning Administrator	Yes	The city last updated their ordinance in 2016 and included 3 feet of freeboard in the SFHA and 1.5 feet of freeboard outside the SFHA. Most ordinance administration is by Community Development or Public Works. ECs are maintained in digital format.
	Newport News	City Manager	Yes	Ordinance was updated in 2014 and requires 2 feet freeboard. Codes Compliance maintains ECs and performs inspections of floodplain construction. City recently joined the CRS.
	Poquoson	Building Official	Yes	Last updated in 2014, the city's ordinance has many higher standards, including coastal A Zone, and freeboard of 3 feet. The ordinance is administered by the Building Official within the Permit Office.
	Williamsburg	Zoning Administrator	No	The city last updated their ordinance in 2015, adopting the State's model ordinance, with 2 feet of freeboard for nonresidential structures and 18 inches for residential structures. The narrow floodplains of Williamsburg do not lend themselves to development pressure.
	James City County	Zoning Administrator	Yes	The ordinance was last updated in 2018 and includes 2 feet of freeboard, and many prohibited uses in the SFHA. It also has higher standards for fill. Community Development office administers the ordinance. Ordinance addresses accessory structures.
	York County	Chief of Stormwater Programs	Yes	The ordinance requires 3 feet of freeboard for residential structures and an additional foot of freeboard for structures in the Coastal A Zone.
Southside	Norfolk	Floodplain Administrator (Planning)	Yes	Revisions to ordinance approved 2020 with several higher standards, including 3 feet freeboard, and coastal A zone regulation to V Zone standards. City has robust flood mitigation program, CRS program and ordinance administration system through city Planning, Building Safety and the Development Services Center.
	Portsmouth	Environmental Manager	Yes	Last updated in 2015, the ordinance requires 3 feet freeboard and V Zones requirements for Coastal A Zone structures. Zoning-related inquiries and information regarding floodplains is handled by the Department of Neighborhood Advancement. The city has a robust flood mitigation program and CRS program.
	Suffolk	Director of Planning and Community Development	No	The floodplain management ordinance was updated in 2015. Flood damage is tied to the assessor's record for properties. High water mark data are collected along the Nansemond River at North Main Street. The city does not maintain ECs digitally.
	Virginia Beach	Public Works Director	Yes	The city ordinance requires 2 feet of freeboard. The ordinance was last updated in 2020. A

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES

SUBREGION	COMMUNITY	Designated Floodplain Manager/Agency	CFM on Staff?	Notes on Floodplain Management Ordinance and Administration
				major rewrite in 2013 had several higher standards, including compensatory fill in specified areas, and no new residential structures on lots created after October 23, 2001. 38% of the SFHA is protected as open space. Lowest floor data for new structures is recorded in online permit record and EC are attached to Certificate of Occupancy. City has a Southern Rivers watershed buffer and the CBPA buffers which help protect natural and beneficial functions of floodplains.
	Chesapeake	Director of Development and Permits	Yes	Ordinance was updated in 2014 and includes 1.5 feet of freeboard. The city maintains ECs digitally.
Western Tidewater	Isle of Wight County	Director of Planning and Zoning	Yes	The County has freeboard of 1.5 feet required in their 2015 ordinance, has no freeboard outside the SFHA.
	Smithfield	Planning & Zoning Administrator	No	2015 ordinance has 1.5 feet freeboard and is administered by Planning, Engineering & Public Works.
	Windsor	Planning and Zoning	No	Ordinance does not require freeboard and is administered by Planning and Zoning Department.
	Franklin	Zoning Administrator	Yes	The city updated ordinance in 2016; requires freeboard of 2 feet. City routinely considers higher standards and the impact when updating ordinance. The Comprehensive Plan promotes a greenway along the Blackwater River and zoning protects open space along the river. The city recently joined the CRS. Online maintenance of ECs is under development. The Downtown area has an older Flood Recovery Plan.
	Southampton County	Director of Community Development	Yes	The County adopted State Model Floodplain Ordinance and included 1.5 feet of freeboard. Residential structures are required to have large, front-yard-type, setbacks along waterfront, rather than smaller rear yard setbacks. Comprehensive Plan encourages conservation easements/ag and forestal districts and reforestation of clear-cut properties plus environmental goals to protect waterways and wetlands. Nottoway and Blackwater Rivers are part of State Scenic River program, limiting development that visually impacts rivers, thereby helping limit development in the floodplain.
	Boykins	Mayor	No	Ordinance requirements administered by town staff, as required.
	Branchville	Unknown	No	Ordinance requirements administered by town staff, as required.
	Courtland	Mayor	No	Ordinance requirements administered by town staff, as required.

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES				
SUBREGION	COMMUNITY	Designated Floodplain Manager/Agency	CFM on Staff?	Notes on Floodplain Management Ordinance and Administration
	Ivor	Clerk	No	Ordinance requirements administered by town staff, as required.
	Surry County	Planning & Community Development Director	No	Ordinance was updated in 2015. Unclear on freeboard as ordinance contains template language: "recommend for > 1 foot".
	Claremont	Information not provided	No	Ordinance not available online and not provided by Town.

An additional indicator of floodplain management capability is participation in the CRS. The CRS is an incentive program that encourages communities to undertake defined flood mitigation activities that go above and beyond the minimum requirements of the NFIP, adding extra local measures to provide protection from flooding. The creditable CRS mitigation activities are assigned a range of point values. As points are accumulated and identified thresholds are reached, communities can apply for an improved CRS class rating. Class ratings, which run from 10 to 1, are tied to flood insurance premium reductions as shown in **Table 6.3**. As class ratings improve (decrease), the percent reduction in flood insurance premiums for NFIP policy holders in that community increases. Every 500 points accumulated is equal to a 5% reduction in flood insurance premiums in the SFHA; premium discounts are typically limited to 5% outside the SFHA.

TABLE 6.3: CRS PREMIUM DISCOUNTS, BY CLASS	
CRS CLASS	PREMIUM REDUCTION
1	45 percent
2	40 percent
3	35 percent
4	30 percent
5	25 percent
6	20 percent
7	15 percent
8	10 percent
9	5 percent
10	0 percent

Source: Federal Emergency Management Agency

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10.

- As of January 2022, there were ten communities in the study area participating in the Community Rating System: Hampton (Class 7); Newport News (Class 7); James City County (Class 5); Norfolk (Class 5); Poquoson (Class 8); Portsmouth (Class 7); Chesapeake (Class 7); York County (Class 7); Virginia Beach (Class 7); and Franklin (Class 9). Successful participation in the CRS shows continued compliance with the NFIP on the part of these communities. Newport News and Franklin are the most recent communities to join CRS and their premium discounts will begin in Spring 2021. Virginia Beach joined in 2019.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for the identification and implementation of corrective and preventative measures specifically designed to reduce the impacts of floods.

- The City of Portsmouth is the only community in the study area that has adopted a separate floodplain management plan, but the community has decided to use the hazard mitigation planning process to develop and enact flood mitigation activities in the future rather than maintaining both documents separately.

Open Space Management Plan: An open space management plan is designed to preserve, protect and restore largely undeveloped lands, and to expand or connect areas in the public domain, including parks, greenways and other outdoor recreation areas. Open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state.

Stormwater Management Plan: A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of frequent urban nuisance flooding.

- Virginia Department of Environmental Quality (VDEQ) is the lead agency for developing and implementing statewide stormwater management and nonpoint source pollution control programs to protect the Commonwealth's water quality and quantity. Currently, three laws apply to land disturbance activity in Virginia: the Stormwater Management Act (§ 62.1-44.15:24 et seq.), Erosion and Sediment Control Law (§ 62.1-44.15:51 et seq.), and Chesapeake Bay Preservation Act (§ 62.1-44.15:67 et seq.). These laws evolved at different times, have been administered by different agencies throughout the years, and created three distinct regulatory programs with varying requirements. At the request of the Chairs of the Virginia House and Senate Natural Resources committees, DEQ pulled together a group of stakeholders to consider ways to streamline and possibly combine these programs. The goal is to make the requirements clearer, more consistent and more “user-friendly”, while continuing to ensure the protection of the Commonwealth’s water quality. The Department asked representatives of all affected constituencies to take part in this important effort – including local governments, the development community, environmental organizations, agriculture, and others.
- Local governments in Virginia are required to administer the stormwater management and erosion and sediment control laws and regulations promulgated by the State through local ordinances. Surry County’s program is administered directly by DEQ.
- As part of this update, the contractor reviewed the City of Virginia Beach’s Stormwater ordinance to understand the higher standards that the City has incorporated above and beyond the State minimum requirements.

Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability is evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability associated with the implementation and success of proposed mitigation activities. Technical capability is evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using GIS to assess community hazard vulnerability.

Staff interviews were used to capture information on administrative and technical capability through the identification of available staff, and available personnel resources, whether through consultants or collaborators with community government. **Table 6.4** provides a summary of the results. A checkmark (✓) indicates that local staff members are tasked with the services listed.

TABLE 6.4: RELEVANT STAFF / PERSONNEL RESOURCES

COMMUNITY	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems and/or HAZUS	Resource development staff or grant writers
PENINSULA										
Hampton	✓	✓	✓	✓	✓			✓	✓	✓
Newport News	✓	✓	✓	✓	✓			✓	✓	✓
Poquoson	✓	✓	✓	✓	✓		✓			✓
Williamsburg	✓	✓	✓	✓	✓			✓	✓	✓
James City County	✓	✓	✓	✓	✓			✓	✓	
York County	✓	✓	✓	✓	✓				✓	
SOUTHSIDE										
Norfolk	✓	✓	✓	✓	✓				✓	✓
Portsmouth	✓	✓	✓	✓	✓	✓		✓	✓	✓
Suffolk	✓	✓	✓	✓				✓	✓	✓
Virginia Beach	✓	✓	✓	✓	✓	✓		✓	✓	
Chesapeake	✓	✓	✓	✓	✓	✓			✓	✓
Franklin	✓	✓	✓	✓	✓			✓	✓	

TABLE 6.4: RELEVANT STAFF / PERSONNEL RESOURCES										
COMMUNITY	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems and/or HAZUS	Resource development staff or grant writers
WESTERN TIDEWATER										
Isle of Wight County	✓	✓	✓	✓					✓	
Smithfield	✓	✓	✓	✓					✓	
Windsor										
Southampton County	✓	✓	✓	✓	✓			✓	✓	✓
Boykins		✓								
Branchville										
Capron										
Courtland	✓	✓								
Ivor										
Newsoms										
Surry County	✓	✓	✓	✓	✓		✓	✓	✓	✓
Claremont					✓					
Dendron										

Fiscal Capability

The ability of a local government to take action is often closely associated with the amount of money available to implement policies and projects. This may take the form of grant funding or locally-based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied to staff time or administrative costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project such as the acquisition of flood-prone homes, which can require a substantial commitment from local, state and federal funding sources.

Staff interviews were used to capture information on fiscal capability through the identification of locally available financial resources. **Table 6.5** provides a summary of the results. A checkmark (✓) indicates that the listed fiscal resource is locally available for hazard mitigation purposes.

TABLE 6.5: FISCAL CAPABILITY

COMMUNITY	Capital Improvement Programming	Community Development Block Grants	Special Purpose Taxes	Gas / Electric Utility Fees	Water / Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation Bonds	Partnering Arrangements or Intergovernmental Agreements
PENINSULA									
Hampton	✓	✓	✓	✓		✓		✓	✓
Newport News	✓	✓			✓	✓			✓
Poquoson	✓	✓				✓		✓	✓
Williamsburg	✓	✓		✓	✓			✓	✓
James City County	✓	✓							✓
York County	✓	✓							✓
SOUTHSIDE									
Norfolk	✓	✓		✓	✓	✓			✓
Portsmouth	✓	✓			✓	✓		✓	✓
Suffolk	✓	✓	✓	✓	✓		✓	✓	✓
Virginia Beach	✓	✓	✓		✓	✓	✓	✓	✓
Chesapeake	✓	✓			✓	✓	✓	✓	✓
WESTERN TIDEWATER									
Isle of Wight County	✓	✓		✓	✓			✓	✓
Smithfield	✓	✓			✓		✓		✓
Windsor	✓	✓					✓		✓
Franklin	✓	✓	✓	✓	✓				✓
Southampton County	✓	✓		✓	✓			✓	✓
Boykins		✓						✓	✓
Branchville		✓						✓	✓
Capron		✓			✓			✓	✓
Courtland		✓			✓			✓	✓
Ivor		✓			✓			✓	✓
Newsoms		✓						✓	✓
Surry County	✓	✓			✓				✓
Claremont		✓			✓				✓
Dendron		✓							✓

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of hazards. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development, which may adversely impact other hazard-related initiatives. Mitigation may not generate the same level of interest among local officials when compared with competing priorities.

Self-Assessment of Capabilities

In addition to the inventory and analysis of specific local capabilities, communities should self-assess their capability to implement hazard mitigation activities. Officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. The committee classified each of the capabilities as either “limited,” “moderate” or “high.”

Table 6.6 summarizes the results of the self-assessment process. An “L” indicates limited capability; an “M” indicates moderate capability; and an “H” indicates high capability.

TABLE 6.6: SELF ASSESSMENT OF LOCAL CAPABILITY					
COMMUNITY	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Political Capability	Overall Capability
PENINSULA					
Hampton	H	H	M	M	M
Newport News	H	H	M	H	H
Poquoson	H	H	M	M	H
Williamsburg	H	H	H	H	H
James City County	H	H	M	H	H
York County	H	H	M	H	H
SOUTHSIDE					
Norfolk	M	H	M	H	M
Portsmouth	M	M	L	M	M
Suffolk	M	H	M	L	M
Virginia Beach	M	H	M	L	M
Chesapeake	H	H	M	M	H
WESTERN TIDEWATER					
Isle of Wight County	H	M	M	M	M
Smithfield	L	L	L	M	L
Windsor	L	L	L	L	L
Franklin	M	M	L	M	M
Southampton County	M	M	L	M	M
Boykins	L	L	L	M	L
Branchville	L	L	L	M	L
Capron	L	L	L	M	L
Courtland	M	M	L	M	M
Ivor	L	L	L	M	L
Newsoms	L	L	L	M	L
Surry County	M	M	M	M	M
Claremont	L	L	L	L	L
Dendron	L	L	L	L	L

INTEGRATING MITIGATION MEASURES INTO COMMUNITY LIFE

The success of future mitigation efforts in a community can be gauged to some extent by its past efforts. Previously implemented mitigation measures indicate that there is and continues to be a desire to reduce the effects of natural hazards in the region. The success of these projects can be influential in building local government support for new mitigation efforts. Additional capability toward realizing mitigation goals is built through the integration of mitigation strategies into other local planning and administrative tasks.

While the notes below are not an exhaustive list of all mitigation actions taken in the region, they do provide a summary of very recent mitigation measures undertaken by communities in Hampton Roads and in part describe how many of the communities have integrated their mitigation strategies into other planning mechanisms. Additionally, as called for in the *National Mitigation Framework*, the aspects of leadership, collaboration, partnership building, and education/skill building have been shown in the following summary notes whenever possible.

Regional Activities

- In 2015, HRPDC prepared grant application for hazard mitigation plan update that combined 7 existing plans into 1 large regional plan. Updated plan streamlined the list of hazards to align more closely with the State Hazard Mitigation Plan. The PDC also conducted two Joint Land Use Studies described below for each participating city, in partnership with the U.S. Navy, Portsmouth, Chesapeake, Norfolk and Virginia Beach.
- The All-Hazards Advisory Committee (AHAC) was formed in 2015 to bring together mitigation practitioners from each of the HRPDC communities. This group is helping the PDC administer the mitigation planning contract among other tasks.
- Coastal Virginia CRS Users' Group meets every other month to review best practices of other communities and stay up to date on floodplain management and CRS issues. Consulting hazard mitigation planners for the HRPDC updated the group on how to create and update mitigation capability analyses at spring 2015 meeting.
- Each community's comprehensive plan, local and state resilience plans, and the State Hazard Mitigation Plan were used and will continue to be used to carefully update the goals and objectives in the HMP to align with existing plan goals at the State and regional levels.
- Most communities in the region include mitigation planning committee members who are also involved in the comprehensive planning process. This helps ensure consistency across planning documents. Since there are 15 comprehensive plans to consider during this HMP update, it is expected that common themes can be found that will help focus the HMP goals and objectives.
- VDEM procured Crisis Track for each of Virginia's counties and independent cities in 2017. The primary objective was to provide all localities with the capability to quickly complete, document, and report the outcomes of local damage assessments in a manner that allowed VDEM to see real-time data of the disaster consequences. This real-time data will help VDEM to be better prepared to support any unmet needs and assist VDEM in more quickly processing requests for Federal Assistance when needed. Crisis Track uses local government GIS data, such as address points and tax parcel layers, to locate and valuate every structure in the Commonwealth. When an incident occurs, local emergency managers use Crisis Track to identify all infrastructure in an area of concern and send pre-populated damage assessment forms to each damage assessment team's mobile device. As teams complete the damage assessment forms, Crisis Track calculates damage costs using tax assessment values and summarizes results for each county. Most of the communities in the study area have pre-populated and tested Crisis Track, and several have already implemented the software for incident assessment.
- HRPDC developed a regional Elevation Certificate database with information from 10 Hampton Roads local governments, to include over 2000 data points. The data from Hampton and Chesapeake were then used to evaluate statistical approaches for estimating building first floor

elevations regionally in support of local and regional vulnerability assessments under various flooding scenarios.[1]

City of Hampton

- The city's Fire Department Public Educator has added more hazards to their 4th grade fire presentation.
- The 2011 Hazard Mitigation Plan, especially HIRA information, was integrated into city's 2014 Emergency Operations Plan update.
- Hampton and Newport News applied for and received a hazard mitigation grant to add a generator to Hines Middle School, which is one of the shelters in the city's MOU with Newport News.
- Hampton received a State Homeland Security Grant in 2014 to add specialized items for sheltering children, such as highchairs and pack and plays.
- As a result of a previous HMP action to evaluate/review options for more effective public warning systems to upgrading/replace existing reverse 911 system, in 2013 Hampton switched to Everbridge which provides more options for alerting the public. This system is also integrated with the system being used by VDEM.
- HMP action to educate elected officials and residents on the importance of the NFIP has resulted in a multi-agency effort to provide flood insurance brochures at all outreach events. The importance of flood insurance is in the city's general presentation that is given to the public on emergency management.
- A high priority action in the HMP was to support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation and flood proofing of non-residential projects where feasible using FEMA hazard mitigation grant programs where appropriate. The city has hired new staff to implement grants and has completed several home elevation projects.
- The city has implemented a revolving loan fund for residential elevation projects. The revolving loan program is up and running. It is the only program of its kind, in Virginia, for residents to apply for low-interest loans to help with qualifying mitigation projects. This project is supported by the Office of Emergency Management, Hampton Redevelopment and Housing Authority, and Old Point National Bank.
- Mitigation action to provide NOAA weather radios to high risk populations was funded and completed with weather radios provided to residents that live in mobile homes in Hampton in April 2015.
- HMP mitigation action to evaluate the relocation of Hampton City Schools Maintenance Building was implemented by chance when the building was destroyed by a tornado that hit Hampton on January 11, 2014. The building was not rebuilt.
- The city plans to improve CRS Class 7 rating to a Class 6 using inputs and capabilities across many city departments.
- City currently has a Newmarket Creek mitigation project in design phase with the USACE, in addition to other projects in design phase: North Armistead Avenue Road Raining, Oakland-Old Point Area Drainage Improvements, Phoebus Area Drainage Improvements at Hygeia, North and Sherwood Street. These projects rely on CIP funding and stormwater fee funds.
- The city announced in December 2021 that they will receive more than $9 million in grants to deal with sea level rise and extreme weather as part of an ongoing statewide effort by the Virginia CFPF. The grants, announced last week by Gov. Ralph Northam, will be directed at four specific projects in Hampton: $3,841,555 for Lake Hampton and North Armistead Avenue; $3,008,500 for the Big Bethel Blueway (Albany Drive at Big Bethel Road); $2,022,143 for the Sunset Creek Urban Channel Naturalization Project; and $291,850 for the Billy Woods Canal. The four Hampton grants were among 30 applications from 22 local government organizations to receive grants made possible with funding from the RGGI.

[1] *Developing First Floor Elevation Data for Coastal Resilience Planning in Hampton Roads*, February 2019. Available online at: https://www.hrpdcva.gov/library/view/932/wr19_01-developing-first-floor-elevation-data-for-coastal-resilience-planning-in-hampton-roads.

- As part of the city's Resilient Hampton initiative, the city hired a Resiliency Officer and has worked in multiple phases to implement the living with water approach across the city. Throughout this effort, the Initiative has approached the work at multiple scales, from looking at policy and process changes that influence resiliency across the city, to supporting plans and projects designed to create benefits for a whole neighborhood, to identifying opportunities to support individual homeowners to increase their resilience. The city issued a General Obligation Bond in 2019 and an Environmental Impact Bond in 2020 to help fund identified projects. Phase I (citywide) planning is complete, while Phase II (watershed level) plans are underway.

City of Newport News

- The Comprehensive Plan update process during the summer of 2015 examined goals, objectives, and actions from the previous HMP. This hazard mitigation planning effort drew mitigation actions from the latest comprehensive plan. Many of the same planning team members are continually involved in both plan updates.
- The emphasis on floodplain management through ordinance administration in the HMP resulted in flood ordinance changes in 2014 that included adoption of freeboard.
- Certified Floodplain Managers, a professional certification program administered by the Association of State Floodplain Managers, increased in number across at least 2 departments and they participate in hazard mitigation planning on a regular basis.
- The City Watch program was expanded to include post-disaster messages as a result of a careful capability analysis.
- The city formed a Generator Committee to address needs in the city identified during hazard mitigation capability review.
- A mitigation action in a previous hazard mitigation plan recommended developing a natural hazards school curriculum. Existing Fire Department programs were expanded to address this need.
- The previous HMP identified City Line apartments as a high hazard area and some retrofits were made to the complex's HVAC system. Additional flood protection measures for this and an adjacent housing complex are being pursued in conjunction with the City of Hampton, U.S. Department of Housing and Urban Development and other State and Federal agency partners.
- Six mitigation actions from the 2017 plan were removed because they have been completed. Projects used a combination of state, Federal and CIP funds.
- The city currently has a Class 7 CRS rating but plans to use the capabilities across several city departments to improve their rating. The city is negotiating a contract that will provide master planning services for water resources, including CRS, stormwater management, floodplain management and resilience planning by a single contractor over the next few years.
- The city's Flood Assistance Program has had measurable benefits using primarily acquisition to mitigate an average of 2 structures per year since 1999. Eighty properties comprising 15.2 acres have been purchased. In some cases, the Newport News Green Foundation gets involved in preserving, transforming and promoting the resultant green spaces created as a result of mitigation projects.
- Many of the city's new and ongoing mitigation actions are tied closely to projects already approved for CIP funding or the Stormwater Fund.

City of Poquoson

- In partnership with Hampton, the two cities hired a shared grants administrator specifically to pursue funding for mitigation actions identified for sea level rise and flood mitigation.
- The city continues to elevate repetitively flooded structures using Federal funding mechanisms, and plans to pursue CFPF funding, as well.
- Many projects to protect critical infrastructure are completed or ongoing. Poquoson has protected almost every pump station, fire station, and several schools over the past decade through demo/rebuild, elevation, generator-installation and other retrofits.
- The city continues to use various measures to collect existing Elevation Certificates from property owners and is investigating methods for putting that information online for public accessibility.

- Poquoson has ongoing partnerships with nearby NASA for drone data collection and with Langley Motor Speedway for car storage prior to predicted flood events.
- The Wythe Creek Road to Hampton elevation project will begin construction in spring 2022. The Victoria Boulevard widening project is still in the planning stages. Cooperation with adjacent York County and Hampton remains critical to getting these projects to completion. City has agreement with York County for road clearance to aid evacuation of Poquoson and York County residents.
- Poquoson does not have a large staff of city employees, but representatives from various departments, including Finance and the City Manager's office, are always deeply involved in mitigation planning meetings and document reviews, which results in bringing flood mitigation to the forefront of other planning efforts such as the comprehensive plan and capital planning.
- City coordinates with Virginia Marine Resources Commission for help enforcing the "No Wake Zones" instituted to help protect flooded structures from further flooding when floodwaters remain high.

City of Williamsburg

- The city has and maintains StormReady designation.
- City staff coordinate mitigation planning and emergency preparedness efforts with both Colonial Williamsburg and the College of William and Mary to ensure coordinated response to a variety of hazard incidents. This high level coordination has led to inclusion of mitigation actions in this plan regarding the high hazard potential dam on campus, the tree maintenance program Colonial Williamsburg uses to protect visitors and historic resources and the development of elements for the Continuity of Operations Plan for the city. The team is also assessing large assembly planning and coordinating command and control efforts especially if a secondary hazard event impacts a large assembly and evacuation is needed.
- The stormwater program has started a series of inter-departmental training sessions to help other city staff who are out in neighborhoods to recognize problems associated with drainage maintenance, including waste dumping, improper use of drains and proper notification of problems. Drainage system maintenance is a medium priority action in the HMP and this innovative method for addressing maintenance problems has been well-received in by the Fire Department.
- Shelter generator maintenance program called for in previous HMPs has been implemented through the CIP, with a regular maintenance budget and real-time monitoring software included.
- Strengthening the GIS capability was a medium priority in the last two HMPs. The city has now hired GIS staff and hazard-related GIS data gathering has been accomplished, including verification of hydrant locations and identification/mapping of critical structures and infrastructure.
- Several hazards are identified and addressed through recommendations in the city's comprehensive plan. Those data and recommendations were reviewed to identify potential mitigation actions for this planning effort.
- The city has a development review process for circulating proposed developments that includes hazard-related reviews by various departments.
- Williamsburg is working with the Local Emergency Planning Committee on the Peninsula to obtain a grant for a commodity flow study in light of the railroad that traverses the city.
- During the pandemic, city officials partnered with the school system, the Health Department, Colonial Williamsburg, William & Mary, James City County and York County regarding clinics for testing, vaccination and supply distribution.

James City County

- Repetitive flood loss data is reviewed annually as part of the County's participation in the CRS, or when the data is made available. This action is included in the Hazard Mitigation Plan but is also part of the County's plan to address flood mitigation through the CRS. The county has maintained a Class 5 CRS rating for several years, which requires inputs across many departments and stakeholders.
- Both the County and Busch Gardens, a theme park in the county, received StormReady designation through NOAA.

- The county is considering expanding their existing pre-disaster debris management plan across several departments and beyond public properties. Public outreach elements are being considered, as well.
- The County is participating in the regional "Flood Fluent" initiative.
- Several mitigation actions in this version of the plan are derived from the "Environment" section of the county's most recent comprehensive plan. This practice reinforces the importance of mitigation planning and spreads the responsibility for implementation across various departments, with funding considered through capital spending.

York County

- A mitigation action in the Hazard Mitigation Plan suggests evaluating sustainability and safety of critical facilities. The county's ongoing plan for generator replacement is now tied to the CIP. The county's new Sheriff's Office incorporated resilient design measures such as a generator.
- York County, Newport News and Newport News Waterworks work jointly on forest management at the Waterworks-owned property. Fire trails are regularly maintained.
- Part of staff responsibilities include making information/speakers available to business for contingency planning as needed, or as requested. This is a mitigation action identified in the Hazard Mitigation Plan and reflected in day-to-day operations.
- The County adopted 3 feet of freeboard for structures built or substantially improved in flood hazard areas. Freeboard was recommended as an action in the hazard mitigation plan.
- Comprehensive Plan adopted in 2013 echoes several of the hazards included in the previous hazard mitigation plan and proposes Implementation Strategies to address them in great detail. The shoreline erosion strategies will continue to be referenced, or included directly, in the 2017 update to the Hazard Mitigation Plan.

City of Norfolk

- Updated Comprehensive Plan was adopted March 26, 2013 and was recognized as an example of content and metrics to include in a comprehensive plan. The plan was also recognized for its inclusion of sea level rise, flooding and mitigation actions as part of the metrics.
- As a result of a previous mitigation action plan strategy to expand existing notification systems, several city departments have come together to expand the city's ability to notify the public. Sources include real-time updates the web page, email distribution lists, Facebook and Twitter.
- The city continues to update the flooding awareness webpage, accessible from the homepage. A cross-departmental Flood Awareness Committee was formed, and also provides quarterly updates to citizens as well as to the professional community regarding the city's progress on flood mitigation as well as providing an opportunity for dialogue for all interested stakeholders. The city has a Coastal Resiliency Manager dedicated to managing resilience projects, coordinating the CRS participation, coordinating grants and emergency managers, and presenting information to public and private boards and commissions across the spectrum of city government and civic organizations.
- The city is part of the Rockefeller Foundation RE.invest Initiative which explores ways the private sector can be engaged to enhance flood protection in some older areas of Norfolk with a history of flooding.
- The city is recognized as part of the initial cohort of the 100 Resilient Cities. Also funded by the Rockefeller Foundation, the program provides access to a worldwide network and knowledge base that will be able to identify additional strategies to help the city be more resilient to physical, social, and economic threats.
- As a result of a previous mitigation action plan strategy, Norfolk and Norfolk Public Schools have funded and are in the design phase of multiple school replacements throughout Norfolk. These new facilities will replace older facilities that do not meet current requirements for stormwater management and, in some cases, elevation for flood protection. New structures will meet these requirements and provide safer emergency shelters in times of need.
- Public Works has completed improvements to Brambleton Avenue that provide better access and egress to Sentara Norfolk General Hospital and Eastern Virginia Medical College during storm and flooding events.

- After a storm or flooding event occurs, properties that have received damage are mapped using GIS as part of the damage assessment reporting. Damage assessment training is provided each spring for staff that inspect properties after events.
- RISE, a Norfolk-based nonprofit funded through the Virginia Department of Housing and Community Development, accelerates innovation and business growth around solutions to coastal communities' critical resilience challenges. RISE and FloodMapp launched a novel (and award-winning) forecast flooding technology with Waze, the navigation app. FloodMapp's innovative solution allows Waze to be the only traffic app to offer drivers real-time, street level alerts about flooded roads. FloodMapp is piloting the program in the City of Norfolk where Waze users will be the first in the world to test the new feature. FloodMapp's groundbreaking forecast technology mixes tidal, riverine and rainfall data to create a rapid, real-time flood inundation model. The information is automatically layered with Norfolk's citywide road network and sent to Waze in real time. Drivers receive pop-up icons and audio alerts to warn them about flooded streets along their route and help them avoid property and life-threatening hazards. Drivers can confirm flooding in the app, which helps validate FloodMapp's technology and makes future Waze alerts more accurate. The information will also be used for an automatic rerouting feature, which is now under development.
- Revisions to the Zoning Ordinance were approved and implemented on January 1, 2014. These revisions allow for development to be more resilient to flood damage. Changes helped lower the city's CRS classification and further reduce flood insurance premiums for property owners in the city. The city now has a Class 5 CRS rating thanks to participation across several city departments.
- The city has acquired Everbridge, calling it Norfolk Alert, to alert property owners in flood-prone areas of need for evacuation or other short-term actions ahead of, during or after events.
- The city's GIS department development a tool termed the Tidal Inundation Tracking Application for Norfolk (TITAN) that shows potential flooding based on current tide projections or other hypothetical scenarios.
- HRPDC and the U.S. Navy worked together with City of Virginia Beach and City of Norfolk on an intergovernmental Joint Land Use Study presented to the public in 2019. More frequent flooding is affecting military operations and access to military facilities. This study focused on identifying specific conditions, including recurrent flooding, coastal storms, and erosion, outside of the military footprint that have the potential to impact Navy operations in Hampton Roads. Two recommendations that stand out for local planners are the wastewater treatment plant vulnerability assessment, and Terminal Boulevard rail and roadway grade separation project.
- Norfolk was awarded a $112 million federal grant from the National Disaster Resilience Competition for the Ohio Creek Watershed Project. Goals were multi-objective and show how flood hazard mitigation can feed into creating economic opportunity, advancing community interconnectivity, and deconcentrating poverty. Expected completion in 2023. Project addressed flooding in two residential, predominantly African American neighborhoods with civic leagues and a strong community identity: Historic Chesterfield Heights with over 400 houses on the Historic National Register; and Grandy Village, which includes a public housing community with more than 300 units.

City of Portsmouth

- In addition to HMP, Portsmouth has the 2015 Floodplain Management Plan. Plans are slightly redundant but serve different purposes.
- Flood Information Pamphlets are distributed by several city departments, including recently to all rental units as inspections are completed, and at the public counters in Planning and Inspections. Originally developed for CRS and repetitive loss mailings, pamphlets have an expanded purpose and audience in recent years.
- Staff created a "flood speakers bureau" for Civic Leagues and has attended several civic/neighborhood meetings to speak.
- Floodplain Management function was transferred to the Department of Neighborhood Advancement in August 2013. New web page was created in 2014.

- Staff training on the NFIP is a priority in the HMP. Staff provided training to City Council and Planning Commission on Biggert-Waters 2012 and other NFIP legislative changes to increase knowledge and allow integration of NFIP information in city planning strategies.
- Identifying and funding drainage improvements and protecting water/sewer infrastructure from flooding is a high priority in the HMP and FMP. Work has been coordinated between several departments and an outside engineering firm and funded through capital improvements planning. New stormwater lines are being replaced with larger lines and outfalls are getting flood gates. New and retrofitted pump stations can be quickly connected to generators or auxiliary pump connections. The city's seawall has also been substantially replaced, a high priority item in both the HMP and the FMP.
- GIS is being used to map flood-prone properties that store hazardous materials as identified by the Fire Department. This inter-departmental use of funds was a priority in the FMP. This action increases the city's ability to identify capability gaps with regard to fire and flood as compounding hazards.
- While not complete, an interdepartmental effort to help homes for persons with disabilities develop emergency operations plans is underway. This priority of the FMP will tie together several existing plans for flood, emergency operations and outreach/warning.
- HRPDC and the U.S. Navy worked together with City of Chesapeake and City of Portsmouth on an intergovernmental Joint Land Use Study (JLUS) presented to the public in 2021. Navy facilities in Portsmouth and Chesapeake face several impacts from the surrounding communities, including transportation impacts (such as congestion, existing and planned capital improvements, facility access, gate security, and rail operations), stormwater management, waterway management, land use conflicts, and residential, commercial, and industrial encroachment impacts. Nuisance and storm surge flooding can have major impacts on Navy operations by obstructing access and damaging local infrastructure on which military facilities rely. This study identifies specific conditions and develops mutually beneficial recommendations to address these issues. The JLUS effectively implemented Mitigation Action 16 from the 2017 HMP by "creating dialog between governmental and nongovernmental stakeholders to encourage incorporation of mitigation strategies into projects and policies".
- Portsmouth has rewritten their Zoning Ordinance to capture recommendations of the Comprehensive Plan, which contains hazard-related elements regarding CRS, CIP-funded drainage improvement projects, geographic information on flood exposure, development of a COOP, and a long list of resilience recommendations such as adding a Resilience Officer (completed), transfer/purchase of development rights in floodprone areas, developing a guide for resilient building retrofits, and positioning cool buildings/shelters for access by socially vulnerable populations.

City of Suffolk

- Information from the 2011 HMP was incorporated into the 2015 Revision of the City of Suffolk Emergency Operations Plan and into the 2015 revision to the City of Suffolk Hazardous Materials Response Plan.
- Flood hazard risk and vulnerability information was considered for the city's 2035 Comprehensive Plan and the recent FIRM updates.
- As a result of a previous mitigation action plan strategy, a FIRM viewer and a Hurricane Surge Viewer are in place on the city's Emergency Management website in the "Flooding" tab. A PDF document also resides there for users who are not comfortable with mapping programs.
- Suffolk OEM answers email and phone requests for address-specific flood data. Personalized maps can either be generated in the office or during community outreach events.
- Hurricane/tropical storm/flood safety talks are delivered upon request to church, civic and community groups.
- Hurricane/flooding preparedness brochures are placed at local libraries, the visitor's center and other public buildings around the city.
- Many of the hazard mitigation plan recommended actions will be incorporated into the city's resilience planning effort related to CFPF grants.

City of Virginia Beach

- The 2015 Comprehensive Plan update references the hazard mitigation plan update process; new upcoming rewrite will incorporate city's resiliency initiatives. The Sustainability Plan references the Hazard Mitigation Plan content in the appendices, echoes the goals and objectives of the Hazard Mitigation Plan, and contains a flood component to address the interrelationship of flood mitigation and sustainability.
- The ComIT Data Center relocation mitigation action is near completion using city funds.
- The city changed floodplain management ordinance to adopt two feet of freeboard for structures built or substantially improved in flood hazard areas.
- City is aggressively tackling enforcement issues in floodplains.
- City is integrating floodplain management more widely into other community actions such as the preliminary development review process which includes flood mitigation recommendations early in the process and formation of the City Manager's Sea Level Rise/Flooding Work Group.
- Although the Hazard Mitigation Plan is not referenced per se in the annual CIP, projects are included that reflect mitigation actions from the plan on a regular basis. One example was the relocation and rebuilding of the city's Animal Control Facility. Another example is the complete replacement of the public safety communication hardware and the 6-year spending/replacement plan that is reflected in each CIP.
- Public information, particularly regarding floodplain management, has been redesigned on the city's web site and the site references and includes information from the HIRA in the Hazard Mitigation Plan.
- CERT curriculum was revised to include damage assessment and storm preparation advice as a result of mitigation actions and hazard information included in the Hazard Mitigation Plan.
- The city's Urban Forestry Management Plan, a component of the Comprehensive Plan, was published in 2014 and includes strategies for better management of dunes and landscaping in V Zones. The plan is expressly tied to the Sustainability Plan, the city's stormwater management regulations, the Strategic Growth Area Plans, and the Outdoors Plan, and includes a reference to Sea Level Rise as a threat to tree cover in the city.
- HRPDC and the U.S. Navy worked together with City of Virginia Beach and City of Norfolk on an intergovernmental Joint Land Use Study presented to the public in 2019. More frequent flooding is affecting military operations and access to military facilities. This study focused on identifying specific conditions, including recurrent flooding, coastal storms, and erosion, outside of the military footprint that have the potential to impact Navy operations in Hampton Roads.
- The city is implementing a long-term comprehensive program for addressing rising sea levels and recurrent flooding risk entitled *Sea Level Wise*. The strategy has four phases: Impact Assessment, Adaptation Research, Strategy Development and Implementation. The *Sea Level Wise* program has been key in identifying projects and planning efforts related to state funding through CFPF. Similar to the HMP mitigation action categories, adaptation for Virginia Beach involves a series of natural mitigations (nature based solutions), engineered defenses (structural flood protection measures), adapted structures (siting/design/retrofit measures), and prepared communities (educational services and financial planning tools). The program also includes a series of watershed-based strategies for precisely targeting flood-related challenges and suggesting opportunities. Data gathering for this effort included collection of lowest floor elevations of many of the city's flood-prone existing structures; data that were used for the Hazus modeling summarized in Section 5 of this plan.
- City passed a bond referendum in 2021 to speed up funding of flood prevention infrastructure in the CIP. Money is administered by Department of Public Works.
- A High Priority mitigation action in the 2017 HMP was to join the CRS. That initiative has been successful thanks to the participation of numerous departments. Virginia Beach currently has 11 certified floodplain managers across numerous departments, in recognition of the role that flood vulnerability plays in everyday administration of city business.
- In summer 2020, the city revised and strengthened stormwater management requirements for new site plans to include calculation of future conditions (precipitation, flooding and sea level rise). Public Works promulgated design standards for residential structures as well as nonresidential.

- The city's new Historic Resources Plan is currently being finalized. This effort has guidance for structure modifications, including guidance for flood-prone historic structures.
- Amazon Web Services awarded Virginia Beach the 2017 City on a Cloud Innovation Challenge for StormSense. This program, in partnership with VIMS, enhances the capability of the city and neighboring communities to predict coastal flooding in ways that are replicable, scalable, and measurable. The project applies data science and artificial intelligence to: create historic, current and future data analysis platforms; address flood-related issues caused by coastal storms; and empower citizens to better manage their real-time and future flood risk. Available online at: https://stormsensedev.vbgov.com/

City of Chesapeake

- Chesapeake recently attained a Class 7 rating in the CRS program (improved from Class 8), qualifying most Chesapeake SFHA property owners for a 15 percent discount in flood insurance premiums, due to its continued vigilance in floodplain management, hazard mitigation planning, open space policies, public outreach in flood issues, and acquisition, demolition and elevation of severe repetitive flood loss properties through various grant programs.
- The city has expanded its ability to notify the public of potential flood hazards by using Everbridge, which is a part of Chesapeake Alert. Additionally, Emergency Management has coordinated with Public Information offices and Public Works to provide the public with real-time updates via its city webpage, Facebook and Twitter.
- Chesapeake provides continued information on flood-related issues, including the NFIP, via the city's home web page and the Emergency Management web page.
- Chesapeake has obtained and continues to apply for FEMA grants for acquiring repetitive flood loss homes and has committed CIP funds to mitigate flooding. City has acquired at least $7,515,092.00 in FMA grant funds over the past twelve years to acquire and demolish 25 and elevate five severe repetitive loss structures. Five of 7 applications are in the process of being processed from a 2018 FMA Grant. Two applications were submitted for houses in 2019 and 3 applications were submitted for houses in 2020. Additionally, stormwater flood protection reduction projects are scheduled for numerous subdivisions in the SFHA.
- Chesapeake begins its hazard mitigation planning through the Natural Event Mitigation Advisory Committee (NEMAC). NEMAC is a citizen/city staff advisory committee appointed by City Council to advise it on all hazards and report yearly on progress in mitigation and resiliency. NEMAC's 8 citizens (who form the quorum) is supported by 9 city department representatives, with each department representing a part of mitigation problems and solutions. NEMAC normally meets 6 times a year to plan for hazards, to make recommendations for improvements in the hazard mitigation plan to increase resiliency, and to provide oversight on accomplishing the actions recommended therein. One particular resiliency improvement overseen by the NEMAC was providing guidance to include sea level rise and land subsidence in the city's standalone 2014 hazard mitigation plan as a critical hazard.
- In 2022, the city will begin a resiliency planning project for the industrial waterfront, a mitigation action that will help protect valuable waterfront businesses for the long-term.
- City built new Public Safety building that serves as the city's EOC. The building can withstand a Category 3 hurricane, a magnitude 4 earthquake as it's the only systematically safe non-DOD building on the East Coast and has multiple redundancy infrastructure built into the building. City Jail project to install a generator to run the HVAC and Kitchen of the building is in current CIP. The city has applied for a grant to outfit the city's Community Centers with generators using FEMA Pre-Disaster Mitigation funds. Chesapeake has applied for PDM funds for mitigation purposes to install generators at Public Utilities Pump Stations. These generators will ensure there is not flooding due to lack of power to pump water.
- City uses CIP funds to outfit all community centers and the conference center with generators and completed the work on two new Fire Stations. Sta #10 in Bowers Hill & Sta #7 in Southern Chesapeake are now open. Sta #10 serves both as a Fire Station and Logics Center for the department, increasing the city's ability to prepare, respond and mitigate following a disaster. Sta #7 is dual use facility, as a Fire Station and a newly added Police Precinct.

- The city will implement planning measures to pursue CFPF funding in the coming planning period. Mitigation projects will align with priorities set by the NEMAC in the hazard mitigation plan.
- HRPDC and the U.S. Navy worked together with City of Chesapeake and City of Portsmouth on an intergovernmental Joint Land Use Study presented to the public in 2021. Navy facilities in Portsmouth and Chesapeake face several impacts from the surrounding communities, including transportation impacts (such as congestion, existing and planned capital improvements, facility access, gate security, and rail operations), stormwater management, waterway management, land use conflicts, and residential, commercial, and industrial encroachment impacts. Nuisance and storm surge flooding can have major impacts on Navy operations by obstructing access and damaging local infrastructure on which military facilities rely. This study identifies specific conditions and develops mutually beneficial recommendations to address these issues.

Isle of Wight County

- Comprehensive Plan updates in the region have included resource conservation areas. Sea level rise continues to be a consideration for future planning efforts. Previous plan mitigation action related to development of a sea level rise adaptation strategy has been reevaluated and removed as a mitigation action because county officials felt that existing zoning measure adequately address new development and vulnerable lands.
- Stormwater drainage in floodprone areas has been identified as a local hazard and related action to implement a drainage plan is being acted upon through implementation of a stormwater master plan in development.
- Flooding of access roads identified as a problem in the HIRA. VDOT owns and maintains all roadways in the county. County has recently added a transportation planner/VDOT liaison to staff to help with coordination of issues like this. Similarly, an extra fueling station for county vehicles was needed and has been installed in conjunction with the new volunteer rescue squad building. The most recent comprehensive plan includes a section devoted to transportation planning.
- The County has increased GIS capabilities in recent years, which will benefit various land use and hazard-planning efforts.
- Several new mitigation actions in this 2022 updated plan reflect similar strategies identified in the most recent comprehensive plan, such as preparation of a green infrastructure network plan.

City of Franklin

- City has successfully enrolled in the CRS as recommended in the 2017 hazard mitigation plan. Planners aspire to improve their rating and increase savings to policyholders.
- Having made Elevation Certificates widely available in the community, city planners see the next logical step to be installing high water marks in downtown buildings to visually remind owners and visitors of the flood risk.
- City is reviewing and considering updates to the Flood Recovery Plan identified in previous versions of this plan.
- The city's 2015 Comprehensive Plan included recommendations regarding HMGP funding for flood proofing nonresidential buildings downtown and elevating floodprone residential buildings downtown.
- American Rescue Plan Act (ARPA) funding made available following the COVID-19 pandemic has been used to address other flood hazard vulnerabilities in the city and radio system and citywide wireless network upgrades. They are working with Dominion to raise electrical panels and other equipment, possibly including the substation.
- The city uses Virginia Department of Forestry materials to distribute to the public to help reduce the prevalence of hazardous trees, as recommended in the 2017 hazard mitigation plan.

Southampton County

- The County has implemented the necessary shelter retrofits and improvements to Southampton County High School, including a new roof and a generator at the substation dedicated to the high school. Emergency operations will be amended accordingly.
- One additional staff member is working to become CFMs in calendar year 2022.

- The County's Comprehensive Plan is undergoing revision one chapter at a time. The new document will include hazard-related impacts.
- The County is helping Newsoms implement their drainage area plan, as called for in the 2017 hazard mitigation plan.
- County Courthouse renovations are underway with considerable flood protection measures included.
- Tree preservation and landscaping requirements are included in a proposed solar ordinance that the County is considering in winter 2021, as called for in previous mitigation plan.
- County has considered participation in the CRS, but after reviewing location of most insured structures in the County, has determined that the program is likely not cost effective.
- The County has implemented many of the ordinance revisions called for in the previous comprehensive plan, which also relate to hazard mitigation, such as smart growth principles such as clustering, and building streets to State standards.
- County has implemented a comprehensive plan recommendation calling for removal and disposal of junk vehicles, dilapidated structures, litter, hazardous materials and debris.

Town of Boykins

- An acquisition project on Spring Garden Street is complete with the exception of 1 vacant home. Boykins Volunteer Fire Department acquired and cleared the remaining structures.
- Identified as a problem flooding area in the HIRA, the town has done what they can to clean out Tarrara Creek. Private property owners have removed beaver dams and other impediments.
- The mayor is going to put a flyer on each door in town reminding people to sign up for the county's reverse 911. He'll mention it at town council meetings and put it on the town's updated website, which he will ask the county to link to from the county site.
- The town has a new web site and Boykins Fire-Rescue has a Facebook page to post hazard-related warnings for community members, such as that shown in **Figure 6.2**.

FIGURE 6.2: BOYKINS FIRE-RESCUE FACEBOOK WARNING, WINTER STORM



Source: Boykins Facebook page, 2022

Town of Newsoms

- Drainage improvements to eliminate standing water in yards and drainage ditches as identified in a 2011 stormwater study were targeted as a high priority in the previous HMP. Town procured a grant in 2012 to evaluate storm drainage and recommend improvements. Preliminary engineering report was completed. Town applied for Community Development Block Grant (CDBG) and, as part of the application, also completed a preliminary housing assessment in 2013. The grant was denied, but the Town has sought additional funding sources and has a Virginia Department of Housing and Community Development grant underway that includes stormwater improvements and other initiatives.

Surry County

- The County's Director of Planning is considering putting together an official administrative design review committee for all development to include hazard review.
- County has a Post-Disaster Debris Management Plan.
- The County recently updated their Radiological Emergency Plan in August 2021. Regular exercises with VDEM maintain currency of the plan, which is especially important given the location of Surry Power Station with the county.

- Surry County Department of Economic Development regularly connects businesses to various agencies and tools that provide business resilience planning assistance.
- Public Information Officer regularly uses social media and the county's web site to disseminate hazard- and mitigation-related information.
- The County's Economic Development Plan is contained within the Comprehensive Plan. Both documents were reviewed for potential mitigation actions under this planning effort.

In summary, much of the work of integrating hazard mitigation into other planning mechanisms has already happened since the adoption of the first hazard mitigation plans. The process is ongoing in Hampton Roads communities as leaders identify new ways to incorporate hazard mitigation priorities into the life of their community. Table 6.7 summarizes how individual communities expect to continue integrating hazard mitigation actions into other planning tools, regulations and activities beyond those activities listed above. Check marks indicate which planning mechanisms are targeted for existing or future coordination and integration with that community's mitigation action plan. None of the communities participating in the NFIP are considering a change in status at this time.

TABLE 6.7: INTEGRATION OF HAZARD MITIGATION ACTIONS INTO OTHER PLANNING MECHANISMS

COMMUNITY	Regulations	Administrative & Technical Procedures	Fiscal Planning (CIP, grants, budgeting)	Land Use Planning (comprehensive, resilience, transportation)	Other (public information, activities, etc)
PENINSULA					
Hampton	✓	✓	✓	✓	✓
Newport News	✓	✓	✓	✓	✓
Poquoson	✓	✓	✓	✓	✓
Williamsburg	✓	✓	✓	✓	✓
James City County	✓	✓	✓	✓	✓
York County	✓	✓	✓	✓	✓
SOUTHSIDE					
Norfolk	✓	✓	✓	✓	✓
Portsmouth	✓	✓	✓	✓	✓
Suffolk	✓	✓	✓	✓	✓
Virginia Beach	✓	✓	✓	✓	✓
Chesapeake	✓	✓	✓	✓	✓
WESTERN TIDEWATER					
Isle of Wight County	✓	✓	✓	✓	✓
Smithfield	✓	✓	✓	✓	✓
Windsor	✓	✓			
Franklin	✓	✓	✓	✓	✓
Southampton County	✓	✓	✓	✓	✓
Boykins	✓	✓	✓	✓	

TABLE 6.7: INTEGRATION OF HAZARD MITIGATION ACTIONS INTO OTHER PLANNING MECHANISMS					
COMMUNITY	Regulations	Administrative & Technical Procedures	Fiscal Planning (CIP, grants, budgeting)	Land Use Planning (comprehensive, resilience, transportation)	Other (public information, activities, etc)
Branchville	✓	✓	✓	✓	
Capron	✓			✓	
Courtland	✓	✓	✓	✓	
Ivor	✓	✓	✓	✓	
Newsoms	✓		✓	✓	
Surry County	✓	✓	✓	✓	✓
Claremont	✓	✓	✓	✓	
Dendron	✓			✓	

Regional Capabilities

The communities of Southside Hampton Roads are part of HRPDC, one of 21 Planning District Commissions in the Commonwealth of Virginia. HRPDC is a regional organization representing the area's sixteen local governments. Planning District Commissions are voluntary associations and were created in 1969 pursuant to the Virginia Area Development Act and a regionally executed Charter Agreement. The HRPDC was formed in 1990 by the merger of the Southeastern Virginia Planning District Commission and the Peninsula Planning District Commission.

The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207, is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis, problems of greater than local significance." The HRPDC mission is to:

- Serve as a forum for local and elected officials and chief administrators to deliberate and decide issues of regional importance;
- Provide the local governments and citizens of Hampton Roads credible and timely planning, research and analysis on matters of mutual concern; and
- Provide leadership and offer strategies and support services to other public and private, local and regional agencies, in their efforts to improve the region's quality of life.

The HRPDC serves as a resource of technical expertise to its member local governments. It provides assistance on local and regional issues pertaining to Economics, Physical and Environmental Planning, Emergency Management, and Transportation. For example, the commission staff is currently working on cataloging GIS data for the region and improving compatibility of the data on a regional basis.

Additional regional capabilities exist with regard to the management of coastal zone resources in the Commonwealth. A permit must be obtained from the Virginia Marine Resources Commission (VMRC) to build, dump or otherwise trespass upon or over, encroach upon, take or use any material from the beds of the bays, ocean, rivers, streams or creeks within the jurisdiction of Virginia. The permitting process is

designed to reduce the unnecessary filling of submerged land, to minimize obstructions or hazards to navigation and to avoid conflicts with other uses of state-owned submerged lands or state waters.

In addition, the VMRC is responsible for managing and regulating the use of Virginia's tidal wetlands in conjunction with Virginia's local wetlands boards. Under Virginia law, tidal wetlands include both vegetated and non-vegetated intertidal areas. Vegetated wetlands include all the land lying between and contiguous to mean low water and an elevation above mean low water equal to a factor 1.5 times the mean tidal range at the site and upon which is growing at least one of the botanical species specified in the Virginia Wetlands Act. Non-vegetated wetlands include all the land lying contiguous to mean low water and between mean low water and mean high water at the site.

Technical assistance and advice on dredging and filling operations that involve subaqueous bottoms and wetlands, all aspects of the marine environment, marine science and marine affairs is available from the VIMS. The institute provides technical assistance, often at no cost, to businesses whose development plans have impacts on marine resources.

The Virginia Coastal Zone Management Program (CZM Program) was established in 1986 to protect and manage Virginia's "coastal zone." The CZM Program is part of a national coastal zone management program, a voluntary partnership between the National Oceanic and Atmospheric Administration, National Ocean Service Office of Ocean and Coastal Resource Management, and U.S. coastal states and territories authorized by the federal Coastal Zone Management Act. The Virginia program was established through an Executive Order, which is renewed by each new governor. The program is not a single centralized agency or entity, but a network of state agencies and local governments which administer the following enforceable laws, regulations and policies that protect our coastal resources:

- Tidal and Nontidal Wetlands;
- Fisheries;
- Subaqueous Lands;
- Dunes and Beaches;
- Point Source Air Pollution;
- Point Source Water Pollution;
- Nonpoint Source Water Pollution;
- Shoreline Sanitation; and
- Coastal Lands.

The geographic areas of particular concern for the CZM Program include:

- spawning/nursery/feeding grounds;
- coastal primary sand dunes;
- barrier islands;
- significant wildlife habitat areas;
- significant public recreation areas;
- significant sand and gravel resource deposits;
- underwater historic resources;
- highly erodible/high hazard areas; and
- waterfront development areas.

Currently, some of the projects that the CZM Program is pursuing that have applications with regard to hazard capabilities include: adapting to climate change, special area management planning, coastal land conservation, shoreline management, and public access.

A local nonprofit organization and mitigation planning stakeholder, Wetlands Watch, has provided regional (and statewide) leadership in the natural resource management arena, especially with regard to sea level rise and related threats to tidal wetlands, wildlife and fish habitats, and the economy of coastal Virginia. Wetlands Watch works to raise awareness, engage and educate all stakeholders and decision-

makers about existing and potential sea level rise impacts, incorporate this threat into regional and local land-use plans and decisions, and develop and implement sea level rise adaptation plans. The group's impact can be seen through the number of new CRS communities in the region, an initiative they promote by creating useful tools and forums for interested communities, and through the evolution of the *Coastal Resilience Master Plan,* among other things.

MITIGATION STRATEGY

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2022 UPDATE

Section 7 was updated to reflect the Committee's work to update the Goals and Objectives. The following major changes were incorporated:

1) All tables were added or updated to reflect new information, including the new goals and objectives;
2) Mitigation actions were reviewed, completed actions were deleted; and, new mitigation actions were revised and added as directed by Committee members; and
3) Mitigation actions were modified to include a ranking for social vulnerability.

INTRODUCTION

This section of the Plan provides the "blueprint" for Hampton Roads to become less vulnerable to natural hazards. It is based on the general consensus of the Committee along with the findings and conclusions

of the Capability Assessment and Risk Assessment. The Mitigation Strategy section consists of the following four subsections:

- MITIGATION GOALS
- IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES
- SELECTION OF MITIGATION TECHNIQUES
- MITIGATION ACTION PLAN

The intent of the Mitigation Strategy is to provide participating communities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions available to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

The development of the strategy included a thorough review of all natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to assist the region in achieving compatible economic, environmental, and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to established priorities assigned to specific departments responsible for their implementation and assigned target completion deadlines. Funding sources are identified when possible, that can be used to assist in project implementation.

The first step in designing the Mitigation Strategy includes the identification of mitigation goals. Mitigation goals represent broad statements that are achieved through the implementation of more specific, action-oriented tasks listed in the Mitigation Action Plan. These actions include both hazard mitigation policies (such as the regulation of land in known hazard areas), and hazard mitigation projects that seek to address specifically targeted at-risk properties (such as the acquisition and relocation of flood-prone structures). Additional mitigation measures are then considered over time as new mitigation opportunities are identified, new data become available, technology improves, and mitigation funding becomes available.

The last step in designing the Mitigation Strategy is the creation of a set of jurisdictionally specific Mitigation Action Plans (MAPs). The MAPs represent the key outcome of the mitigation planning process. MAPs include a prioritized list of proposed hazard mitigation actions (policies and projects), including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources, and an estimated target date for completion. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The collection of actions listed in the MAP also serves as a synopsis of activities for local decision makers.

In preparing the Mitigation Action Plans, committee members considered their overall hazard risk and capability to mitigate natural hazards, in addition to the mitigation goals. The prioritization of mitigation actions was based on the following five factors: (1) effect on overall risk to life and property; (2) ease of implementation; (3) political and community support; (4) a general economic cost/benefit review; and (5) funding availability. A separate ranking for impact on socially vulnerable populations is also included. This High, Moderate or Low impact rating is based on the NRI vulnerability information provided in Section 5. Where projects were identified in a specific location and/or tied to reducing vulnerability from a single hazard, the hazard-specific ranking for that Census tract or hazard was used. Projects geared toward reducing risk community-wide, such as general outreach, were ranked based on the relative NRI social vulnerability of that community versus the percent of counties/cities with lower social vulnerability in Virginia (Low - less than 40% of other counties/cities have lower social vulnerability; Moderate – 41-75%; High –75-100%). In cases where an action was specifically geared toward socially vulnerable populations within a community, the impact was rated High.

MITIGATION GOALS

The goals of the Hampton Roads Hazard Mitigation Plan were crafted as part of Workshop #3, a facilitated discussion and brainstorming session with committee members (see Section 2: *Planning Process*). As part of the 2022 update, the planning consultant reviewed the goals and objectives of the previous plan as well as pertinent goals and objectives from Virginia Beach's *Sea Level Wise: Adaptation Strategy*, Norfolk's *Coastal Resilience Strategy Report*, Hampton's *Living with Water Hampton: A Holistic Approach to Addressing Sea Level Rise and Resiliency*, Virginia's *Coastal Resilience Master Planning Framework,* and the 2018 *Commonwealth of Virginia Hazard Mitigation Plan.* In this way, the committee was able to incorporate some important regional resilience goals and work to find common ground in statewide, regional and local mitigation programming.

The groups reassessed each goal word for word, reprioritized the list, and edited overall for brevity. The original document ("2017 Plan Goals and Objectives") and updated ("2022 Goals and Objectives") goals with strikethrough and underline are provided in **Table 7.1** below, with notes about the discussion leading to the changes. Each of the following goal statements represent a broad target to achieve through implementation of specific *Mitigation Action Plans*.

TABLE 7.1: UPDATED GOALS AND OBJECTIVES

2017 PLAN GOALS AND OBJECTIVES	2022 GOALS AND OBJECTIVES
Goal 1: Increase community resiliency by reducing vulnerability to hazards. *Objective 1.1: Reduce damage to repetitively flooded properties* *Objective 1.2: Protect existing and future development* *Objective 1.3: Protect critical facilities/infrastructure* *Objective 1.4: Maintain government services throughout hazard events* *Objective 1.5: Reduce hazard-related impacts on daily routines* *Objective 1.6: Preserve and enhance benefits of natural areas*	**Goal 1: Increase community resiliency by reducing vulnerability to hazards.** *Objective 1.1: Reduce damage to all repetitively flooded properties, not just NFIP-insured structures* *Objective 1.2: Protect existing and future development* *Objective 1.3: Protect critical facilities/infrastructure, including High Hazard Potential Dams* *Objective 1.4: Maintain diverse, equitable and inclusive government functions and services throughout the duration of hazard events* *Objective 1.5: Reduce hazard-related impacts on daily routines* *Objective 1.6: Preserve and enhance benefits of natural areas* **Why the Change?** High Hazard Potential Dams were added to clarify that a high priority goal and objective of the plan is to reduce long-term vulnerabilities from eligible high hazard potential dams that pose an unacceptable risk to the public. Changes to Objective 1.4 express the explicit focus communities are making to ensure that the functions of government touch *all* citizens before, during and after hazard events.
Goal 2: Educate the public about hazard vulnerabilities and ways to reduce risk *Objective 2.1: Encourage property owners to assume responsibility for reducing vulnerability*	**Goal 2: Educate the public about hazard vulnerabilities and ways to reduce risk** *Objective 2.1: Encourage citizens and businesses ~~property owners~~ to assume responsibility for reducing vulnerability* *Objective 2.2: Ensure that information and hazard education opportunities are available to all elements of the communities* *Objective 2.3: Pursue public/private partnerships that help facilitate access to hazard-related educational opportunities and gather feedback from citizens* **Why the Change?** The committee felt Objective 2.1 should be expanded to include all citizens, not just property owners. Renters, for example, need hazard education to protect their personal property and businesses, as well. Objective 2.2 was added to document community goals to work toward a whole-community effort with regard to hazard education. Objective 2.3 focuses on the importance of involving other stakeholders in hazard outreach.
Goal 3: Strengthen and develop partnerships for mitigating hazard impacts *Objective 3.1: Integrate mitigation concepts into local and regional government plans, policies and actions* *Objective 3.2: Improve and standardize hazard data collection and mapping* *Objective 3.3: Leverage shared resources in pursuit of funding for hazard mitigation projects* *Objective 3.4: Develop partnerships among local, regional, national, and international organizations*	**Goal 3: Strengthen and develop partnerships for mitigating hazard impacts** *Objective 3.1: Integrate mitigation concepts into local and regional government plans, policies and actions* *Objective 3.2: Improve and standardize hazard data collection and mapping* *Objective 3.3: Leverage shared resources in pursuit of funding for hazard mitigation projects* *Objective 3.4: Develop partnerships among private, local, regional, national, and international organizations* **Why the Change?** Objective 3.4 was changed to emphasize the importance of private funding sources – a change that has come about in the past 5 years.

IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

44 CFR Requirement
Part 201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effect of each hazard, with particular emphasis on new and existing buildings and infrastructure.

In formulating Hampton Roads' *Mitigation Strategy*, a wide range of activities was considered in order to help achieve the goals and address specific hazard concerns. At the third workshop, committee members considered six broad categories of mitigation techniques. Committee discussions regarding each category are summarized beneath each category, including notes on the appropriateness and applicability of each as it applies to Hampton Roads.

1. Prevention

Preventative activities are intended to reduce the impact of future hazard events, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are constructed. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Building codes
- Open space preservation
- Floodplain regulations
- Stormwater management regulations
- Drainage system maintenance
- Capital improvements programming
- Shoreline/riverine setbacks

Committee Discussion: Prevention activities have been implemented in the past in Hampton Roads, are ongoing, and will continue to be included in this and future mitigation action plans. Many communities will mitigate flood damage through planning and zoning actions, such as amendments to their floodplain management ordinances which are viewed as very effective mitigation tools locally. Most communities in the region are continually updating zoning ordinances, especially for flood zones. The statewide building code is viewed as a rather static mitigation tool; it has components that mitigate especially for wind and flood, but is not a product that local governments exert a great deal of influence upon regularly. Appendix F of the building code could be adopted by communities concerned about protecting future construction from the impacts of radon exposure.

Open space preservation strategies are contained in most of the regional comprehensive plans, including Newport News. In York County and several other communities, open space preservation is also addressed in subdivision regulations. Franklin has taken action to promote cluster development outside of flood hazard areas and create conservation and recreation districts along riverbanks. Several communities, including Hampton, Newport News and Southampton County, have integrated information from their existing hazard mitigation plans into Comprehensive Plan revisions.

Stormwater management regulations and drainage system maintenance rules promulgated at the state level are viewed as quite robust and not in need of additional local action at this time, although Virginia Beach has adopted more stringent regulations to require use of future precipitation levels; in addition, VDOT performs much of the drainage system maintenance in the Wester Tidewater region. Similarly, the state's Chesapeake Bay Act regulations governing shoreline setbacks are enforced locally. Capital

improvements programming is seen as a useful tool in the implementation of high priority mitigation activities across the participating communities.

2. Property Protection

Property protection measures involve the modification of existing buildings and structures or the removal of the structures from hazardous locations. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting (i.e., windproofing, floodproofing, seismic design)
- Safe rooms, shutters, shatter-resistant glass
- Insurance

Committee Discussion: Property protection measures have been implemented in the past in the region and across the state, and are ongoing primarily through HMGP projects. These measures will continue to be included in this and future mitigation action plans. Acquisition is preferred over elevation for Isle of Wight County. Relocation of flood-prone structures is not a high priority in the Western Tidewater region, and is not a preferred alternative in the more built-out municipalities on the Peninsula and Southside. Building elevation projects, critical facilities protection, and floodproofing/retrofitting are popular alternatives with the region's emergency managers, and many communities continually seek ways to increase insurance coverage for vulnerable property owners.

The Community Rating System and related activities encompass and highlight several property protection measures ongoing in the participating communities. The committee decided to continue acquisition, relocation, and elevation measures for repetitively flooded properties, including critical facilities retrofits, in the Mitigation Action Plan, but did not act on any measures specifically for safe rooms or shatter-resistant glass as tornadoes are not a high risk critical hazard. Some communities in Western Tidewater have had discussions about providing safe rooms in designated areas, but no action was taken for this plan.

Existing building code requirements are seen as sufficient with regard to wind and tornado protection; however, hurricane shutters and shatter-resistant glass may be an option for critical facility or emergency shelter retrofits as necessary. Lobbying to ensure critical infrastructure partners are required to have generator power backup, as well as wind protection design elements, was brought up as both a preventive and property protection measure. Many of the study area communities have installed or are considering installation of back-up generators for specific critical facilities, and this will be reflected in the MAP.

With regard to insurance, some communities in Western Tidewater have produced community flyers regarding the importance of having insurance coverage on structures, and the counties participate in the Virginia Association of Counties Group Self-Insurance Risk Pool, a member-owned program that provides equitable rates with stable prices for long-term budgeting purposes. The City of Norfolk recently completed a detailed Program for Public Information and Flood Insurance Coverage Improvement Plan to address areas of the City that are under-insured for flood.

3. Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Natural areas could include floodplains, wetlands, steep slopes, barrier islands and sand dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Land acquisition
- Floodplain protection
- Watershed management

- Beach and dune preservation
- Riparian buffers
- Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks)
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization
- Historic properties and archaeological site preservation

Committee Discussion: Natural resource protection measures remain commonly-used throughout the coastal Virginia region. Many state programs discussed in Section 6, such as the Chesapeake Bay Act, are established natural resource protection measures that are not expected to be weakened in the near- or long-term. The most important of these measures in relation to Hampton Road's critical hazards are floodplain protection, erosion and sediment control, wetland preservation, and watershed management. Several communities in Western Tidewater discussed the fact that they did a lot of land acquisition after Isabel and Floyd and feel like that measure is no longer a high priority under consideration, and others indicated the cost of flood-prone land acquisition is often prohibitive for their local governments.

Several rivers in the study area are designated scenic rivers and that designation has positively impacted watershed management efforts. Forest and vegetation management were discussed and determined to be low priority items at this time, although changes in risk or vulnerability for wildfire may change this thinking in the future. Beach and dune preservation is another state-promulgated program that requires permitting for impacts.

Several communities decided to continue floodplain protection measures and land acquisition in the Mitigation Action Plan, but did not act specifically on other natural resource protection measures as those are considered to be sufficiently addressed through state regulations. Invasive species control is an important habitat preservation technique used, especially in Isle of Wight County within a 200-acre park containing both wetlands and floodplains. York County has a rare and endangered species overlay in the zoning ordinance, as well as an overlay zone for protection of historic or significant archaeological sites. Slope stabilization is not seen as a particularly high priority need in the study area, although individual projects have been implemented in the past, such as a bridge replacement in Franklin and cliff stabilization at a park along the James River at Fort Boykins. Smithfield recently spent $3 million on historic property preservation on the Pagan River to protect a valuable historic asset; additional projects may be under consideration but were not believed to be tied to hazard mitigation at this time.

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the hazard itself through construction. These projects are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Dams/levees/dikes/floodwalls/seawalls
- Diversions/detention/retention
- Channel modification
- Beach nourishment
- Storm sewers

Committee Discussion: New large-scale reservoirs are not under consideration at this time in the region. Dam regulations at the state level are considered sufficient and communities are not considering additional regulation; however, physical upgrades to existing dams are necessary and some are currently underway, including raising and strengthening of the Newport News Waterworks reservoir. Virginia DCR provided input on additional dam maintenance, retrofit and repair projects that are necessary in the region in the coming years. "Dutch Dialogues", or conversations with Dutch engineers

regarding successful flood mitigation techniques overseas, including structures, have resonated with several Hampton Roads communities as they explore ways to protect their built environment from sea level rise. Examples under consideration include green streets and other infrastructure that help manage stormwater so that rising seas and stormwater can be managed effectively. In Newport News, Norfolk and Portsmouth, deteriorating seawalls are under consideration for replacement with increased levels of protection. Virginia Beach, Norfolk and Hampton have ongoing beach nourishment programs to provide flood protection and recreation amenities, and this will be reflected in MAP actions for those communities.

Other structural protection measures are in place and must be maintained by the communities or private owners. Channel modifications, diversions, and detention/retention, such as tide gates, backflow preventers and stream restoration, have been effective in reducing flood hazards in some areas of the region and will remain viable mitigation actions in the future, especially for reducing the compounding effects of increased precipitation, floods and sea level rise. Stream restoration was recently included as a BMP in the State's BMP clearinghouse and some committee members believe that this may result in this method being considered and possibly used more in the future.

Isle of Wight County is implementing some watershed management measures through installation of larger BMPs. Dry hydrants, and smoke testing of sanitary sewers, and the stormwater management preventive maintenance schedule are potential structural projects, with dry hydrants particularly important in wildfire control in the western parts of the study area. High value structural projects are being considered for some study area communities.

5. Emergency Services

Although not typically considered a "mitigation" technique, emergency services can minimize the impacts of a hazard event on people and property. These actions are often taken prior to, during, or in response to an emergency or disaster. Examples include:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Sandbagging for flood protection
- Installing temporary shutters for wind protection

Committee Discussion: Traditional riverine warning systems are inappropriate for some of the region's flood hazards, but a system of citizen and institutional tidal gauge monitoring provides limited input to community emergency planners for specific watersheds in the region. Hampton and Newport News have flood gauges with alerts along Newmarket Creek. Flood warning systems in Southampton County and Franklin are implemented and effective and Isle of Wight County has switched to a more robust system. Several communities have recently implemented Everbridge unified critical communications software to deliver messages to targeted audiences, and most communities have some form of reverse 911. Leveraging the various communities' flood warning systems to create a more regional approach would aid the citizens who live and commute through multiple jurisdictions. Regional cooperation on this front could benefit citizens and visitors to the region and may result in savings to communities by reducing the need to invest in so many systems.

Evacuation planning is aided at the regional and state levels, but local planners use many tools to continually manage and improve the program; several are now considering more use of sheltering in place, the use of central evacuation locations or evacuating more targeted groups rather than automatically going to mass evacuations. Evacuation and sheltering plans for vulnerable populations are a high priority for the region's emergency planners at this time, and Western Tidewater planners continue to work with NC officials regarding Outer Banks evacuation routes that traverse the region.

Sandbagging for flood protection is generally considered helpful, but local governments are not involved in helping property owners sandbag, with the exception of Franklin and Virginia Beach. In Franklin, a new rule allows downtown business owners to get sand and bags from the City. Virginia Beach does provide sandbagging opportunities when necessitated based on storm impacts. Sandbagging is not provided for

any and every storm in Virginia Beach, but is most likely available in response to a hurricane. Individual property owners may decide to sandbag for protection, but this is not an action committee members want to include in the MAP, as longer-term retrofit protection methods are deemed preferable. Adding generator electrical circuits to support jail operations during power outages was discussed and included in the MAP for Chesapeake. This activity is both an Emergency Services action and a Property Protection measure. Some communities, such as Poquoson, Newport News, and York County, have installed shutters for wind protection on Emergency Operations Centers; Hampton is building a new EOC outside the SFHA. Committee members in Western Tidewater discussed battery backups for stoplights, but indicated that in their region, such a measure would require assistance and cooperation with VDOT to implement.

6. Public Education and Awareness

Public education and awareness activities are used to advise residents, elected officials, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures used to educate and inform the public include:

- Outreach projects
- Speaker series/demonstration events
- Hazard mapping
- Real estate disclosure
- Library materials
- School children educational programs
- Hazard expositions
- Inter-governmental coordination

Committee Discussion: Public education and outreach activities are a particular focus of emergency planners in the region and are ongoing, particularly through existing web sites and several CRS-related activities. Speaker series and demonstration events, such as hurricane awareness events, are supported by several of the local governments throughout the year, but may not rise to the importance of being included in the MAP for each of these communities. For example, Hampton participates in the Home Expo and Emergency Preparedness Day annually, and York County has a Safety Town Program each summer. Norfolk has a speaker series on stormwater concepts for schoolchildren. The groups considered ways to improve upon these programs in the MAP moving forward, including working with the State Department of Education to integrate mitigation lessons in the Virginia Standards of Learning. This is potentially a mitigation action for future State Hazard Mitigation Plan updates.

FEMA, working with the U.S. Army Corps of Engineers, has revised many of the Flood Insurance Rate Maps for the region as ongoing coastal studies are completed. Additional hazard mapping was discussed and some communities have worked with HRPDC to gather more structure lowest floor elevations in flood prone areas. Real estate disclosure, particularly for flood risk and radon risk, is guided by current State regulations and not influenced by local government. Library materials, school programs, and open houses are included in the MAP for many communities.

Committee members discussed train-the-trainer opportunities in conjunction with the City's Community Emergency Response Team (CERT) and the Tidewater Builders Association and several decided to add this as an action or to append it to existing actions despite the altered functions of CERTs during the COVID-19 disaster. The HRPDC supports several efforts at inter-governmental coordination, including the Hampton Roads All Hazards Advisory Committee (AHAC) and HR Green. There is also a local CRS User's Group that is very active among CRS and CRS-interested communities in the study area.

SELECTION OF MITIGATION TECHNIQUES

In order to determine the most appropriate mitigation techniques, committee members reviewed and considered the findings of the *Capability Assessment* and *Risk Assessment*. Other considerations included each mitigation action's effect on overall risk reduction, its ease of implementation, its degree of political and community support, its general cost-effectiveness and funding availability.

FEMA guidance for meeting the planning requirements of the Disaster Mitigation Act of 2000 also specifies that local governments should prioritize their mitigation actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. A Mitigation Technique Matrix (**Table 7.2**) shows that those hazards posing the greatest threat are addressed by the updated MAP.

The matrix provides the committee with the opportunity to cross-reference each of the priority hazards (as determined through the *Risk Assessment*) with the comprehensive range of available mitigation techniques, including prevention, property protection, natural resource protection, structural projects, emergency services, and public education and awareness. The *Mitigation Action Plan* includes an array of actions targeting multiple hazards, not just those classified as either high or moderate risk.

As part of the 2022 update, the committee reviewed several documents to assist with the development of new mitigation actions and the assessment of existing actions. Review documents included: 1) a spreadsheet of each community's capabilities and any mitigation program gaps subsequently identified; 2) each community's Comprehensive Plan and Resilience Plans (if available), specifically components that may be compatible with mitigation goals, or that may be appropriate as mitigation actions; 3) contractor review of local floodplain management regulations; 4) the mitigation action items from the existing plans with 2022 status information; and 5) several recommended publications, including FEMA Publication *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013, FEMA's *Mitigation Best Practices* and *Mitigation Action Portfolio* web site, and resilience design guidelines for Miami Beach, Boston and New York City.

TABLE 7.2: MITIGATION TECHNIQUE MATRIX						
MITIGATION TECHNIQUE	HIGH RISK HAZARDS			MODERATE RISK HAZARDS		
	Flooding	Tropical/Coastal Storm	Sea Level Rise and Land Subsidence	Winter Storm	Tornado	Hazardous Materials Incident
PREVENTION	✓	✓	✓	✓	✓	✓
PROPERTY PROTECTION	✓	✓	✓	✓	✓	
NATURAL RESOURCE PROTECTION	✓		✓			✓
STRUCTURAL PROJECTS	✓	✓	✓	✓	✓	
EMERGENCY SERVICES	✓	✓		✓	✓	✓
PUBLIC EDUCATION AND AWARENESS	✓	✓	✓	✓	✓	✓

MITIGATION ACTION PLAN

The mitigation actions proposed for local adoption are listed in the MAP on the pages that follow. They will be implemented according to the plan maintenance procedures established for the *Hampton Roads Hazard Mitigation Plan* (see Section 8: Plan Maintenance Procedures). The action items have been designed to achieve the mitigation goals and priorities established by the committee.

Each proposed mitigation action has been identified as an effective measure to reduce hazard risk in Hampton Roads. Each action is described with available background information such as the location of the project and general cost benefit information.

Other information provided includes data on cost estimates and potential funding sources to implement the action should funding be required (not all proposed actions are contingent upon funding). Most importantly, implementation mechanisms are provided for each action, including the designation of a lead agency or department responsible for carrying the action out, as well as a timeframe for its completion. These implementation mechanisms ensure that the *Hampton Roads Hazard Mitigation Plan* remains a functional document that can be monitored for progress over time. Proposed actions are not listed in exact priority order though each has been assigned a priority level of “high,” “moderate” or “low” as described in the previous section.

Table 7.3 describes the key elements of the Mitigation Action Plan, and **Table 7.4** lists the additional considerations that were evaluated for each proposed action once selected for inclusion in the Mitigation Action Plan. This includes social, technical, administrative, political, legal, economic, and environmental considerations collectively known as "STAPLEE" evaluation criteria.

As part of the plan update process, the committee reviewed the list of recommended actions included in their respective existing plans to determine if the actions should be deleted because they are completed, deferred, cancelled, or continued, and made recommendations regarding modified and new actions. Summary results of this review are included in **Appendix F**.

TABLE 7.3: KEY ELEMENTS OF THE MITIGATION ACTION PLAN	
Proposed Action	Identifies a specific action that, if accomplished, will reduce vulnerability and risk in the impact area. Actions may be in the form of local policies (i.e., regulatory or incentive-based measures), programs or structural mitigation projects and should be consistent with any pre-identified mitigation goals and objectives.
Site and Location	Provides details with regard to the physical location or geographic extent of the proposed action, such as the location of a specific structure to be mitigated, whether a program will be Citywide, countywide or regional, etc.
Cost Benefit	Provides a brief synopsis of how the proposed action will reduce damages for one or more hazards.
Hazard(s) Addressed	Lists the hazard(s) the proposed action is designed to mitigate for.
Goal(s) Addressed	Indicates the Plan's established mitigation goal(s) the proposed action is designed to help achieve.
Priority	Indicates whether the action is a "high" priority, "moderate" priority, or "low" priority based on the established prioritization criteria.
Impact on Socially Vulnerable Populations	Indicates whether the action has a "high" impact, "moderate" impact , or "low" impact based on the established ranking criteria.
Estimated Cost	Indicates what the total cost will be to accomplish this action. This amount will be an estimate until actual final dollar amounts can be determined.
Potential Funding Sources	If applicable, indicates how the cost to complete the action will be funded. For example, funds may be provided from existing operating budgets or general funds, a previously established contingency fund, or a cost-sharing federal or state grant program.
Lead Agency/Department Responsible	Identifies the local agency, department or organization that is best suited to implement the proposed action.
Implementation Schedule	Indicates when the action will begin and when it is estimated to be completed. Some actions will require only a minimal amount of time, while others may require a long-term or continuous effort.

TABLE 7.4: ADDITIONAL CONSIDERATIONS (STAPLEE EVALUATION)	
Socially Acceptable	Is the proposed action socially acceptable to the community? Is the action compatible with present and future community values? Are there equity issues involved that would mean that one segment of the community is adversely affected?
Technically Feasible	Will the proposed action serve as a long term solution? Will it create any negative secondary impacts? Are there any foreseeable problems or technical constraints that could limit its effectiveness?
Administratively Possible	Does the community have the capability to implement the proposed action? Is there someone available to coordinate and sustain the effort?
Politically Acceptable	Is there political support to implement the proposed action? Is there enough public support to ensure the success of the action?
Legal	Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for the action? Are there any potential legal consequences of the action?
Economically Sound	What are the costs and benefits of the proposed action? Does the cost seem reasonable for the size of the problem and the estimated benefits? Are there funding sources available to help offset costs of the action? Is the action compatible with other economic goals of the community?
Environmentally Sound	How will the action impact the environment? Will the action require any environmental regulatory approvals? Is the action consistent with other environmental goals of the community?

The following is a list of current funding sources and their acronyms as may be indicated in the mitigation actions. Additional acronyms used throughout this plan are interpreted in Appendix G. The pool of potential funding mechanisms is changing very rapidly as a result of COVID and other Federal and state legislative priorities at the time of this update.

Key to Potential Funding Source Acronyms:

DHS U.S. Department of Homeland Security
- **BRIC –** Building Resilient Infrastructure and Communities
- **HMGP –** Hazard Mitigation Grant Program
- **FMA –** Flood Mitigation Assistance Program
- **HHPD –** Rehabilitation of High Hazard Potential Dams (HHPD) grant program

ARPA American Rescue Plan Act

USACE U.S. Army Corps of Engineers
- **SFCP** – Small Flood Control Projects
- **FPMS** – Flood Plain Management Services Program
- **CAP** – Continuing Authorities Program

DOI U.S. Department of the Interior
- **LWCF –** Land and Water Conservation Fund Grants

EDA U.S. Economic Development Administration
- **DMTA –** Disaster Mitigation and Technical Assistance Grants

EPA U.S. Environmental Protection Agency
- **CWA –** Clean Water Act Section 319 Grants

HUD U.S. Department of Housing and Urban Development
- **CDBG –** Community Development Block Grant Program

USDA U.S. Department of Agriculture
- **EWP –** Emergency Watershed Protection
- **WPFP –** Watershed Protection and Flood Prevention
- **WSP –** Watershed Surveys and Planning

Virginia
- **CFPF – Virginia Community Flood Preparedness Fund**

Table 7.5 provides a matrix indicating that each critical and noncritical hazard affecting communities is addressed in the Mitigation Action Plan.

TABLE 7.5: MITIGATION ACTIONS FOR CRITICAL AND NON-CRITICAL HAZARDS

	Flooding	Tropical/Coastal Storm	Sea Level Rise and Land Subsidence	Tornado	Winter Storm	Hazardous Materials Incident	Landslide/Coastal Erosion	Earthquake	Wildfire	Radon Exposure	Flooding Due to Impoundment Failure	Pandemic Flu or Communicable Disease
Regional Actions	M*	2, 3	M	2	2	2	2	2, 3	2	2,4	2	2
Hampton	M	M	M	M	M	M	M	M	M	M	M	M
Newport News	M	M	M	3	3	3	M	3, 5	3, 8	3	3, 10	3
Poquoson	M	M	M	M	M	M	M	M	M	4	n/a	4, 10
Williamsburg	M	M	M	M	M	M	M	M	M	M	M	M
James City County	M	M	M	M	M	M	6, 9	M	M	1,7	M	1,7
York County	M	M	M	M	M	M	M	M	M	M	M	M
Norfolk	M	M	M	M	M	3	M	M	3	3,5	M	3,5
Portsmouth	M	M	M	M	M	M	M	M	M	M	n/a	M
Suffolk	M	M	M	M	M	M	2,4	M	M	2	2,8	2
Virginia Beach	M	M	M	M	M	M	M	M	M	6,20	M	M
Chesapeake	M	M	M	M	M	M	M	M	M	M	M	M
Isle of Wight County	M	M	M	M	M	M	M	M	M	5,8	5,8	5,8
Smithfield	M	M	M	M	M	8	M	M	6, 8	8	n/a	8
Windsor	M	3	1	3	3	3	1	3	3	3	n/a	3
Franklin	M	M	M	M	M	M	5,11	M	M	12, 13	n/a	12
Southampton County	M	M	17	M	M	M	M	M	M	M	n/a	10,11
Boykins	M	2,4	3,4	3,4	2,4	3,4	3,4	3,4	M	3,4	n/a	3,4
Branchville	M	M	M	M	M	M	1,3	M	M	1,3	n/a	1,3
Capron	1	1	1	1	1	1	1	1	1	1	n/a	1
Courtland	M	M	M	M	M	M	1,4	3,4	M	2,4	n/a	2,4
Ivor	4,3	3	3,4	3	3,4	3	3	3	M	3	n/a	3
Newsoms	M	1	M	1,2	1,5	1,2	1	1	1,2	1,2	n/a	1,2
Surry County	M	M	M	M	M	M	M	M	M	M	n/a	M
Claremont	M	M	M	M	M	2,5	M	M	M	M	n/a	2,5
Dendron	1	1	1	1	1	1	1	1	1	1	n/a	1

**M = 3 or more actions address this hazard*

REGIONAL STRATEGIES

REGIONAL MITIGATION ACTION 1	
Use existing or create new Elevation Certificates to collect lowest floor elevation data for flood-prone structures in the region, focusing initially on repetitive loss areas in each community.	
BACKGROUND INFORMATION	
Site and Location:	Hampton Roads region, particularly repetitive flood loss areas as identified in Section 5 of this plan
Cost Benefit:	Lowest floor elevation data for pre-FIRM structures are critical information for developing robust cost-benefit analyses of mitigation options for flood-prone structures. The data are necessary in order to prioritize and fund mitigation projects, especially through Federal and state grant processes.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low; Hampton, Newport News, Norfolk and Portsmouth have Moderate NRI flood risk – all other communities have Low
Estimated Cost:	Estimated $30/structure, based on similar project in eastern North Carolina
Potential Funding Sources:	USACE: FPMS; DHS: BRIC and HMGP; Virginia CFPF
Lead Agency/Department Responsible:	AHAC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Significant progress made in recent years by gathering archived Elevation Certificates from building records.	

REGIONAL MITIGATION ACTION 2	
Use AHAC structure and HRPDC resources to develop additional regional mitigation strategies and initiate annual workshop on mitigation project funding.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Hampton Roads study area
Cost Benefit:	Through AHAC organizational structure, VDEM and HRPDC can provide no-cost assistance to the communities to help satisfy reporting requirements, make progress on mitigation actions, and apply for mitigation grant funding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	AHAC/HRPDC, partner with Wetlands Watch, HR Green
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Proposed workshop agenda: 1. HRPDC and VDEM to provide update on funds available, details on how to apply, and what projects are eligible; 2. HRPDC update on regional mitigation actions and progress; 3. Break into community-based work groups to provide report on status of each mitigation action (modified, complete, not started and why).	

REGIONAL MITIGATION ACTION 3	
Analyze and update the platform, availability, and accuracy of HAZUS input data and output results for the purposes of conducting future, more detailed vulnerability analyses.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Hampton Roads study area
Cost Benefit:	Some of the data used to update HAZUS in this study were not intended for the purposes of flood vulnerability analyses. Particularly, the assessor databases from communities are for tax purposes and the data are incomplete.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm and Earthquake
Goal(s) Addressed:	Goal 1, Goal 3; Objective 3.2, 3.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/Low; Hampton, Newport News, Norfolk and Portsmouth have Moderate NRI flood risk – all other communities have Low
Estimated Cost:	$60,000
Potential Funding Sources:	USACE, HMGP, HMGP 5% Initiative, BRIC
Lead Agency/Department Responsible:	HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The PDC has established a platform, but as data and computing needs change, platforms requires ongoing analysis. Some progress has been made and the PDC continues to investigate workshare arrangements with VDEM, CRS Task Force, VFMA/ASFPM and the Silver Jackets.	

REGIONAL MITIGATION ACTION 4	
Use commercially available radon test kits to determine radon levels in structures. Evaluate radon data against known geological formations in the region to determine geographic variability in vulnerability. End product will be a refined map of radon zones.	
BACKGROUND INFORMATION	
Site and Location:	Hampton Roads, particularly areas of suspected high radon concentration over the western extent of the Yorktown Formation.
Cost Benefit:	Radon exposure has a high cost; it is a known cause of lung cancer, especially in smokers. Radon tests are inexpensive (<$50) and structural mitigation is inexpensive. The results of additional testing and map refinement will provide local and state officials with additional tools to advise homeowners when testing is advised, resulting in mitigation of lung cancer. Leaders at the local, regional and State level will gain valuable information to determine if a change in capabilities is warranted (*e.g.*, building code requirements, real estate transaction disclosures).
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Radon Exposure
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.5; Goal 2, Objective 2.1, 2.2, 2.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate – Franklin has very high NRI social vulnerability; Hampton, Newport News, Portsmouth and Williamsburg have relatively moderate social vulnerability; all other communities have low or relatively low
Estimated Cost:	Estimated $30/structure, plus mapping costs
Potential Funding Sources:	EPA, DHS: HMGP, BRIC
Lead Agency/Department Responsible:	HRPDC, College of William & Mary
Implementation Schedule:	Begin project within 2 years of plan adoption; project may extend beyond 2027 planning horizon
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 5	
Partner with VDEM to review repetitive flood loss data from FEMA on a regular basis, update repetitive flood loss area polygons and shapefiles, and analyze data for patterns, errors and mitigation opportunities.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Implementing this action at the State level would reduce the burden on communities by centralizing the process. Using state GIS capabilities would ensure consistency across the Commonwealth and help make this data available beyond just CRS participating communities.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS; Virginia CFPF
Lead Agency/Department Responsible:	VDEM, HRPDC, all Hampton Roads flood-prone communities, particularly those participating in the CRS
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
VDEM GIS staff can assist with ranking RL polygons by more detailed social vulnerability measure than NRI.	

REGIONAL MITIGATION ACTION 6	
Address high and significant hazard dam safety in the region, to include: • **Investigate and conduct risk assessments on dams using risk prioritization methodology;** • **Conduct alternatives analyses to identify preferred plans for dam rehabilitations and the estimated costs for design and construction;** • **Repair, removal, or any other structural or nonstructural measures to rehabilitate an eligible high hazard potential dam, including development of conceptual, preliminary, and final design plans;** • **Conduct additional inundation studies, and use dam inundation data and flood depths to determine if retrofits to affected critical facilities may be necessary.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions. Harwood's Mill Dam in York County, Little Creek Dam in James City County and Godwin's Millpond Dam in Suffolk are of particular concern because they are high hazard dams in poor condition. See Figures 5.13 and 5.14 for dam locations.
Cost Benefit:	Local engineering expertise and regional knowledge may prove effective in supplementing existing, limited state resources for inspecting and rating dams. Dam inundation planning is similarly impacted.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.3; Goal 3, Objective 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate
Estimated Cost:	TBD
Potential Funding Sources:	FEMA: HHPD; ARPA; Virginia CFPF
Lead Agency/Department Responsible:	Virginia DCR, HRPDC, affected communities
Implementation Schedule:	Continuously over next 5 years

ADDITIONAL COMMENTS
HRPDC and its localities work to act as local sponsors of HHPD projects and determine whether specific structural or non-structural measures are needed to meet state standards. In more complex situations, dam owners are advised to undertake alternatives analysis to ensure a cost effective solution is implemented that also meets state and federal environmental requirements.

REGIONAL MITIGATION ACTION 7	
Provide regional leadership regarding the new NFIP's new Risk Rating 2.0 system and renewal policy planning, to include assistance with: **1) Evaluation of rating accuracy and "minus-rated" policies;** **2) Messaging and outreach to homeowners;** **3) Elevation Certificate correction; and** **4) Mitigation assistance for property protection.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	The PDC has contacts and the ability to assemble and then disseminate information at a more cost-effective price point than if each locality on its own.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	FEMA: HMGP, BRIC
Lead Agency/Department Responsible:	HRPDC AHAC, Virginia DCR
Implementation Schedule:	Over the next 2 years
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 8	
Strengthen existing and create new regional transportation networks and hubs for evacuation and sheltering. The purposes and needs for evacuation and sheltering are evolving, and communities are moving away from traditional, large shelters to house large populations toward a more targeted approach that tries to anticipate disaster-related needs more specifically. Educating the public about these changes is an important component to this type of regional planning.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Evacuation and sheltering costs, in particular, can be impacted by how many people are evacuated and how they are moved to shelters. The services available at shelters is impacted, as well. Regional approaches to evacuation can save valuable time and money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All hazards
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – evacuation of socially vulnerable populations will be a focus of the planning effort
Estimated Cost:	TBD
Potential Funding Sources:	FEMA
Lead Agency/Department Responsible:	HRPDC AHAC; Stakeholders (e.g., hospital systems, universities, military bases, American Red Cross, social service agencies, transportation partners)
Implementation Schedule:	Immediately upon adoption
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 9	
Work with private companies to advance continuity of operations, including but not limited to power, gas, and water service restoration. Mitigation actions may include implementation of system redundancies, mutual aid agreements or other partnerships to address critical capability gaps. Physical retrofits may increase resilience of critical infrastructure, such as burying power lines and provision of dependable backup power to water and wastewater treatment facilities.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Damages are reduced when critical lifelines are returned to service promptly after a disaster. By creating partnerships between private utility providers, the region can expect a faster return to full operations, thereby reducing losses to business and property owners.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All hazards
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	ARPA, FEMA
Lead Agency/Department Responsible:	Dominion, HRPDC AHAC
Implementation Schedule:	Within 4 years of plan adoption
ADDITIONAL COMMENTS	

HAMPTON

HAMPTON MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program and Community Rating System, with goal of obtaining Class 6 CRS rating. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums; a Class 6 rating equates to a 20% flood insurance premium savings for most flood-prone property owners. New construction and future development are protected from current flood conditions through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management, Public Works and Community Development
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 2	
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. This action includes acquisition/demolition of repetitive and severe repetitive losses from trustee sales/tax sales.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City has collected elevation data and will continue collection as part of this action in order to more easily make cost-benefit analyses of at risk structures. City acquisition of repetitively flooded trustee sales is a cost-effective way to remove severely flood-prone structures from the real estate market and prevent resale without mitigation. These properties can be purchased inexpensively. Treasurer's Office can provide list of tax sales on regular basis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	Cost will be based on specific flood protection measures chosen. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Community Development, Treasurer's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Locally funded projects may be creditable under the Community Rating System.	

HAMPTON MITIGATION ACTION 3	
Provide flood, wind and heat protection and dry access/egress for critical facilities and infrastructure. Retrofits may include, but are not limited to: elevate and harden communication sites, provide generator backup or prewire evacuation shelters for quick hook-ups, and upgrade sewer pump stations.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide
Cost Benefit:	Benefits of mitigating damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Benefits are based on reduced response times, and longevity of critical infrastructure.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Extreme Heat
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Cost will be based on specific protection measures chosen for each facility. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities
Lead Agency/Department Responsible:	Emergency Management, Public Works, Hampton City Schools
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
New 911/EOC is nearing construction out of the SFHA, on Big Bethel Road.	

HAMPTON MITIGATION ACTION 4	
Adopt and implement holistic water plans to mitigate flooding on a watershed level.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Identify and prioritize impactful and implementable projects, policies, and programs to reduce flooding impacts, spur flood-safe redevelopment and add value to affected neighborhoods.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approximately $250,000 per water plan, or $1 million in total for remaining plans
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Community Development, Public Works
Implementation Schedule:	Ongoing; planning complete in approximately 5 years
ADDITIONAL COMMENTS	
Planning is led by the Resilient Hampton Initiative, and is based on the idea of living with water. The focus is on flood mitigation, economic growth, mobility and access, green infrastructure, natural resources, and revitalization of flood-prone areas. Plans aim to coordinate a variety of goals while mitigating flooding impacts, working together with the community to identify assets, approaches, and projects.	

HAMPTON MITIGATION ACTION 5	
Maximize use of social media before, during and after hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Minimal cost to reach larger audience more effectively
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$200,000 annually, including staff time
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Marketing Department, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Other information that we will need to spread and the most effective methods, may include short videos, maps, links, photos, and infographics. In 2021, Hampton won an award for Top 10 Digital City for its size range. Efforts to reach a broad group of citizens are working and should continue.	

HAMPTON MITIGATION ACTION 6	
Develop a Resilient Hampton Education Plan, which may include a CRS Plan for Public Information. **Prepare public outreach materials and conduct outreach to educate elected officials and residents on methods of mitigating flood damage, the importance of maintaining flood insurance coverage, the City's floodplain management efforts, and the benefits of the City's CRS participation.** **Expand capacity building and training for various groups and neighborhood-serving organizations to include communication about mitigation, building code requirements, and response.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on vulnerable neighborhoods with less access to social or broadcast media
Cost Benefit:	Local residents are better able to address and then communicate the needs of their specific neighborhoods. Using community members to transmit information to neighbors can expand capacity of City staff to communicate, mitigate and respond more effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Extreme Heat
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$5,000 to $50,000
Potential Funding Sources:	General Fund – Neighborhood Education Programs; HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management, Community Development, Marketing, Public Works
Implementation Schedule:	Ongoing; incorporate into upcoming Resilient Hampton education plan
ADDITIONAL COMMENTS	
Also considering partnerships with neighboring localities to share training opportunities for interested citizens. Make sure homeowners have flood insurance coverage. Flood insurance coverage has been shown to reduce response needs and help Hampton's citizens return to normalcy more quickly after flooding.	

HAMPTON MITIGATION ACTION 7	
Improve stormwater management capacity of existing system, to include improving drainage system maintenance using increased sediment and debris clearance, and ongoing analysis of the current system's status of functionality.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide. Engineering studies have specifically identified Mill Creek Terrace, Mary Peake and Riverdale as particular areas of concern.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance and retrofits are required to keep the system functioning effectively, especially as sea level rises.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4, 1.5, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$22.1 million (see additional information below)
Potential Funding Sources:	Stormwater Utility Fee; Bond Funding; ARPA; IIJA
Lead Agency/Department Responsible:	Public Works Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Hampton's MS4 permit has requirements for this activity and the city is required to increase debris and sediment removal for each 5-year permit. Pochin Place was completed December 2020, cost $762,183, the total cost for the remaining mitigation efforts in the Mill Creek Watershed are $2,361,000, Mary Peake Watershed $10,561,699 and the Riverdale Watershed is $10,561,699. The total cost is estimated at $22,120,109.	

HAMPTON MITIGATION ACTION 8	
Coordinate with owners of post-FIRM structures that are NFIP "minus-rated" to help property owners determine reason for rating and implementing solutions. Identify funding sources to help identify and fund retrofits.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone locations citywide
Cost Benefit:	Minus-ratings are typically related to flood vents and are straightforward, low cost retrofits. Assistance from City staff and/or private insurers could help owners reduce flood insurance premiums while gaining flood resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2, Objective 2.1, 2.3; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time. Some private companies that offer flood insurance often provide this service to homeowners free of charge.
Potential Funding Sources:	HMGP 5% Initiative; Hampton's flood mitigation fund provides low-cost loans for mitigation
Lead Agency/Department Responsible:	Community Development, Emergency Management, Public Works
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 9	
Conduct repetitive loss area analyses of repetitive flood loss areas, partnering with HRPDC and VDEM where relevant. Include outreach to homeowners regarding potential mitigation options.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas Citywide (see Section 5 for maps)
Cost Benefit:	Analyses benefit property owners by identifying potential mitigation actions, making the repetitively flooded areas better known to elected officials and the public, and possibly garnering CRS points to contribute to reducing flood insurance premiums.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	$100,000
Potential Funding Sources:	Grant funding through Emergency Management; see also Regional Action #5
Lead Agency/Department Responsible:	Community Development, Public Works/Engineering and Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 10	
Continue to build resiliency into the city's approach to social, economic and physical challenges. Incorporate resilience strategies into City plans (community plan, capital improvement plan, master plans, etc.). Develop a tool to evaluate how City decisions align with resiliency goals.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	As the historic patterns of natural hazards shift with the impacts of climate change, addressing hazards and their impacts on citizens is increasingly the work of all City departments. Disseminating responsibility for addressing resilience to relevant staff through education and training, and updating guidelines and creating tools, is more cost effective than hiring additional resources to address hazards. Approaching resiliency from a whole-community standpoint in plans helps to reduce counterproductive measures, conflicting projects, and redundancy in operation, thus saving taxpayer funds in the long-term.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3 and 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	CIP
Lead Agency/Department Responsible:	City Manager's Office and Community Development Resiliency Officer
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 11	
Maintain storm-resistant public beaches.	
BACKGROUND INFORMATION	
Site and Location:	Atlantic Ocean/Chesapeake Bay shoreline
Cost Benefit:	Maintaining the existing beach profile provides flood protection and wave protection to waterfront structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$7,000,000 as proposed for 2022
Potential Funding Sources:	ARPA
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 12	
Ensure safe ramp access is provided for rapid extraction of City-owned boats prior to Tropical/Coastal storm.	
BACKGROUND INFORMATION	
Site and Location:	Hampton River and Back River
Cost Benefit:	Emergency Services has invested considerable resources in rescue boats. The ability to extract these boats protects assets from storm damage or loss.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Undetermined
Potential Funding Sources:	
Lead Agency/Department Responsible:	Public Safety and Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
As various City departments examined options for redevelopment at the Sunset Boat Ramp in 2021, Emergency Management highlighted the importance of the public ramp for this purpose.	

HAMPTON MITIGATION ACTION 13	
Develop, finalize and implement Disaster Recovery Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	A plan for disaster recovery minimizes the negative impacts of hazard events on City functions, citizens and businesses, and may even identify opportunities for safer redevelopment.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS, VDEM
Lead Agency/Department Responsible:	Emergency Management, Community Development
Implementation Schedule:	Ongoing, with plan expected to be finalized in 2022 or 2023.
ADDITIONAL COMMENTS	
Disaster recovery can be short-term or long-term depending on the nature of the event itself. The City is developing a Disaster Recovery Plan to set out expectations for managing multiple hazard events and the related recovery processes, to include setting up a Storm Response Center, assigning roles and responsibilities to the recovery team members, collecting and backing up data, restoring/continuing City and private utility operations, and testing and maintaining critical facilities. Major disasters may also require longer-term recovery plans that address Community Development and resiliency issues to minimize hazardous redevelopment practices.	

HAMPTON MITIGATION ACTION 14	
Develop a plan to collect surveyed high water mark data following flood events.	
BACKGROUND INFORMATION	
Site and Location:	Citywide floodplains
Cost Benefit:	Collection of high water mark data allows better calculation of a storm's frequency, thus improving cost benefit analyses for future mitigation projects.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	Staff time, Post-disaster surveys could be used to collect high water mark elevations at approximately $500/structure (for a large number of surveys at once)
Potential Funding Sources:	USACE: FPMS; VDEM: HMGP, HMGP 5% Initiative, USGS
Lead Agency/Department Responsible:	Public Works, Emergency Management
Implementation Schedule:	Set up any necessary post-disaster contracts within 2 years of plan adoption
ADDITIONAL COMMENTS	
Structural inventories with elevations, high water marks, and flood frequency data help prepare accurate cost-benefit analyses for a large number of structures rapidly, which is especially useful in a post-disaster scenario.	

HAMPTON MITIGATION ACTION 15	
Provide business resiliency planning services to the City's business owners, particularly Virginia Department of Minority Business Enterprise (DMBE)-certified SWaM businesses that may have access to fewer resources than larger establishments. Workshops and outreach would identify businesses interested in further planning, with more detailed assistance then provided to assist businesses with details regarding risk and vulnerability assessment, preparedness, continuity of operations planning and adaptation/recovery. Help businesses identify specific mitigation projects and sources of funding to reduce vulnerability and increase resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Businesses that are prepared for disasters unique to their location are more likely to remain operational or to resume operations quickly post-disaster, thus making the business' services available to residents more quickly. Pre-disaster planning costs reduce post-disaster damages for the business, the customers, and the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4, 1.5; Goal 2, Objectives 2.1, 2.2, 2.3; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Medium
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined based on business community interest
Potential Funding Sources:	DHS: BRIC, HMGP; Virginia CFPF; EDA DMTA; Commonwealth Center for Recurrent Flooding Resiliency (CCRFR)
Lead Agency/Department Responsible:	Economic Development, CCRFR
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
The CCRFR has prepared the Coastal Virginia Small Business Self-Assessment and Guide available at: https://www.floodingresiliency.org/coastal-virginia-small-business-resilience-self-assessment-and-guide/ which could be useful for beginning this action.	

HAMPTON MITIGATION ACTION 16	
Implement structural and nature-based flood control projects in flood prone areas, such as tide gates, berms, constructed wetlands, roadway elevations, etc. This action includes projects identified by the *Resilient Hampton* Initiative plans.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide
Cost Benefit:	Multi-objective projects have benefits across the spectrum, including flood protection benefits, and benefits that accrue from natural and beneficial functions of floodplains and wetlands.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Cost will be based on specific flood protection measures chosen.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Community Development, Treasurer's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

NEWPORT NEWS

NEWPORT NEWS MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements. Improve floodplain management program and CRS rating.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums. New construction and future development are protected from floods through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management/Engineering
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
The city is currently a class 7 in the CRS program.	

NEWPORT NEWS MITIGATION ACTION 2	
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. Flood protection may include small structural flood control projects, such as tide gates, or backflow preventers. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood loss areas Citywide
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City's Flood Assistance Program has had measurable benefits using primarily acquisition to mitigate an estimated 2 structures per year since 1999. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2 and Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – Salter's Creek and Newmarket Creek repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability. The other 6 repetitive flood loss areas affect moderate to low risk areas.
Estimated Cost:	Estimated $750,000 per year through various channels and sources
Potential Funding Sources:	CIP; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF. Flood Assistance Program has primarily used City funds.
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
80 properties comprising 15.2 acres have been purchased.	

NEWPORT NEWS MITIGATION ACTION 3	
Protect critical facilities and infrastructure, including access/egress. Retrofits may include, but are not limited to: upgrades or relocation of the 911/EOC/311 facilities and wind vulnerability of building, components and equipment; floodproofing or elevating pump stations; retrofitting remaining pump stations with generators or quick-connect hookups.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide. Pump stations #2, #53 and #99 have been identified as high priority locations for non-structural mitigation measures.
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Benefits are based on reduced response times, and longevity of critical infrastructure. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4s
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Cost will be based on specific flood protection measures chosen for each building.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities
Lead Agency/Department Responsible:	Emergency Management, Facilities Engineering
Implementation Schedule:	Long-term, 3 to 7 years
ADDITIONAL COMMENTS	
Wind retrofits should ensure EOC is protected with winds up to 120mph.	

NEWPORT NEWS MITIGATION ACTION 4	
Construct new access road to Pump Station 49 on Warwick Boulevard.	
BACKGROUND INFORMATION	
Site and Location:	Pump Station 49, Warwick Blvd – new access road from Old Courthouse Way
Cost Benefit:	Existing access drive is below the 100-year flood elevation and has been flooded by the adjacent Stoney Run Creek during significant storm events. This flooding prevents access to the station including the delivery of fuel needed to run the station emergency power generator. Finished floor elevation of the station is above the 100-year flood elevation and it is not considered susceptible to flooding. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$300,000, includes acquisition of undeveloped commercial property
Potential Funding Sources:	DHS: HMGP, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Within 5 to 7 years
ADDITIONAL COMMENTS	
Other alternatives considered but rejected include: 1) raise existing service road (would require undesirable impacts to Stoney Run); and 2) new access road from Warwick Blvd (steep grade issues would limit access).	

NEWPORT NEWS MITIGATION ACTION 5	
Drainage improvements on Chelsea Place, to include increased flow through the drainage outfall from the apartments and diversion of some of the flow from Edgemoor Drive to a new outfall.	
BACKGROUND INFORMATION	
Site and Location:	Chelsea Place Apartments, Warwick Blvd
Cost Benefit:	Existing drainage system drains to a channel along the CSX right-of-way, then through a small culvert to a drainage channel along Warwick Blvd. The culvert under the railroad is undersized and causes flooding in the parking lot of the apartments. The flooding enters at least 15 ground floor apartments rendering them unrentable and has resulted in the loss of multiple vehicles.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1,1, 1,2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$750,000
Potential Funding Sources:	Stormwater Management Fund
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Construction estimated to begin late 2022
ADDITIONAL COMMENTS	
Project delayed by CSX close to agreement for crossing. Design is being updated.	

NEWPORT NEWS MITIGATION ACTION 6	
Provide various watershed and flood warning improvements to reduce danger to lives and property from flooding along Newmarket Creek. This action may include Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Newmarket Creek watershed
Cost Benefit:	Several alternatives considered. Combination of computer modeling improvements, early warning/detection systems and drainage improvements considered most beneficial for multi-objective management of the watershed. Benefits include: 1) upgrades to current watershed models to pinpoint drainage improvements; 2) detection systems to alert City officials to pre-determined water levels in drainage system to initiate procedures for warning/evacuating residents; 3) drainage improvements (quality and quantity controls) to improve lifespan of the system, reduce nuisance flooding, and provide credit for pollutant reduction; 4) measures may provide sufficient flood mitigation/protection to result in removal of repetitive flood loss properties from the City's inventory and may provide points under CRS.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.3, 3.4
Impact on Socially Vulnerable Populations:	High – Newmarket Creek repetitive flood loss area contains areas of relatively high NRI flood risk, which includes analysis of social vulnerability.
Priority (High, Moderate, Low):	High
Estimated Cost:	Computer model upgrade = $152,000 Projects pending watershed model & analysis in 2023 Early Warning/Detection systems = $200,000 Drainage Improvements – pipe installations= $7,350,000 Drainage Improvements – channel upgrades = $3,725,000 Drainage Improvements – BMP installations = $6,683,000
Potential Funding Sources:	DHS: FMA, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	
Implementation Schedule:	5 to 10 years; sensors have been installed
ADDITIONAL COMMENTS	
Other alternatives considered include: raise elevation of all houses within 100-year floodplain; purchase properties and relocate residents in 100-year floodplain; build structures (levees, floodwalls, gates/pumps) to protect properties; provide detection systems within watershed to alert to high water levels within major drainage channels; modify current City programs to streamline application process for homeowners; assist in redeveloping areas of the watershed (commercial/businesses, recreational areas, and residential neighborhoods).	

NEWPORT NEWS MITIGATION ACTION 7	
Improve drainage system maintenance, including increased sediment and debris clearance.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance is required to keep the system functioning effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$2,275,500
Potential Funding Sources:	Stormwater User Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing as part of 5-year CIP updated annually. New projects continually identified.
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 8	
Continue Forest Management Program to mitigate wildfire hazards and promote forest health.	
BACKGROUND INFORMATION	
Site and Location:	Program is primarily focused on Waterworks land holdings near the utility's reservoirs.
Cost Benefit:	This ongoing program reduces the number of fires, and works to control pine beetle infestations. Forest thinning is a primary control mechanism. This is one of many programs the utility implements related to hazard mitigation.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Drought
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Net cost is low because costs are offset by selling the timber
Potential Funding Sources:	Waterworks Enterprise Fund
Lead Agency/Department Responsible:	Newport News Waterworks
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 9	
Prepare public outreach materials. Educate elected officials and residents on the importance of the NFIP and the City's floodplain management efforts, maintaining flood insurance coverage, and methods for mitigating flood damage. City's comprehensive master floodplain management planning will include developing educational, outreach and more accessible materials and tools.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide
Cost Benefit:	Making sure homeowners have flood insurance coverage has been shown to reduce response needs and help Newport News' citizens return to normalcy more quickly after flooding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – Salter's Creek and Newmarket Creek repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability. The other 6 repetitive flood loss areas affect moderate to low risk areas.
Estimated Cost:	<$5,000 per year
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
While this action is ongoing, it is important to retain in the hazard mitigation plan to ensure continued funding is secured annually.	

NEWPORT NEWS MITIGATION ACTION 10	
Rehabilitation and improvement of Harwood's Mill Dam which impounds Harwood's Mill Reservoir to provide water for Harwood's Mill Water Treatment Plant. The planned improvement project consists of the demolition of the existing outlet works and principal spillway chute and construction of a new principal spillway floor slab, training walls, intake structure and flume, access bridge, concrete crest wall and the rehabilitation of the existing spillway weir.	
BACKGROUND INFORMATION	
Site and Location:	Yorktown, Virginia – Route 17
Cost Benefit:	Repairs are needed to bring project into compliant with State regulations. Project avoids damages which could result from a compromised spillway.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Downstream of the dam are areas of relatively moderate to relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$12,800,000
Potential Funding Sources:	CIP
Lead Agency/Department Responsible:	Facilities Engineering
Implementation Schedule:	February 2022 – December 2023
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 11	
Stormwater Master Planning: the City will develop three separate, yet inter-dependent master plans for citywide stormwater management, floodplain management, and resilience & climate change management.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's current Stormwater and Floodplain management plans are out of date and no longer viable for addressing current or future flooding problems. Last year the state issued new requirements for addressing climate change.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$5,500,000
Potential Funding Sources:	Capital Improvement Plan, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Planning to begin 2022 and will last 3 years
ADDITIONAL COMMENTS	
Newport News does not have a comprehensive City specific plan for addressing climate change and resilience. The combined master planning will include an assessment of the existing state of several components of the City's stormwater management; public engagement; general inventory, documentation, and evaluation of infrastructure; analysis of ordinances and design manuals; greenway corridor planning and conceptual plan development with capital planning, cost estimating, and financial planning. Planning will also provide data on where structures lie in the City with regard to future flooding and sea level rise so that regulations governing future development can based on more detailed vulnerability.	

NEWPORT NEWS MITIGATION ACTION 12	
Improve the Lions Bridge Dam which impounds Mariners' Lake to bring the dam into compliance with current state dam safety standards.	
BACKGROUND INFORMATION	
Site and Location:	100 Museum Drive
Cost Benefit:	The current Lions Bridge Dam was built in 1937 before dam safety regulations. The current dam is considered a significant hazard dam because greater than 400 vehicles per day travel on the roadway across the dam. The dam will be armored to safely withstand overtopping during the half probable maximum flood.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.5, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$11,000,000
Potential Funding Sources:	Capital Improvement Plan, Lake Maury Fund
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design will be completed Spring 2022, construction will begin late 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 13	
Nicewood Area Drainage Improvements. Evaluation of existing storm system and implementation of recommended improvements to address flooding.	
BACKGROUND INFORMATION	
Site and Location:	Area around the intersection of Malden Lane and Maryle Court to Nicewood Park in the Runnymeade Subdivision
Cost Benefit:	Citizens within the area of the intersection of Malden Lane and Maryle Court and the outfalling storm system to Nicewood Park experience frequent flooding during significant rain events. The existing storm drainage system is inadequate. The project will reduce the risk of flooding and damages to approximately 70 homes and approximately 2200 linear feet of roadway.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low – the area has very low NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$2,100,000
Potential Funding Sources:	Stormwater user Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design will begin 2022
ADDITIONAL COMMENTS	
The project includes funding for a detailed model of the storm system to determine what improvements are required, along with funds for the design and construction of a new system once improvements are identified.	

NEWPORT NEWS MITIGATION ACTION 14	
Marshall Ridley. Redevelopment of a large area of outdated apartments with no existing stormwater management system in place. The new development will include multiple BMPs and a regional stormwater management facility.	
BACKGROUND INFORMATION	
Site and Location:	Between Jefferson Avenue and Ivy Avenue, between 12th Street and 18th Street
Cost Benefit:	The area currently does not have any stormwater management, so all stormwater outfalls directly into Seafood Industrial Park Small Boat Harbor without detention or water quality treatment. The new development will provide treatment and serve as a regional BMP for approximately 30 acres. Provide improved drainage on public right-of-way to alleviate nuisance flooding; upgrade to City's drainage system for another 50 years, reduce maintenance costs for repairs, and provide a new storm system that meets current design standards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – the area has very high or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$6,000,000
Potential Funding Sources:	Stormwater user Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2021, Construction 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 15	
Governors Drive Stream Restoration & BMP, including restoration of Flaxmill Creek to alleviate erosion and protect a major HRSD force main.	
BACKGROUND INFORMATION	
Site and Location:	Flaxmill Creek between Governors Drive and Riverview Farm Park.
Cost Benefit:	The existing drainage channel at the rear of residential properties is experiencing erosion and has deteriorated to a point where it is unstable.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm; Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$2,000,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, & State Local Assistance Fund (SLAF)
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2022, Construction 2024
ADDITIONAL COMMENTS	
The project will include providing a stable and constant cross-section with applicable natural and stone armaments for conducting stormwater runoff from a 10-year storm event. This channel conducts stormwater runoff from several public right-of-ways such as Lucas Creek Rd, Menchville Rd, and roads within Denbigh Plantation.	

NEWPORT NEWS MITIGATION ACTION 16	
Analyze and improve drainage/stormwater system along Stoney Run.	
BACKGROUND INFORMATION	
Site and Location:	Northern portion of the Stoney Run Watershed
Cost Benefit:	Several neighborhoods (Colony Pines, Windsor Great Park, and surrounding areas), totaling approximately 900 acres, within the northern portion of the Stoney Run watershed experience repeated issues frequent flooding during high intensity storm events. Most of the storm system was designed and constructed under a 5-year design storm requirement, and current regulations require storm systems be designed to handle a 10-year storm event. A detailed analysis will determine potential modifications and additions to the stormwater system, including the stormwater management facilities. Funding is included to design and implement identified modifications and additions necessary to improve the drainage system and maintain the efficient conveyance of runoff while meeting regulatory requirements for water quantity and quality.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$8,500,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, SLAF, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Computer Model Analysis 2021, Construction within 5 – 10 years
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 17	
Salters Creek Analysis and Drainage Improvements. Develop computer model analysis and implement identified drainage projects. Reduce flooding throughout the Salters Creek watershed by improving the capacity of the existing drainage system, providing additional storage, and ensuring compliance with stormwater regulations.	
BACKGROUND INFORMATION	
Site and Location:	Salters Creek Watershed
Cost Benefit:	The Salters Creek watershed in the Southeast Community is approximately 1,236 acres and is extremely low-lying. As a result, the surrounding area experiences issues with drainage and frequent flooding from storms and high tides. A detailed computer model analysis will be performed to determine potential modifications and additions to the stormwater system. Funding is also included for the design and construction of identified improvements. The project will result in implementing improvements necessary to maintain the efficient conveyance of runoff during storm and high tidal events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – Salter's Creek repetitive flood loss area contains areas of very high or relatively high flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$7,200,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, SLAF, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2021, Construction 3-7 years
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 18	
James River Shoreline Stabilization. Stabilize 720 linear feet of shoreline on the James River to address severe erosion and failure of the steep slope along River Rd, and protect existing utilities and the road.	
BACKGROUND INFORMATION	
Site and Location:	James River along River Rd from 9304 to 9508 River Road
Cost Benefit:	The project provides restoration and stabilization of 720 feet of shoreline adjacent to River Road to reduce erosion of the existing embankments, prevent loss of shoreline, and protect the City's roadway and underground utilities. The improvements will be a combination of stone riprap sills and a vegetative slope along with a living shoreline.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Landslide/Coastal Erosion, Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$3,400,000
Potential Funding Sources:	CAP funding, Stormwater Fees, CIP
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 19	
Christopher Shores Drainage Improvements. Address repeated flooding in the Christopher Shores subdivision by installing larger storm pipes and additional pipes and inlets to alleviate flooding during tidal events.	
BACKGROUND INFORMATION	
Site and Location:	Christopher Shores subdivision
Cost Benefit:	The project consists of construction of a new storm drain system and outfalls to replace an existing system that is outdated and does not conform to present City standards. This project will alleviate ongoing flooding issues caused by rainfall events, storm surges, and tidal action of Hampton Roads within the existing closed drainage systems in approximately 66 acres of the Christopher Shores area of the Southeast Community. Street flooding is an issue for residents especially when it hampers their ability to evacuate the area when major storm events are predicted.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$5,600,000
Potential Funding Sources:	Stormwater Fees, CIP
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Construction 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 20	
Deep Creek Shoreline Stabilization. Stabilize the shoreline at Menchville Marina on Deep Creek.	
BACKGROUND INFORMATION	
Site and Location:	Menchville Marina, 494 South Menchville Road
Cost Benefit:	Restore and stabilize approximately 300 LF of shoreline along Deep Creek at the Menchville Marina. Existing conditions include old wooden posts and nuisance vegetation, as well as erosion problems.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low – the area has low NRI Coastal Flood Risk
Estimated Cost:	$600,000
Potential Funding Sources:	Stormwater Fees, CIP
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Construction 2022
ADDITIONAL COMMENTS	

POQUOSON

POQUOSON MITIGATION ACTION 1
Continue participating in the National Flood Insurance Program and the Community Rating System, with a goal of becoming a Class 7 community. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements. Encourage additional staff to become Certified Floodplain Managers. **Study feasibility of implementing additional floodplain management ordinance changes, including:** **1. Changes to the definition of "substantial improvement" that would require accumulation of costs of improvements and repairs of buildings, based on issued building permits, over a set time period; and,** **2. Coastal A Zone regulations that apply coastal high hazard area requirements in areas delineated by FEMA as subject to wave heights between 3 feet and 1.5 feet high.**

BACKGROUND INFORMATION	
Site and Location:	Special Flood Hazard Areas of Poquoson
Cost Benefit:	Additional measures to manage floodplains can further reduce flood response needs in the long-term, and reduce flood insurance premiums through CRS rating changes in the near-term. The NFIP and related flood mapping and development regulations have proven benefits nationwide.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets; HMGP 5% Initiative
Lead Agency/Department Responsible:	Building Inspections
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS

POQUOSON MITIGATION ACTION 2	
Elevate, relocate, acquire, retrofit or floodproof structures in hurricane prone areas. Flood protection may include minor localized flood reduction projects, as well. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide, and Citywide for wind retrofits
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	In multiple $250,000 phases as grant money becomes available. Individual structure costs vary.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management and Building Inspections
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

POQUOSON MITIGATION ACTION 3	
Implement the Shoreline Management Plan developed by Virginia Institute of Marine Science, as conditions warrant.	
BACKGROUND INFORMATION	
Site and Location:	Shorelines Citywide
Cost Benefit:	Implementation is not costly and could be absorbed by existing department budgets. Materials to share with property owners and training for staff (and interested property owners) are available from VIMS at very low cost. Adding links from the City web page to the VIMS toolbox is low cost but would provide valuable information to property owners.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.6; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time only
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning Department, Permitting, and Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Currently, Virginia's Shoreline Erosion Advisory Service is not funded. Property owners need guidance on best management shoreline protection methods from reliable sources and not necessarily just from shoreline repair contractors. The *Poquoson Comprehensive Plan 2008-2028*, Environmental Management Element, Shoreline Sub-Element, states as its second goal, "Develop a shoreline management plan to ensure property shoreline protection and create a framework for incentive[s] based on programs to encourage less intrusive means of shoreline protection." While permitting incentives were considered that might encourage living shorelines, City staff determined that permit fees and review times are already as low as possible.	

POQUOSON MITIGATION ACTION 4	
Continue to increase flood and wind protection and flood access/egress for critical facilities and infrastructure. Elevate new critical facilities, retrofit existing facilities as necessary, and elevate roads to provide access to elevated critical facilities. Retrofits may include but are not limited to: installation of emergency backup power, elevation of structure or components, relocation or retrofit of building components, and installation of tidal/flap valves on drainage structures. Coordinate with public utilities to protect or retrofit transformers, critical infrastructure and overhead power lines.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide.
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Flooding of roads prevents access to elevated critical facilities. Benefits are based on reduced response times, and longevity of critical infrastructure. Elevation of roads could reduce evacuation times once flooding begins, and protect roadbeds from erosion associated with sea level rise in the future.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Cost will be based on measures chosen for each building
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities; Virginia CFPF
Lead Agency/Department Responsible:	Public Works/Engineering, Fire Department, Police Department, Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Some vital infrastructure such as storm sewer and sanitary sewer are subject to flooding, and possibly vulnerable to sea level rise in the future.	

POQUOSON MITIGATION ACTION 5	
Collect and share hazard-related data in GIS-compatible format, including but not limited to: **1) add tide gauges for flood prediction and collect high water marks and calculate flood frequency for all coastal storms;** **2) continue to collect Elevation Certificates for each structure in the 100-year floodplain and post online for property owner use;** **3) use sidescan LIDAR to collect additional data regarding structure elevations Citywide;** **4) incorporate new software for the assessor's database that includes flood elevation data;** **5) use drone-produced real-time storm surge/tidal conditions mapping developed in conjunction with NASA and ODU; and,** **6) inventory and prioritize low-lying secondary roads and intersections critical to evacuation.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Collection of elevation information and retention of Elevation Certificates can reduce surveying costs for property owners and buyers in the future. The partnership with NASA for real-time mapping has been a very successful and low-cost venture.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion, Winter Storm, Hazardous Materials Incident
Goal(s) Addressed:	Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time Post-disaster surveys could be used to collect structure elevations at approximately $300/structure (for a large number of structures at once)
Potential Funding Sources:	NASA and ODU; HRPDC, USACE: FPMS; DHS: HMGP, HMGP 5% Initiative; USGS; Virginia CFPF
Lead Agency/Department Responsible:	Engineering, Building Inspections, Emergency Management
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The City Building Inspector continues to compile and digitize a collection of Elevation Certificates for existing structures, elevated/mitigated structures and new structures, and he maintains pertinent data from the forms in a digital format. City has collected high water marks after recent floods and anticipates doing so again in the future. City notifies residents on low-lowing roads of evacuation needs early via CodeRed, posts digital signage and advises them to move personal property early in the evacuation process.

POQUOSON MITIGATION ACTION 6	
Review and update Pre-Disaster Debris Management Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Pre-disaster debris management reduces damage to structures and infrastructure from flood and wind. Also, regular clean-up requirements can reduce the costs of post-disaster debris clean-up. City could also have access to the additional 5-percent cost incentive from FEMA's Public Assistance money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5, 1.6; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing capital budgets; HMGP, BRIC or FMA (with very clearly articulated benefits for flood damage reduction); Virginia CFPF
Lead Agency/Department Responsible:	Public Works, Solid Waste
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City recently purchased two new tractors for pre-event debris clearance.	

POQUOSON MITIGATION ACTION 7	
Coordinate with public utilities, and use City resources to trim trees in the public right-of-way.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits include reduced debris clean-up costs and increased utility service reliability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Tornadoes, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$100,000, including contributions from utility providers
Potential Funding Sources:	Existing capital budgets, HMGP. In some cases, utilities may be eligible for some FEMA grant monies, as well.
Lead Agency/Department Responsible:	Public Works, utility providers; City has agreement with York County for keeping roadways clear to accommodate evacuations
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

POQUOSON MITIGATION ACTION 8	
Eliminate barriers to the orderly evacuation of citizens: **1) Elevate and widen the causeway to Hampton (Wythe Creek Road);** **2) Widen Victory Boulevard;** **3) Continue car evacuation agreement with Langley Motor Speedway to allow citizens to park cars there prior to expected flooding; and,** **4) Address low-lying roadways/intersections identified in Mitigation Action #5, including use of temporary flood barriers for critical resident evacuation routes and first responder access/egress.**	
BACKGROUND INFORMATION	
Site and Location:	Wythe Creek Road and Victory Boulevard
Cost Benefit:	These two roadways are considered critical infrastructure for the evacuation and protection of citizens in Poquoson. Wythe Creek Road floods regularly at high tide, cutting off the route and requiring all citizens to evacuate via Victory Boulevard. Providing a no-cost alternative for parking vehicles out of harm's way encourages people to consider the advantages and consequences of evacuating cars and people.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.5; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost to Poquoson:	Wythe Creek Road - $19.8 million Victory Boulevard - $22.7 million
Potential Funding Sources:	VDOT, Hampton, York County and other partners; Virginia CFPF
Lead Agency/Department Responsible:	Engineering and City Manager's Office
Implementation Schedule:	Wythe Creek Road is scheduled for construction in 2022; Victory Boulevard widening is in the planning stages.
ADDITIONAL COMMENTS	
The City also has emergency access roads which are normally closed but which can be linked together in case of evacuation or emergency.	

POQUOSON MITIGATION ACTION 9	
Support and maintain decal system for re-entry to the City following a disaster. Use social networking to strengthen the system.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits accrue to: 1. property owners through reduced secondary damage (*e.g.,* from car wakes on flooded streets); and, 2. Police operating budgets through reduced traffic management costs, better response times and more efficient use of staff following a disaster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornadoes, Earthquake
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 2; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$2,500 annually
Potential Funding Sources:	Capital budget; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	City Manager's Office; Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Gawkers and sightseers from outside Poquoson are not cognizant of the added damage and inconvenience their visits can inflict. A low-cost decal system was put in place in 2010, and together with police presence at key entry points to the City, officials can now control re-entry.	

POQUOSON MITIGATION ACTION 10	
Support and maintain Code Red, the City's Reverse 911 system. Prepare messages to release to citizens before and after a natural hazard event.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Other methods of notifying citizens require massive amounts of staff time which exceed budgetary restraints. Code Red quickly and efficiently uses existing infrastructure to notify property owners of appropriate pre- and post-disaster mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Drought, Extreme Heat, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10,000 to $15,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
While the Code Red system is already functioning, an opportunity to use the system to urge property owners to take mitigative actions exists. Identification of persons with disabilities has been built into the dispatch notifications.	

POQUOSON MITIGATION ACTION 11	
Protect flood-prone natural resources as a buffer against sea level rise, including, but not limited to: **1) Protect in perpetuity the 69 acres of natural land at the end of Poquoson Avenue donated to the City;** **2) Provide additional access points for the City's Blueway system, a series of canoe and kayak water trails in and around the City and Plum Tree Island; and,** **3) Provide opportunities for retail and residential development on land that is less prone to flooding and sea level rise, such as the Big Woods area.**	
BACKGROUND INFORMATION	
Site and Location:	Eastern portion of the City, especially undeveloped portions along the water.
Cost Benefit:	Just as damages from sea level rise are not easily quantifiable, the benefits of adjusting to sea level rise are also more abstract. These measures are relatively low in cost compared to the damages that flooding will continue to inflict in Poquoson if no adjustments are made.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	1) Existing budgets for legal and real estate costs. 2) Access points on the Blueway may incur costs to the city as additional sites are identified. Costs would be dependent on site amenities. 3) Staff time
Potential Funding Sources:	Existing budgets; DCR: VRTF, L&WCF, VCWRLF; Virginia CFPF
Lead Agency/Department Responsible:	Parks, City Manager's Office, Planning
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
A long-term plan of gradual adjustment begins with small steps. This action highlights the opportunity to identify additional ways to protect flood-prone areas with multiple benefits for citizens in the long- and short-term. While zoning regulations may protect land in the short-term, zoning can be altered by future officials. CRS points may be available for sub-action #1, especially for the recently protected 6 acres set aside for parks.

POQUOSON MITIGATION ACTION 12	
Continue to participate in coalition with Virginia Tech and others using drones for storm/event damage assessment and wildland fire management.	
BACKGROUND INFORMATION	
Site and Location:	Eastern portion of the City, primarily
Cost Benefit:	This low-cost method of assessing damage after a storm or to assess wildfire potential in undeveloped areas has benefits for the reduction of spreading wildfire risk and the management of post-flood redevelopment.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Wildfire, Tornado, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objectives 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DCR: VRTF, L&WCF, VCWRLF; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	City Manager's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The City has drones and trained drone operators available to implement this action.	

WILLIAMSBURG

WILLIAMSBURG MITIGATION ACTION 1	
Maintain and improve drainage system maintenance, including increased sediment and debris clearance. Purchase additional equipment for pre-storm debris clearance. Explore turf options for parking lots, streetscapes and underground retention where feasible, particularly in Colonial Williamsburg.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance is required to keep the system functioning effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$40,000
Potential Funding Sources:	Existing Budget and CIP
Lead Agency/Department Responsible:	Public Works, Colonial Williamsburg, College of William & Mary
Implementation Schedule:	This is a continuous activity of the City's Public Works Department.
ADDITIONAL COMMENTS	
Smoke testing on sewer system is part of the action. Cross training on stormwater management problem detection with other departments is critical for maintenance in Williamsburg and will continue.	

WILLIAMSBURG MITIGATION ACTION 2	
Continue participating in the National Flood Insurance Program. Review and update floodplain management ordinance to include current resilience standards. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements.	
BACKGROUND INFORMATION	
Site and Location:	Special Flood Hazard Areas of Williamsburg
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Designated Floodplain Manager
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 3	
Maintain StormReady designation through the National Weather Service.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	StormReady helps arm communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Extreme Heat
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$2,000 annually
Potential Funding Sources:	Local funds
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 4	
Continue Colonial Williamsburg Tree Maintenance Program. Expand in-house crew.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Seasonal inspections and trimming reduce storm damage from trees, particularly in the historic area, and increase guest safety.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Winter Storm, Tornado, Tropical/Coastal Storm, Wildfire, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	<$5,000 annually
Potential Funding Sources:	Private – CWF
Lead Agency/Department Responsible:	CWF Landscape crew with City assistance; College of William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
This action will be coordinated with the Fire Department to make sure fire equipment access is maintained, as well. Choice of species and wind resistance is especially important when selecting trees for the colonial area and the College of William & Mary. Goals of this program include guest safety, building preservation, scouting with 24-hour phone line, and overall tree risk assessment. Pre-storm checklists and procedures begin each hurricane season and are increased one week prior to potential storm landfall. The Colonial Williamsburg Arboretum is a Level 2 Certified Arboretum comprised of 18th-century tree and woody shrub varieties. The collection features 25 period species of oak trees and more than 30 historic gardens. The Arboretum is home to 20 Virginia state champion trees and two national champion trees.	

WILLIAMSBURG MITIGATION ACTION 5	
Continue shelter generator maintenance and monitoring program. Assess need for and uses of additional shelter at William & Mary Tennis Center.	
BACKGROUND INFORMATION	
Site and Location:	Shelters citywide
Cost Benefit:	The maintenance and daily monitoring of shelter generators helps ensure that these facilities operate at full capacity when needed.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$4,000 annually
Potential Funding Sources:	Local funds; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Generator status is continually monitored through a computer system accessed by Fire Department personnel.	

WILLIAMSBURG MITIGATION ACTION 6	
Strengthen GIS digital mapping program. Efforts include, but are not limited to, constant data updates with regard to water/sewer/SWM utilities, improved geodata and cloud use with data migration to a portal for use by public and by practitioners in the field. Additional hazard data to be added may include radon exposure in conjunction with William & Mary researchers.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's ongoing efforts to increase databases related to hazards is reflected in this plan. Additional databases help staff and planners recognize and plan for various hazards, persons with disabilities, evacuations and response.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Landslide/Coastal Erosion, Radon Exposure
Goal(s) Addressed:	Goal 1; Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	Local funds; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	IT, William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
New layers are continually added to the system. Staff training on use of the map data is included in the cost estimate. City maintains handheld GPS unit for data collection. The City's goals with regard to GIS are to leverage hazard data for public safety purposes and to create a data driven, efficient system of City administration.	

WILLIAMSBURG MITIGATION ACTION 7	
Expand capacity/training for CERT groups and neighborhood-serving organizations to include communication about mitigation and response.	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on vulnerable neighborhoods with less access to social or broadcast media
Cost Benefit:	Local residents are better able to address or communicate the needs of their specific neighborhoods. CERT members can expand capacity of City staff to communicate, mitigate and respond more effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Landslide/Coastal Erosion, Radon Exposure, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 1; Goal 2, Objective 2.1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	HSGP/CCP grants, local funding; DHS: HMGP 5% Initiative, BRIC
Lead Agency/Department Responsible:	Emergency Management, partnering with James City County Emergency Management and College of William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
CERT team is very active in Williamsburg and training is provided to members at least 2 times per year. They participate in 1 exercise per year and refresher training is also provided. During COVID, CERT remained active with monthly radio reports and other training and outreach.	

WILLIAMSBURG MITIGATION ACTION 8	
Expand social media and use of Everbridge mass notification system for pre- and post-disaster information distribution; partner with CERT for assistance.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Getting information to citizens before, during and after disaster events is critical to reducing damage, reducing panic and creating a resilient citizen base that responds positively to government messages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 2; Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$10,500 annually
Potential Funding Sources:	Locality funding, VDEM Radiological funding DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Communications Specialist, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
In recent years, the role of the City's Public Information Officer has expanded. The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Identify other information that City can disseminate and the most effective methods, such as short videos, maps, links, photos, and infographics.	

WILLIAMSBURG MITIGATION ACTION 9	
Per the *William & Mary Hazard Mitigation Plan* (2014), implement mitigation projects to protect historical and critical infrastructure at the College of William & Mary: **1) dry or wet floodproof vulnerable basements;** **2) implement corrective actions necessary to ensure compliance of Lake Matoaka Dam with state dam safety regulations;** **3) weatherize buildings to reduce damage associated with water infiltration through roofs and windows;** **4) continue rooftop inspection program, looking for signs of wear or damage;** **5) elevate building mechanical systems above potential areas of flooding and standing water; and,** **6) Identify areas affected by the City's drainage system and collaborate on means of improvement to improve stormwater flow.**	
BACKGROUND INFORMATION	
Site and Location:	Campuswide; the *William & Mary Hazard Mitigation Plan* (2014) identifies priority buildings.
Cost Benefit:	Partnerships with the College benefit citizens, students and staff by reducing need for emergency response and protecting all who live in the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake
Goal(s) Addressed:	Goal 1; Goal 3: Objectives 3.1, 3.2, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Costs to be developed as individual projects are developed
Potential Funding Sources:	DHS: BRIC, HMGP
Lead Agency/Department Responsible:	College of William & Mary
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The Lake Matoaka Dam project significantly reduces the potential for dam failure. Components include: installing articulated block armor along the backside of the dam to protect the earthen structure from failure during a storm where the roadway is overtopped. Brick-faced training walls on both sides will channel the water from the overtopping flood to the armored section where it then flows across the downstream face to the discharge channel of College Creek. The block will be covered with topsoil and grass so will not be visible. Currently, in the event of a storm event that results in flow overtopping the dam, the dam will likely fail resulting in the loss of Jamestown Road which will adversely impacts the ability of emergency responders to reach citizens of Williamsburg and William and Mary students. Also, dam failure will sever the utilities under the road (electric power, communications, water and sewer) which will result in loss of service. Dating back several years the grounds department has been doing 2 to 3 stormwater mitigation projects per year. Furthermore, many of the newly installed planting beds are infiltration beds. Examples include the ADA ramp planting beds at T-Hall and the planting bed behind Blow Hall. These are above and beyond the requirements of the MS4 plan. The outfall and BMP facility renovations each year are done to either upgrade or correct the deficiencies with these structures. We also regrade gravel roads to mitigate storm water erosion in these areas. This past summer (2021) the road/path off Compton road was regraded due to severe erosion and the tripping hazard it posed to the students and staff using the path. Project is in the planning stage to raise the stormwater pipe under Yates Drive to correct a blockage on the north side of Yates Hall.

WILLIAMSBURG MITIGATION ACTION 10	
Prepare elements of Continuity of Operations Plan (COOP) to address cyber security, utility continuity and redundancies, and communications.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Plans that reduce the impacts of ongoing disasters save taxpayer dollars by bringing businesses back online sooner and providing normal services to citizens in need.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	CIP, DHS/VDEM
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 11	
Address command and control coordination for large assembly hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Areas where large assemblies are permitted, such as the Grand Illumination each December, especially those near the railroad tracks.
Cost Benefit:	Organized command and control reduces loss of life and property associated with large gatherings.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Earthquake, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1: Objective 1.5; Goal 3: Objectives 3.1, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

JAMES CITY COUNTY

JAMES CITY COUNTY MITIGATION ACTION 1	
Protect critical facilities, including refuges, while increasing potential refuge capacity and/or protected areas. Protection measures may include emergency generators or other power sources, wind or flood retrofits, elevation, relocation, or reconstruction.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The purpose of this action is to maintain citizen safety, and continuity of county operations during a disaster event. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined based on corrective actions selected
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, EMPG
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Continuing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 2	
Mitigate flooding problems identified in the flood studies performed for Powhatan Creek watershed. Measures may include, but are not limited to improvements to road crossings by increasing flow capacity, or installing over-topping protection, and stream restoration.	
BACKGROUND INFORMATION	
Site and Location:	Powhatan Creek watershed
Cost Benefit:	Lower cost improvements to roadways are expected to provide significant benefits in this area.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate - NRI Coastal Flood Risk
Estimated Cost:	$6,000,000
Potential Funding Sources:	VDOT, Federal Transportation Administration, DHS
Lead Agency/Department Responsible:	General Services Stormwater
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 3	
Conduct annual meeting with VDOT and utilities to identify hazard areas and potential projects to mitigate those areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Keeping roads and utilities operational during high frequency events and maximizing their operability during disasters is a countywide priority.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm, Tornado, Earthquake, Hazardous Materials Incident, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5; Goal 3, Objective 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 4	
Elevate, acquire, relocate, retrofit or floodproof structures in flood-prone areas. Flood protection may include minor localized flood reduction projects, as well. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide, and Countywide for wind retrofits. Particular focus on Chickahominy Haven and Powhatan Shores, as well as repetitive flood loss areas throughout the County.
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Historically, approximately $90,000 per structure. However, this may change based on funding availability.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA and 5% initiative funds; Virginia CFPF
Lead Agency/Department Responsible:	Community Housing
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 5	
Continue strengthening the County's Floodplain Management Program with the following actions: **1) Review floodplain ordinance regularly for appropriateness of higher standards and necessary updates;** **2) Provide specialized training and support for Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors;** **3) Continue to assess repetitive loss data annually for loss accuracy, geographic accuracy, and determination whether structure(s) on property have been mitigated and if so, by what means. Provide corrections as necessary using FEMA AW-501;** **4) Maintain current CRS Class 5 rating or better; and,** **5) Building Safety and Permits plans examiners to provide information and resources to help builders and owners evaluate hydrostatic (flood) vent options. Materials to be available on department's website. Request FEMA QuickGuide for Virginia from DCR.**	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide
Cost Benefit:	The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Staff time
Potential Funding Sources:	Virginia CFPF; Virginia NFIP Community Assistance Program State Support Services Element
Lead Agency/Department Responsible:	Community Development/General Services , Emergency Management, Virginia DCR
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 6	
Continue outreach efforts through "Flood Fluent" web site, hurricane and winter weather preparedness activities through FEMA and NOAA, and the social media outreach activities of Emergency Management.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Benefits derive from reduced flood insurance premiums and increased public knowledge as a result of this initiative. The approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) involving outreach/marketing professionals from within County government; 3) investigating regional partnerships that could result in additional cost savings through cost sharing; 4) using existing programs and resources to maximum advantage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm, Winter Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Wildfire, Drought, Extreme Heat and Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 2,; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $7,500 annually
Potential Funding Sources:	Existing budgets and staff time; DHS: PDM, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management (lead)
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
Audiences include, but are not limited to: property owners, new residents, tourists, businesses, County officials, pet owners, and schoolchildren. Stakeholders may include: various County departments, HRPDC, Peninsula Housing and Builders Association, Parent Teacher Associations, VDEM, DEQ, and DCR. Potential outreach needs include: flood risk awareness, focus on repetitive loss property owners in outreach efforts, contingency planning for businesses, response guidance with emphasis on community resiliency, publicizing the County's mitigation efforts, informing property owners of long-term and short-term property protection measures (*e.g.,* protecting vinyl siding windows from wind damage, flood vent demos and displays), creating a dedicated web site/social media sites for floodplain management permitting process, early preparation of post-disaster permitting and redevelopment materials such as press releases, videos, brochures, forms, and fees. Use questionnaires on social media to garner feedback.

JAMES CITY COUNTY MITIGATION ACTION 7	
Conduct annual Hazard Mitigation Workshop to update and share hazard mitigation information, discuss potential projects. Invite relevant County departments, non-profit agencies and other stakeholders. Develop annual Hazard Mitigation Potential Project List with ready packages for submittal as funding becomes available.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Ready packages for submittal will: • allow the County to increase focus on hazard mitigation opportunities; • closely track hazard mitigation efforts, implementation, and successes; and, • maximize opportunities to move forward with specific mitigation actions identified over time.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1., 3.3; Goal 4, Objectives 4.1, 4.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management, Finance, Community Development/General Services , VDEM, Silver Jackets, VFMA
Implementation Schedule:	Immediately
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 8	
Implement regulations and procedures to ensure that site development projects, including those initiated by the County, are consistent with the protection of environmentally sensitive areas and the maintenance of the County's overall environmental quality so that development projects do not exacerbate current or future flooding in flood prone areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Protecting new development from increasing current or future flooding may increase development costs in the near-term but reduces response and repair costs in the future.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD on project-specific basis
Potential Funding Sources:	DHS: BRIC; Virginia CFPF
Lead Agency/Department Responsible:	All
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
This action is also included in the County's Comprehensive Plan, *2045: Our County, Our Shared Future.*	

JAMES CITY COUNTY MITIGATION ACTION 9	
Finalize, fund and implement the County's Flood Resiliency Plan and associated projects, which are adopted herein by reference. Projects are expected to include shoreline erosion and stream restoration projects among others. Three watershed management plans are also expected to begin in the near future (2 are updates and 1 is new), which will prioritize stream restoration needs and outline priorities for CIP funding.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Flood resiliency planning will take into account future conditions for precipitation and flooding in an effort to reduce not just short term average annual flood damages, but also long-term damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Staff time for Resiliency Plan; detailed project costs to be determined in planning process
Potential Funding Sources:	CIP; Virginia CFPF; DHS: BRIC, FMA, HMGP; USACE: SFCP, FPMS
Lead Agency/Department Responsible:	Community Development/General Services
Implementation Schedule:	Within 1 year of plan adoption
ADDITIONAL COMMENTS	

YORK COUNTY

YORK COUNTY MITIGATION ACTION 1	
Continue outreach efforts using the following steps: **1. Assess County's public information needs** **2. Formulate multi-hazard messages** **3. Identify outreach projects to convey the messages** **4. Examine other public information initiatives** **5. Implement**	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The organized nature of the approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) investigating regional partnerships that could result in additional cost savings through cost sharing; 3) using existing programs and resources to maximum advantage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Wildfire, Drought, Extreme Heat and Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam, Radon Exposure, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $7,500
Potential Funding Sources:	Existing budgets and staff time
Lead Agency/Department Responsible:	Emergency Management, Development Services
Implementation Schedule:	Within 2 years of plan adoption

ADDITIONAL COMMENTS
Audiences include: property owners, elected officials, businesses, County officials, pet owners, and schoolchildren. Stakeholders may include: various County departments, HRPDC, Peninsula Housing and Builders Association, Parent Teacher Associations, VDEM, DEQ, DCR, and American Red Cross. Potential outreach needs include: content and method of public service announcements, flood risk awareness, focus on repetitive loss property owners in outreach efforts, contingency planning for businesses, publicizing the County's mitigation efforts, informing property owners of long-term and short-term property protection measures (*e.g.,* protecting vinyl siding windows from wind damage), creating a dedicated web site/social media sites for floodplain management permitting process, increasing property owner awareness of flood zone location and flood insurance availability, awareness of the flood hazard in general, and information about the Letter of Map Amendment process regarding the FEMA FIRM, early preparation of post-disaster permitting and redevelopment materials such as press releases, videos, brochures, forms, and fees. Use questionnaires on social media to garner feedback.

YORK COUNTY MITIGATION ACTION 2	
Continue strengthening the County's Floodplain Management Program with the following actions: **1) Review and update floodplain ordinance regularly and continue to provide annual Floodplain Management Report;** **2) Consider regulating land outside 100-year floodplain but subject to future flooding as a result of sea level rise;** **3) Continue participating in the Community Rating System;** **4) Collect lowest floor elevation data for flood-prone structures;** **5) Continue specialized training and support for Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors; and,** **6) Continue to assess repetitive flood loss data annually for loss accuracy, geographic accuracy, and determination whether structure(s) on property have been mitigated and if so, by what means. Provide corrections as necessary using FEMA AW-501.**	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide
Cost Benefit:	The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Winter Storm, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Public Works and Development Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 3	
Retrofit or floodproof structures in flood-prone areas; projects may include elevation, acquisition, relocation and minor localized flood reduction projects. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects. Tie mitigation efforts to outreach efforts listed in action #1 and encourage property owners to perform minor retrofits on their own.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide, and Countywide for wind retrofits.
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	In multiple phases as grant money becomes available. Individual structure costs vary.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Public Works, Planning
Implementation Schedule:	Ongoing as opportunities are identified
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 4	
Develop public outreach materials to educate citizens about the wildland fire hazard and the wildland/urban interface.	
BACKGROUND INFORMATION	
Site and Location:	Wildfire urban interface zones countywide
Cost Benefit:	Knowledge of wildfire hazards can be helpful in encouraging homeowners to mitigate the hazard themselves. Low-cost measures are available to responsibly mitigate the wildfire hazard, especially during high risk times.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 5	
Maintain program for continued assessment and mitigation of identified stormwater "choke points"; ensure roads remain flood free for evacuation of low-lying areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide; especially ensuring access/egress to the Seaford and Back Creek Road areas.
Cost Benefit:	Pre-disaster assessment and action to alleviate choke points can reduce flooding damage and improve the stormwater system's ability to perform as designed.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	This program is absorbed into staff time spent on stormwater program and thus is not budgeted separately.
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 6	
Evaluate critical facilities for safety and sustainability during emergencies. Take appropriate corrective actions, which may include but are not limited to: providing backup power sources, wind retrofits and flood retrofits.	
BACKGROUND INFORMATION	
Site and Location:	Countywide to include generators to boost effectiveness of York High School and construction of a new Sheriff's Office with generator power
Cost Benefit:	Critical facility operation protects the public, maintains governmental operations and furthers community sustainability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 7	
Continue support of the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds.	
BACKGROUND INFORMATION	
Site and Location:	Waterworks reservoir watersheds in the County
Cost Benefit:	This ongoing program reduces the number of fires, and works to control pine beetle infestations. Forest thinning is a primary control mechanism. This is one of many programs the utility implements related to hazard mitigation. Additional benefits from environmental or ecosystem benefits may be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.3; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Waterworks Enterprise Fund, existing budgets; DHS: HMGP
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 8	
Manage shoreline erosion through the following actions: **1. Request and share VIMS staff recommendations for shoreline erosion control permit applications with Wetlands Board citizen members; and,** **2. Continue to include shoreline erosion control element in the Comprehensive Plan.**	
BACKGROUND INFORMATION	
Site and Location:	Shorelines countywide
Cost Benefit:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.6; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate – NRI Hurricane Risk
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Development Services Department, Planning Division, Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 9	
Increase knowledge of hazardous materials storage areas to reduce impacts from overlapping hazard events through the following: **1) Create and maintain geodatabase of known storage locations of hazardous materials;** **2) Add hazmat data to dispatch system so that first responders can better visualize sites during response;** **3) Use data layer to build better response capabilities; and** **4) Analyze data in conjunction with other hazard layers (flood, sea level rise, wildfire, etc.) to identify problem areas and possible retrofits to reduce risk.**	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Database provides critical information for hazard planning, especially when hazards overlap. For example, knowing the location of hazardous materials in the floodplain can be a critical element in floodplain management planning.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials Incident, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$5,000 to $10,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Life Safety, Information Technology (GIS), PLEPC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
County has hazard point layers that requires continual update and maintenance. Peninsula LEPC is working to establish this capability throughout the Peninsula region.	

YORK COUNTY MITIGATION ACTION 10	
Install and maintain high water marks signs and gauges in flood-prone areas.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas countywide
Cost Benefit:	Drivers who are aware of the extent of high water on roads can avoid unsafe travel, avoiding damage to humans, rescue personnel, and vehicles.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Estimated $200 per sign post, installed
Potential Funding Sources:	HRPDC; VDOT; DHS: BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF; USACE: FPMS
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
High water signs and markers have been strategically placed in low-lying areas of York County. They are regularly inspected and maintained - especially during the approach of significant storms. York County has investigated tidal gauges/sensors through VIMS and the City of Newport News. County is currently relying on the gauge near the USCG Base (Yorktown).	

YORK COUNTY MITIGATION ACTION 11	
Consider expanding existing Pre-Disaster Debris Management Plan to refocus beyond stormwater management on public property and to include public outreach and hazardous materials facilities. Remove existing trees and debris that pose hazard during natural disaster.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Pre-disaster debris management reduces damage to structures and infrastructure from flood, wind and possibly snow. Also, regular clean-up requirements can reduce the costs of post-disaster debris clean-up. County could also have access to the additional 5-percent cost incentive from FEMA's Public Assistance money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing capital budgets; HMGP, HMGP 5% Initiative, BRIC or FMA (with very clearly articulated benefits for flood damage reduction); Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
Prior to any significant storm, Public Works inspects and cleans every ditch within the County. Any hazards or debris found in the ROW are removed. The County does not enter private property to remove existing hazards without a Right of Entry Permit. This action is only done on an as needed basis (for example, it was done following Hurricane Isabel in 2003). Consider adding language that encourages citizens to perform pre-storm inspections and take action on their own to reduce risk.	

YORK COUNTY MITIGATION ACTION 12	
Align existing Disaster Recovery Plan with regional expectations. As Hampton Roads region develops a regional plan, continually monitor progress to ensure York County has all necessary components up to date.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Recovery plans reduce vulnerability after an event by helping to ensure that "return to normalcy" is coupled with mitigation strategies to address long-term vulnerability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1; Goal 2: Objective 2.3; Goal 3: Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Low/Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC, HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Planning Division, Emergency Management
Implementation Schedule:	Within 5 years of plan adoption and in accordance with regional plan schedule
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 13	
Review and consider adoption of International Residential Code Appendix F, Radon Control Methods. This appendix to the Virginia USBC contains provisions intended to mitigate the transfer of radon gases from the soil into dwelling units.	
BACKGROUND INFORMATION	
Site and Location:	Countywide, although measures could be targeted to high radon concentrations areas of the County if future data collection and mapping provides improved data
Cost Benefit:	Mitigation measures to resist radon entry into new construction and prepare the building for post-construction radon mitigation (if necessary) require minimum cost at the time of construction.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.5; Goal 3: Objective 3.1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Building Regulation
Implementation Schedule:	Within 5 to 7 years after plan adoption
ADDITIONAL COMMENTS	
See requirements at: https://codes.iccsafe.org/content/IRC2018/appendix-f-radon-control-methods	

YORK COUNTY MITIGATION ACTION 14	
Modify County Comprehensive Plan (Charting the Course to 2035) to account for hazard mitigation and flood resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Cost is minimal to incorporate hazard mitigation plan elements, such as actions, goals and objectives, into an accompanying plan for the county's future. Plan integration helps reduce conflict and re-emphasize important concepts in the mitigation planning arena.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal
Potential Funding Sources:	CIP, Virginia CFPF
Lead Agency/Department Responsible:	Planning Division
Implementation Schedule:	In conjunction with next scheduled Comp Plan update
ADDITIONAL COMMENTS	

NORFOLK

NORFOLK MITIGATION ACTION 1	
Maintain and protect the City's beaches and shorelines using structural means.	
BACKGROUND INFORMATION	
Site and Location:	Chesapeake Bay, Willoughby Bay, Elizabeth River, Lafayette River, Pretty Lake shorelines
Cost Benefit:	Increased frequency and severity of flooding in Norfolk is expected to dramatically increase flood damages in coming years. Without well-planned protection measures, Norfolk's shoreline is particularly vulnerable to erosion resulting from floods and sea level rise. FEMA will now fund hazard mitigation projects that include sea level rise estimates for calculating benefits.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Landslide/Coastal Erosion, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High –The majority of the census tracts along the shoreline have relatively high or very high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$300,000,000 (5-year expenditure)
Potential Funding Sources:	USACE, General funds, CIP, CFPF, Municipal Bonds, Special Service District Assessments, DHS: HMGP, BRIC
Lead Agency/Department Responsible:	Office of Resilience, Public Works
Implementation Schedule:	Ongoing
COMMENTS	
Multiple activities are covered under this effort, including breakwater and other structural features, beach surveys and source identification, and environmental permitting. Following completion of the recent USACE beach nourishment project, periodic renourishment is required on the average of once every nine years in order to maintain the integrity of the flood and storm protection. Norfolk completes biennial dune surveys and wave gauge monitoring as part of its maintenance commitment to the USACE. In January 2022, Norfolk was awarded up to $249.3M for Coastal Storm Risk Management; $134M needed from nonfederal sponsor. See Norfolk Action 2 for related nonstructural CSRM projection measures.	

NORFOLK MITIGATION ACTION 2	
Maintain and protect the City's beaches and shorelines using natural shoreline protection measures.	
BACKGROUND INFORMATION	
Site and Location:	Chesapeake Bay, Willoughby Bay, Elizabeth River, Lafayette River, Pretty Lake shorelines
Cost Benefit:	Increased frequency and severity of flooding in Norfolk is expected to dramatically increase flood damages in coming years. Natural protection measures help the shoreline adjust to sea level rise with less intervention. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Landslide/Coastal Erosion, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High –The majority of the census tracts along the shoreline have relatively high or very high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$50,000,000
Potential Funding Sources:	USACE, General funds, CIP, CFPF, Municipal Bonds, Special Service District Assessments, DHS: HMGP, BRIC
Lead Agency/Department Responsible:	Office of Resilience, Public Works
Implementation Schedule:	Ongoing
COMMENTS	
Multiple activities are covered under this effort, including shoreline restoration, and dune planting and stabilization and environmental permitting. Features include Natural and Nature Based Features (NNBFs). The first segment of the Coastal Storm Risk Management project with the USACE calls for 7,200 lf new living shorelines (+3,800 lf mitigated), and 5,250 lf of oyster reefs.	

NORFOLK MITIGATION ACTION 3
Provide educational engagement and improve communications to residents to increase awareness of vulnerability to multiple hazards. Focus on hurricanes, sea level rise, flooding, nuisance flooding and severe repetitive flood losses. **Provide engagement that increases citizens' ability to take mitigative actions prior to disaster event. Focus on hurricane preparedness and flood mitigation.**

BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Public education can have numerous intangible benefits from the public safety peace of mind. It can result in preventing or lessening damage caused by disasters and can save lives. Teaching citizens how to protect their lives and property themselves has tangible benefits to property owners and the City by reducing the need to for disaster response and increasing community resiliency.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5: Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	Operating Budget, DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Preparedness & Response, Chief Resilience Officer, Planning, Public Works, Chief Marketing Officer
Implementation Schedule:	Ongoing

COMMENTS
Outreach to floodplain residents and repetitively flooded areas is a part of the community's CRS program and will continue. This action is also part of the City's Strategy for Continued Compliance with the NFIP.

NORFOLK MITIGATION ACTION 4
Continue to implement capital improvements that improve stormwater management and control flooding, especially for undersized and out-of-date drainage systems and patterns.

BACKGROUND INFORMATION	
Site and Location:	Citywide. Projects mitigate flooding and run-off problems throughout the City. New projects will be chosen as opportunities to improve city TMDL requirements and stormwater capacity are identified.
Cost Benefit:	Annual damage occurs to homes and businesses in vulnerable areas due to poor drainage. FEMA will now fund hazard mitigation projects that include sea level rise estimates.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approx. $19,000,000 per year
Potential Funding Sources:	General funds, CIP, DHS: HMGP & BRIC, Private funds; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing

COMMENTS
Hazard Mitigation Grants should be considered as a potential funding source and used as a basis for property protection. Existing consultant's study has identified multiple flood mitigation measures. Additional projects will be identified throughout city that will improve drainage capacity as well as improve water quality. The new Watershed Master Plan recently awarded by the Virginia CFPF will update the 2012 Citywide Drainage Master Plan with additional criteria within the prioritization formula to include Social Vulnerability Index as a priority input. Projects and designs should be prepared for future applications of funds when they become available.

NORFOLK MITIGATION ACTION 5	
Identify and improve critical facilities and infrastructure to minimize flood and wind damage, specifically targeting schools, EOC and emergency shelters. Action may also include placing utility lines underground or preemptive traffic systems for emergency vehicles. **Purchase and install generators or other continuous power sources for critical facilities and infrastructure. This action may include, but is not limited to pump stations, EOC, shelters, underpasses and important traffic signals.** **Include critical public facility generator requirements and required connection materials in the USACE Emergency Power Facility Assessment Tool (EPFAT).**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Critical facilities are located within the floodplain due to built environment of the City. Providing protected utilities and backups are necessary to properly aid in protecting and serving citizens. Maintaining a functioning EOC is vital to response and recovery efforts Citywide from a large variety of possible hazards. Damage occurs yearly with damaged equipment and vehicles stuck in underpasses. During Hurricane Isabel, City lost +90 percent of traffic signal operations for various time periods. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$1,000,000
Potential Funding Sources:	DHS: HMGP, BRIC, Virginia CFPF; ARPA
Lead Agency/Department Responsible:	Public Works, Emergency Preparedness & Response, Public Utilities
Implementation Schedule:	Ongoing

COMMENTS
This action may include multiple projects including, upgrading of utilities and emergency connections, as well as improving transportation access to buildings and flood protection of facilities.

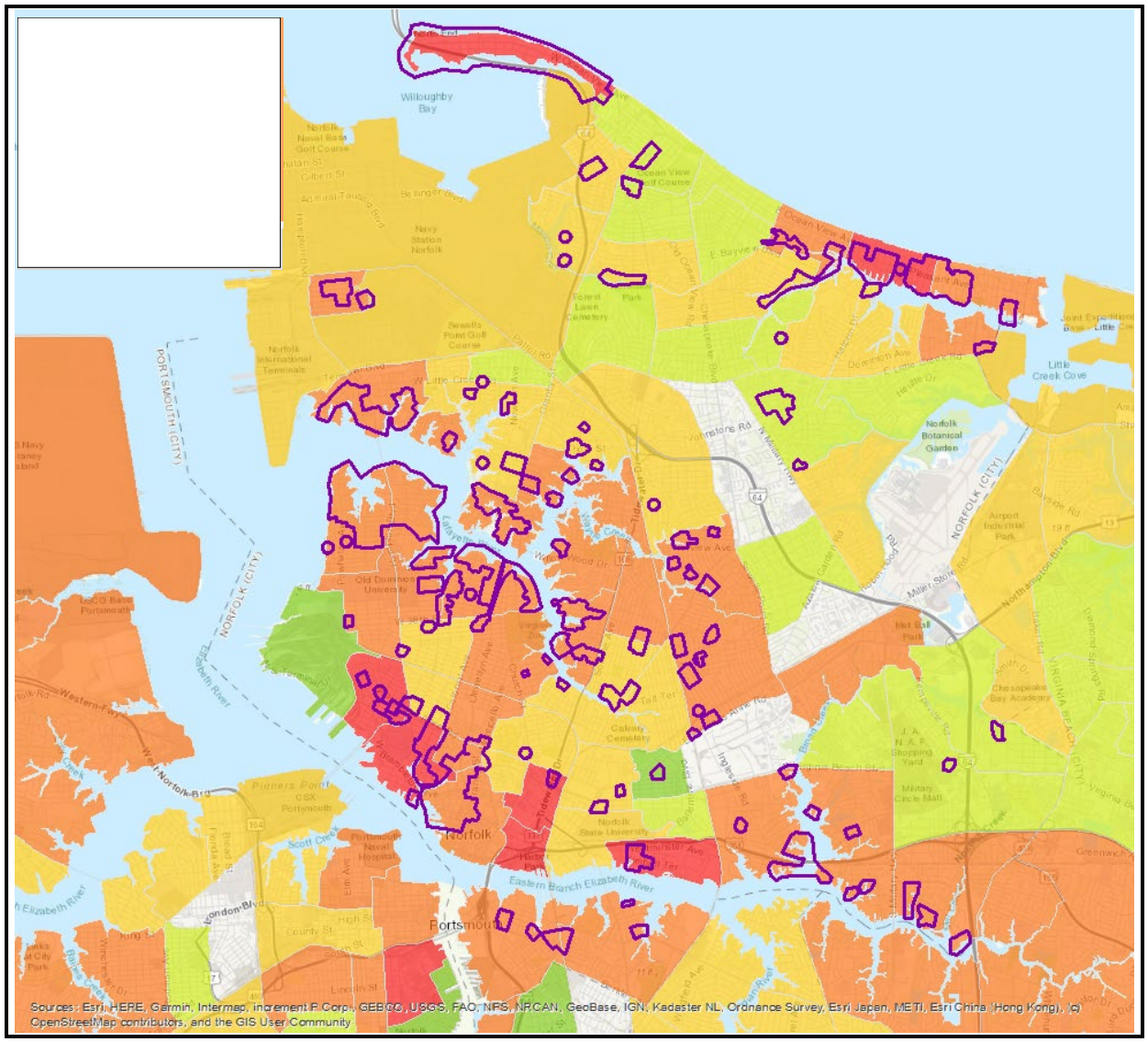
NORFOLK MITIGATION ACTION 6
Protect flood-prone structures through the following ongoing actions: **1) Incorporate CDC's Social Vulnerability Index tools to align actions with the City's commitment to being a diverse, equitable and inclusive city;** **2) Give highest priority to protection of "severe repetitive losses" as defined by the National Flood Insurance Program (NFIP), including verifying the location of all repetitive losses, verifying location and need for mitigation;** **3) Second highest priority to mitigation of historic resources, or meeting the Secretary of the Interior's standards for eligibility as a historic resource. Historic resources should be protected in place, or relocated; raised not razed;** **4) Prepare Repetitive Loss Area Analyses for CRS credit under CRS Activity 512(b);** **5) Elevate, acquire, relocate or otherwise retrofit structures. This action includes Mitigation Reconstruction projects for non-historic resources, ground floor conversion projects and basement fill projects.** **6) Target potential properties or clusters of properties on low elevations near wetlands for purchase and conversion to public open space;**

BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City, particularly those with high social vulnerability
Cost Benefit:	Repetitive losses and severe repetitive losses drain public funds for disaster response and require repeated expenditures on the part of property owners. Mitigation actions that fix the problems long-term are cost effective when average annual damages exceed average annual costs of retrofitting, elevating or acquiring the structure. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Very High – Norfolk has 114 repetitive flood loss areas; 87 of them (or 76%) are located

	in areas designated as having Relatively High or Very High NRI flood risk. See map excerpt below for additional detail.
Estimated Cost:	$5,000 to $300,000 per structure.
Potential Funding Sources:	DHS: HMGP, FMA, BRIC, FMA; USACE: FPMS; Virginia CFPF
Lead Agency/Department Responsible:	City Planning
Implementation Schedule:	Ongoing

COMMENTS
Structures insured through the NFIP are often eligible for more grant funds than uninsured structures. The repetitive flood loss areas provided in Section 5 of this plan will help identify areas of the City to be addressed through this action. Measures should include parcel scale, neighborhood scale, and watershed scale protection measures. Parcel scale measures include rain barrels, pervious pavers, and rain gardens amongst other best practices.


Willoughby Bay
Norfolk Naval Base Golf Course
Navy Station Norfolk
Sewells Point Golf Course
Norfolk International Terminals
PORTSMOUTH (CITY)
NORFOLK (CITY)
Old Dominion University
Norfolk
Portsmouth
Eastern Branch Elizabeth River
Norfolk State University
Calvary Cemetery
Norfolk Botanical Garden
Little Creek Cove
Airport Industrial Park
Met Ball Park
Chesapeake Bay Academy
Military Circle Mall
Pinners Point
CSX Portsmouth
Portsmouth Naval Hospital
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

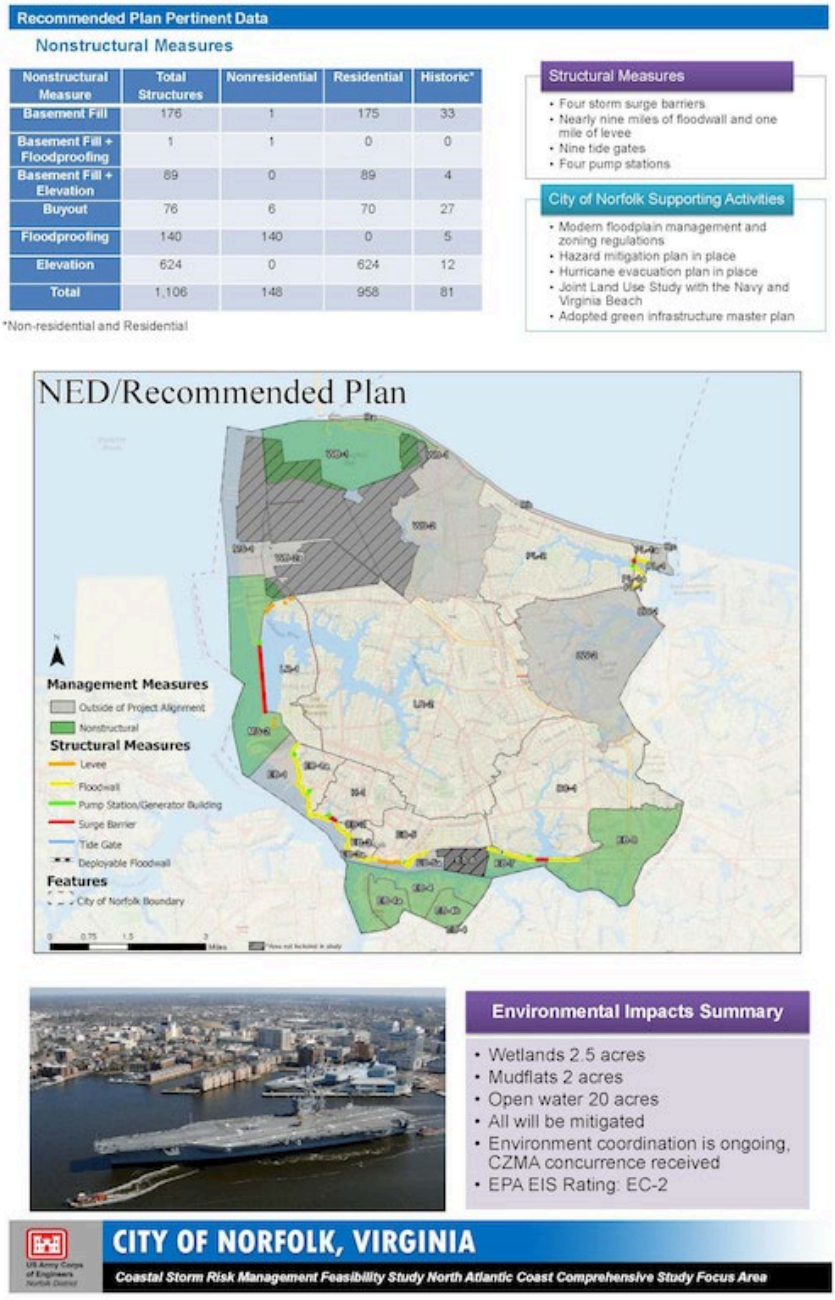
NORFOLK MITIGATION ACTION 7	
Implement a full rollout of Crisis Track to improve post-event damage assessment procedures so that damages, event frequencies, and other data are more readily available for mitigation planning and fully integrated into VDEM and FEMA's SDE Tool.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Crisis Track will allow easier processing of post-disaster permits and assessments, increasing reliance on the system and integration with VDEM systems for assessing damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquakes, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	HMGP, HMGP 5% Initiative, City funds, VDEM
Lead Agency/Department Responsible:	Information Technology, Emergency Preparedness & Response, Finance, City Planning, Neighborhood Services
Implementation Schedule:	Ongoing
COMMENTS	
Create and implement a post-incident data collection plan which would organize city staff, volunteers and damage assessment teams. Include pre-approved documents and procedures with regard to substantial damage/improvement and personnel to conduct inspections/determinations.	

NORFOLK MITIGATION ACTION 8	
Implement actions to improve Community Rating System (CRS) classification to at least a Class 4 with a 30 percent discount on most flood insurance policies.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's Class 5 rating currently results in flood insurance premium savings of 25%. The dollars saved go back into property owners' pockets to spend in the local economy. Implementing additional activities creditable under CRS is expected to increase the number of policies Citywide, thus decreasing reliance on City and federal resources after a flood. Many of the measures suggested by CRS activities are non-structural in nature and help reduce the flood vulnerability of new and substantially improved construction.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.2; Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$500,000
Potential Funding Sources:	Staff time; Virginia CFPF
Lead Agency/Department Responsible:	Planning & Community Dev.; Public Works
Implementation Schedule:	Within 3 years
COMMENTS	
Lobby for changes to State stormwater requirements to obtain CRS Watershed Management Plan credit.	

NORFOLK MITIGATION ACTION 9	
Assess and protect historic resources and structures from flooding and sea level rise. Measures should include short-, medium- and long-term solutions.	
BACKGROUND INFORMATION	
Site and Location:	Historic structures and areas throughout the City
Cost Benefit:	Historic structures throughout the city are located in flood prone areas. Value of historic resources are more than just the value of the structure which adds value to normal mitigation methods.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All of the City's historic districts with one exception are in areas of Very High or Relatively High NRI Flood Risk. (Ballentine Place is rated Moderate.)
Estimated Cost:	Staff time/consultant fees estimated at $50,000 to resurvey existing historic areas with new surveys estimated at $75,000
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF; NPS, VDHR, Preservation Virginia
Lead Agency/Department Responsible:	City Planning, Chief Resilience Officer
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Initial methods should include updating surveys of listed historic areas and structures. Other neighborhoods should be reviewed and determined if the structures and integrity of the neighborhood have been preserved to allow for additional surveys. Different methods should be explored to preserve and protect structures, including generation of FEMA approved guidance for protection of these structures and areas that differ from current allowed practices for residential and non-residential structures.	

NORFOLK MITIGATION ACTION 10	
Identify and implement resilient strategies throughout the city to provide better watershed, neighborhood and parcel specific flood protection and mitigation. Perform feasibility study for coastal storm risk protection for Norfolk southside neighborhoods based on future sea level rise and flood conditions. Other projects include, but are not limited to recommendations of the Joint Land Use Study in conjunction with the City of Virginia Beach and the U.S. Navy, as well as the Norfolk Coastal Storm Risk Management solutions.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Resilient strategies range from small to larger scale projects. Ability to provide protection to properties at risk with innovative measures are necessary to protect entire city.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Variable based on individual projects.
Estimated Cost:	+$60,000,000
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC, ACOE, City CIP, HUD; USACE; Virginia CFPF; OLDCC through DoD MIR Review; ARPA
Lead Agency/Department Responsible:	Chief Resilience Officer, Public Works, City Planning, Emergency Preparedness and Response
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Methods should include hard infrastructure and green infrastructure. Multiple methods can be joined together to provide better protection to the properties and all citizens. JLUS recommendations include: Willoughby Bay Shoreline Floodwall Willoughby Spit Floodplain Management Strategy Pretty Lake Storm Surge Barrier Norview Avenue Drainage Study Resilient Underpass Pump Station Study Lafayette River Annex Vulnerability Study Mason Creek Flood Mitigation Strategy Wastewater Treatment Plant Vulnerability Assessment Terminal Boulevard Rail and Roadway Grade Separation (new rail underpass)	

Norfolk Coastal Storm Risk Management solutions are shown in the diagram below.



NORFOLK MITIGATION ACTION 11	
Explore partnership with NASA to use Interferometric Synthetic Aperture Radar (InSAR) to study changes in the rate of localized subsidence and possible links to relative sea level rise.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	InSAR makes high-density measurements over large areas by using radar signals from Earth-orbiting satellites to measure changes in land-surface altitude at high degrees of measurement resolution and spatial detail. It is often less expensive than obtaining sparse point measurements from labor-intensive spirit-leveling and GPS surveys, and can provide millions of data points in a region about 10,000 square kilometers.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3: Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; National Science Foundation; ODU ICAR
Lead Agency/Department Responsible:	Office of Resilience, NASA
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	

NORFOLK MITIGATION ACTION 12	
Update the City's Combined Coastal and Precipitation Flooding Master Plan to meet the minimum CRS requirements for a Watershed Master Plan	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The CRS watershed master will provide Norfolk with a tool it can use to make decisions that will reduce the increased flooding from development on a watershed-wide basis and incorporate future conditions to inform CIP investment decisions and land development policy that addresses existing flood problems.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$350,000
Potential Funding Sources:	General funds, CIP, Virginia CFPF
Lead Agency/Department Responsible:	Office of Resilience, Public Works, Planning
Implementation Schedule:	Ongoing
COMMENTS	
The City of Norfolk was awarded a $315,000 grant from the Virginia CFPF for this effort. Norfolk will provide $35,000 and solicit a consultant to facilitate development of the watershed master plan, incorporating future conditions and including social vulnerability as a factor within the prioritization formulae.	

NORFOLK MITIGATION ACTION 13	
Obtain direct technical assistance to incorporate green infrastructure, social vulnerability, and environmental justice into Benefit-Cost Analysis/Ratio (BCA/R) calculations for structural/hybrid flood protection measures for the Southside communities of Berkley and Campostella.	
BACKGROUND INFORMATION	
Site and Location:	Southside communities of Berkley and Campostella
Cost Benefit:	The BCR methodology used for the CSRM feasibility study does not account for the decades of redlining and disinvestment that has plagued the Southside and depressed BCR inputs such as property assessments. The Southside has "Very High Social Vulnerability," with low access to transportation, making the population difficult to evacuate. Southside is a "disadvantaged community" (EO 14008) and is surrounding by heavy industry which will bring environmental toxins and life-threatening debris into the community in the event that only nonstructural flood protection measures are provided.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5, 1.6; Goal 3, Objectives 3.2, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$100,000 - $250,000
Potential Funding Sources:	BRIC, General funds, CIP, Virginia CFPF
Lead Agency/Department Responsible:	Office of Resilience
Implementation Schedule:	Ongoing
COMMENTS	
The Southside community is historic, with large portions listed on the National Register of Historic Places.	

NORFOLK MITIGATION ACTION 14	
Increase number of real-time flood inundation storm sensors installed throughout the City and made available for public API integration within Norfolk Open GIS Data portal.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Storm sensors optimization within a real-time continuous-simulation model will allow City staff and the public to refine the inputs necessary to inform high-tech outputs such as a refined Digital Elevation Model for Norfolk, real-time STORM Dashboard map, flooded street re-router for Waze GPS app, tailwater conditions for urban coastally-influenced stormwater systems.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.5; Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$250,000 - $750,000
Potential Funding Sources:	General funds, CIP, Virginia CFPF, HRPDC
Lead Agency/Department Responsible:	Office of Resilience, Public Works, EOC
Implementation Schedule:	Ongoing
COMMENTS	
The City of Norfolk was awarded a $315,000 grant from the Virginia CFPF for this and related efforts. The HRPDC was the recipient of a grant to install multiple storm sensors throughout Hampton Roads, including five in Norfolk.	

PORTSMOUTH

PORTSMOUTH MITIGATION ACTION 1	
Develop a post-disaster continuity of operations plan to assist in more rapid recovery after a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	By identifying post-disaster processes for almost all City department functions across an array of hazard events, and putting these processes on paper, the plan would aid staff and temporary staff in keeping processes running smoothly and not contributing to additional conflicts.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Staff time, DHS planning grants, HMGP 5% Initiative; ARPA
Lead Agency/Department Responsible:	Emergency Management, Planning, Permits & Inspections, Engineering, Public Works
Implementation Schedule:	Phase II is being planned and awaiting funding
ADDITIONAL COMMENTS	
Identifying post-disaster processes/functions for all departments could feed into a recovery plan for future disasters.	

PORTSMOUTH MITIGATION ACTION 2	
Designate non-flood-prone pickup points within the city evacuation zones to assist citizens who must rely on alternative or public transportation to evacuate.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	As seen with Hurricane Katrina, the evacuation of large numbers of residents after a hazard event has already commenced adds layers of difficulty and danger. Promoting and providing safe pickup points will reduce hazards to citizens.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time for identification of population centers and publicizing the pickup points
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Emergency Management, Planning
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Locations have been established for hurricane evacuation, along with agreement with HRT to help in an event. More robust analysis is needed to refine pickup points and also determine points of distribution during an emergency.	

PORTSMOUTH MITIGATION ACTION 3	
Hurricane/flood outreach/education to residents and businesses. Determine new and best way(s) to get information to the most vulnerable and least connected residents.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Protection of personal property and lives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$20,000
Potential Funding Sources:	City budgets; use free FEMA materials when available; HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Planning
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Flyers have been used in the past, primarily on topic of flooding with some information on hurricanes. These are sent out to those in the flood zones. Fire Dept sends out notifications on social media through City Marketing department.	

PORTSMOUTH MITIGATION ACTION 4	
Identify sources and evaluate use of available data to pinpoint the location of persons with disabilities for mitigation, evacuation, response, recovery.	
BACKGROUND INFORMATION	
Site and Location:	Citywide areas of high social vulnerability
Cost Benefit:	Protection of persons with disabilities before, during and after hazard events has broad benefits for protecting lives and property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined as projects are identified.
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, GIS
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
City contractor will review available data sources on vulnerability indices as potential addendum to this plan. Certain data is difficult to obtain because of privacy concerns (e.g. health department raw data).	

PORTSMOUTH MITIGATION ACTION 5	
Implement additional flood monitoring stations to track real-time water levels in targeted areas to support response efforts. Leverage regional efforts to determine best technology, including cost effectiveness analysis.	
BACKGROUND INFORMATION	
Site and Location:	Olde Towne/ Downtown, Paradise Creek/ Cradock
Cost Benefit:	Enable real-time assessment of flood levels which will allow more responsive warnings and alerts to be broadcast.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$80,000 plus $10,000 annual maintenance
Potential Funding Sources:	USGS, FEMA, State, City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Emergency Management, HRPDC
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
System in place to collect and report data. Still in process of improving functionality of software.	

PORTSMOUTH MITIGATION ACTION 6	
Systematically track and map areas that sustain non-tidal flooding and "sunny day" flooding, with focus on currently flooded streets and areas susceptible to future flooding. Allow community to sign up for notifications when streets flood and pair floodwater sensors with rain gauge data to improve prediction capability. Expand number of sensors.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Tracking where flooding actually occurs will allow mitigation action and projects to be directed to those areas. Flooded roads reduce functionality of transportation system, hampering commerce and emergency response.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time
Potential Funding Sources:	City CIP budget
Lead Agency/Department Responsible:	Engineering, Planning, Emergency Management, Public Works, GIS; DHS: HMGP 5% Initiative; Virginia CFPF
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Desired expansion of existing sensors should focus on accuracy and cost effectiveness.	

PORTSMOUTH MITIGATION ACTION 7	
Protect City's critical infrastructure: 1) implement Citywide drainage improvement projects; 2) elevate city emergency generators above the base flood elevation plus 2 feet freeboard; 3) retrofit/elevate/relocate existing facilities to provide future flood protection.	
BACKGROUND INFORMATION	
Site and Location:	Citywide. Specific examples include Old Town Stormwater Pump Station, new pump station being planned, and Frederick Boulevard corridor upgrades.
Cost Benefit:	Frequent flooding in these areas damages cars, structures and contents. Damages to city infrastructure will also be reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$500,000,000
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, State; DHS: HMGP
Lead Agency/Department Responsible:	Engineering, Public Works
Implementation Schedule:	Long term; as funding becomes available
ADDITIONAL COMMENTS	
Long-term program. Several projects (e.g. Street drainage, sea-wall, pump station etc.) have been initiated.	

PORTSMOUTH MITIGATION ACTION 8	
Implement action items from 2015 Floodplain Management Plan and Repetitive Flood Loss Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Each action has separate costs and benefits identified in Plan. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	As shown in the plan
Potential Funding Sources:	City budgets, DHS: BRIC, HMGP, Severe Repetitive Loss, stormwater funds; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Ongoing. Some long-term as funding available
ADDITIONAL COMMENTS	
Not planning to update the 2015 plan as City as largely transitioned to regional hazard mitigation plan for this role and future Plan/Strategies to be developed.	

PORTSMOUTH MITIGATION ACTION 9	
Mitigate flood-prone and repetitive flood loss structures. Mitigation measures may include acquisition, relocation, elevation, or other retrofit measures to provide flood protection. This action includes Mitigation Reconstruction projects. Develop a guide or adapt an existing manual that advises residents/property owners how they can retrofit their buildings for increased sustainability and resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Within the City's flood zones
Cost Benefit:	Benefits for individual structures are based on the average annual damages, which is based on the structure's lowest floor elevation and frequency of flooding. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$10,000 to $200,000 per structure (paid by citizen or through grant funds obtained by citizen)
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
At this time, City does not desire to pay for mitigation of individual structures. City intends to provide options, knowledge/technical support, resources and information to support residents in individual efforts.	

PORTSMOUTH MITIGATION ACTION 10	
Determine whether Repetitive Flood Loss properties have been mitigated.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time estimated at $50 per structure x 220 structures = $11,000
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
City is continuing to track homeowner efforts via permitting process. FEMA has not made any additional data available on RL/SRL properties.	

PORTSMOUTH MITIGATION ACTION 11	
Advocate for improved and increased grants for mitigation activities from State and Federal sources.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The current processes are long and cumbersome. More streamlined processes and access to mitigation funds will aid in the mitigation of flooded properties and areas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objectives 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Planning, Emergency Management, Permits & Inspections, Engineering
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
City would prefer HMGP funds benefit citizens directly for improvements on private property and to provide additional avenues for mitigation efforts.	

PORTSMOUTH MITIGATION ACTION 12	
Review and revise City's series of procedures and pre-approved messages to ensure that Code sections do not conflict and do not hamper recovery efforts and that permitting is streamlined and efficient. Leverage technology to facilitate prompt permit processing during or after an event using mobile and electronic means.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that processes are in place prior to a disaster event will speed recovery and increase the community's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Wildfire, Earthquake
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Permits & Inspections, Engineering, Public Works, Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	

PORTSMOUTH MITIGATION ACTION 13	
Review existing plans to ensure that they integrate mitigation concepts. Ensure that future plans integrate mitigation concepts detailed in the Hazard Mitigation Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that plans incorporate mitigation concepts and strategies will aid the City's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Planning, Permits & Inspections, Engineering, Public Works, Emergency Management
Implementation Schedule:	Ongoing as new plans are developed
ADDITIONAL COMMENTS	
Build One Portsmouth Comp Plan adopted was successful implementation of this concept.	

PORTSMOUTH MITIGATION ACTION 14	
Implement green infrastructure for flood and stormwater abatement.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Green infrastructure can be a cost-effective approach for improving water quality and can provide multiple environmental, economic, and community benefits. Under HMGP grants, additional benefits from environmental or ecosystem benefits may be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	To be determined
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, EPA, State; DHS: HMGP, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Engineering, Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Some projects are being initiated (*e.g.* Court Street Improvements). Future projects are prioritizing the use of green infrastructure.	

PORTSMOUTH MITIGATION ACTION 15	
Replace the Seawall.	
BACKGROUND INFORMATION	
Site and Location:	Downtown
Cost Benefit:	The Portsmouth waterfront seawall and bulkhead is a major element of the downtown waterfront. It is aging and in need of replacement to ensure safety of citizens and visitors. It is impacted daily by pedestrian and vessel use, weather and the waters of the river.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$20,000,000
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, State
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Significant components of the seawall have been replaced; project is approximately 75% complete.	

PORTSMOUTH MITIGATION ACTION 16	
Create dialogs with other governmental (e.g. HRT, HRSD, Port of Virginia) and non-governmental (e.g. Dominion Virginia Power, Verizon, etc) stakeholders to encourage and coordinate incorporation of mitigation strategies into projects and policies that affect Portsmouth's citizens and visitors.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that our partner organizations incorporate mitigation concepts and strategies into their projects and policies will aid the City's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Engineering, Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Coordination is ongoing as the City leverages regional meetings to promote mutually beneficial projects. As an example, Dominion has undergounded assets due to high wind assessment in the Churchland area. The recently completed regional Joint Land Use Study with the City of Chesapeake and the U.S. Navy is another example.	

PORTSMOUTH MITIGATION ACTION 17	
Develop inventory of first floor elevations (and possibly Elevation Certificates) of structures in flood zones in low- to moderate-income housing areas.	
BACKGROUND INFORMATION	
Site and Location:	Citywide low to moderate areas
Cost Benefit:	In order to assess any potential mitigation actions, first floor elevations (at a minimum) will be needed. Assisting low to moderate income homeowners to obtain this information will allow these structures to be protected from future flooding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	To be determined
Potential Funding Sources:	USACE, FEMA, HUD; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
City and corporate partners are initiating a new project to provide accurate data collection for a large number of structures in a short timeframe.	

PORTSMOUTH MITIGATION ACTION 18	
Continue implementing City's Heat Injury Prevention Plan and position cool buildings for easiest access by high vulnerability populations and neighborhoods.	
BACKGROUND INFORMATION	
Site and Location:	High vulnerability areas citywide
Cost Benefit:	This low cost plan, when implemented, prevents heat injuries by making existing City buildings available to people without access to air conditioning.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Tropical/Coastal Storm (and associated power outages)
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Facility operating costs and minimal staff time to prepare outreach
Potential Funding Sources:	Facility operating costs/utilities
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK

SUFFOLK MITIGATION ACTION 1	
Protect repetitively flooded infrastructure and structures through elevation, acquisition, relocation, retrofits or repurposing. Other structural means are included, as appropriate, for protecting critical infrastructure. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the City
Cost Benefit:	In rural areas of the city, roads flood each time there is a significant rainfall. In the urban downtown, commercial structures flood frequently. FEMA now funds hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$10,000 to $200,000 per structure; infrastructure protection costs to be determined
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management and Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 2	
Provide emergency power to critical infrastructure, critical facilities and critical roadway intersections during extended power outages. Increase emergency generator capabilities at school facilities used as shelters to meet ADA functional needs requirements.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the City
Cost Benefit:	Maintaining basic city functions in the aftermath of both major and minor events is important for the safety of citizens and the environment. Emergency power is mandatory at the shelters to address access and medical equipment that requires electricity. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$500,000
Potential Funding Sources:	Existing Budgets; DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Utilities, Public Works, Facility Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City Hall, Public Works Operations, and Public Works Operations Yards at Whaleyville, Holland and Chuckatuck all have emergency backup generators installed and functional. 36 traffic signals have backup gas generators and 22 signals have battery only backup. New requirement mandates any new signal built or rehabilitated must have a permanent backup generator.	

SUFFOLK MITIGATION ACTION 3	
Provide hurricane and flood outreach and education materials to residents within the City to make flood protection information available to property and business owners and renters.	
BACKGROUND INFORMATION	
Site and Location:	Throughout City floodplains, with materials available at public libraries, recreation centers and City Hall
Cost Benefit:	Protection of personal property and lives
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$2500
Potential Funding Sources:	Existing budgets; use free FEMA materials; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 4	
Continue to implement capital improvements that improve stormwater management and control flooding, especially for undersized and out-of-date drainage systems and patterns. This action includes all initiatives identified in the 2022 Resilience Plan.	
BACKGROUND INFORMATION	
Site and Location:	City-wide. Projects mitigate flooding and run-off problems throughout the City, including drainage projects previously identified and planned such as Oldetown Drainage Project and Oakland Drainage Project
Cost Benefit:	Annual damage occurs to homes and business in vulnerable areas due to poor drainage. Additional green infrastructure values from environmental or ecosystem benefits should be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Estimated $1,000,000 annually, but variable based on several factors
Potential Funding Sources:	General funds, DHS: BRIC, HMGP, Private funds; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing

COMMENTS
Hazard Mitigation Grants should be considered as a potential funding source and used as a basis for property protection.

SUFFOLK MITIGATION ACTION 5	
Develop a Resilience Plan that incorporates a stormwater drainage plan to address issues in flood-prone areas; prioritize and implement plan recommendations. This action includes all initiatives identified in the 2022 Resilience Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Flooding as a result of stormwater accumulation can exacerbate coastal flooding, contributing to flood damages of cars, structures, roads and other infrastructure. Nuisance flooding can result in businesses closed down. Additional green infrastructure values from environmental or ecosystem benefits should be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$250,000 to $3,000,000
Potential Funding Sources:	General funds; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 6	
Continue strengthening the City's Floodplain Management Program with the following actions: **1) Reviewing and adopting State Model Floodplain Ordinance, including 1 foot freeboard elevation requirement;** **2) Incorporating floodplain requirements into permit process with information in the online FAQs, BFE required on the building permit application (as required by NFIP), creating and posting online standardized forms for substantial improvement/damage determination;** **3) Providing specialized training and support Certified Floodplain Manager (CFM) certification for applicable City staff;** **4) Preparing educational materials in the permit office on the value of flood insurance, freeboard and NFIP compliance; and,** **5) Continuing participation in the Severe Repetitive Loss program.**	
BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City
Cost Benefit:	• The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties. • Freeboard - More stringent measures for flood prone structures have a very small upfront cost that is recovered within approximately 10 years through lower flood insurance costs. The reduction in average annual damages with just 1 foot of freeboard is substantial.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Staff time
Potential Funding Sources:	Negligible
Lead Agency/Department Responsible:	Planning (lead) and Public Works
Implementation Schedule:	Within 4 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 7	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding and Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Staff time estimated at $100 per structure x 13 structures = $650
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; VDEM
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary. Receipt of data from FEMA or State officials is problematic.	

SUFFOLK MITIGATION ACTION 8	
Retrofit Primary Shelters in the City to conform to the Ultimate Design Wind Speed for Risk Category 3 structures as referenced in the current edition of the Uniform Statewide Building Code, Part 1 (USBC).	
BACKGROUND INFORMATION	
Site and Location:	Citywide locations
Cost Benefit:	According to the Suffolk Public Schools Director of Facilities, none of the schools in the City designated as shelters are engineered to withstand winds greater than 90 mph. A Category 2 or greater hurricane would result in residents having to take shelter outside the City. Transportation costs for such an evacuation would be staggering.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Extreme Heat
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	Capital budgets; DHS
Lead Agency/Department Responsible:	Capital Programs Director and Public Schools Director of Facilities and Planning
Implementation Schedule:	5 to 7 years
ADDITIONAL COMMENTS	
Hurricane shutters may provide a partial solution for some structures at a lower cost than complete retrofits.	

SUFFOLK MITIGATION ACTION 9	
Install markers indicating the flood water depth along streets or roads subject to tidal, riverine or urban flooding.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas citywide; City is developing a program to prioritize the installation of these signs starting with the arterial and collector highways and priority routes within the City's urbanized area.
Cost Benefit:	Elevated water levels in recent weather events have caused damage and down time to emergency vehicles while responding to calls for assistance. These markers can also be useful during droughts to indicate low water levels.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Drought
Goal(s) Addressed:	Goal 1, Objective 1.5; Goal 2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	<$10,000
Potential Funding Sources:	Public Works annual operating budget; DHS: BRIC, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Traffic Engineering, Emergency Management
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Other alternatives considered included developing a policy regarding emergency vehicle operations on flooded streets or roads; however, flood depth markers would have added benefits by alerting a broader audience of citizens and commuters regarding areas with unsafe water levels for driving. Savings of up to $5,000 per City vehicle in repairs could be realized.	

SUFFOLK MITIGATION ACTION 10	
Retrofit the East Suffolk Recreation Center with an emergency generator to support shelter operations for that section of the City.	
BACKGROUND INFORMATION	
Site and Location:	East Suffolk
Cost Benefit:	When school is in session, using a school as a shelter is a conflict. The Recreation Center is a potential alternative. Also, this center would add a second ADA-compatible shelter to the City's shelter inventory, increasing accessibility for persons with disabilities.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$7500
Potential Funding Sources:	Capital Budget (for generator), Mitigation Grant (for quick-connect); DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Capital Programs and Facilities, Department of Parks and Recreation
Implementation Schedule:	5 to 7 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 11	
Work with the owner to rehabilitate Godwin's Millpond Dam.	
BACKGROUND INFORMATION	
Site and Location:	6145 Godwin Boulevard, Suffolk
Cost Benefit:	Potential impacts of dam failure include: 1 roadway (Route 10 for .04 miles downstream), 1 home, and 3 businesses. The dam impounds 165.00 acre-feet at normal pool.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding due to Impoundment Failure/High Hazard Dam, Flooding
Goal(s) Addressed:	Goal 1, Objective 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Relatively Low
Estimated Cost:	To be determined based on additional inspection and analysis of retrofits needed.
Potential Funding Sources:	FEMA: HHPD; owner resources; CIP
Lead Agency/Department Responsible:	Fire & Rescue
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Godwin's Millpond Dam was assessed "poor" in 2018 by DCR. The high hazard potential earthen dam is located along Chuckatuck Creek and has a drainage area of 6.87 square miles.	

VIRGINIA BEACH

VIRGINIA BEACH MITIGATION ACTION 1	
Relocate the ComIT Data Center.	
BACKGROUND INFORMATION	
Site and Location:	ComIT Data Center, Building 2, 2405 Courthouse Drive
Cost Benefit:	There have historically been marginal flooding problems in Building 2 that included: 1) Flooding from a leak in the fire sprinkler system on 1st floor. 2) Flooding from leaks in the roof's drainage system. 3) Water backup on the Data Center sub-floor, due to the drainage system, which has occurred on multiple occasions. 4) In 2004, there were two occasions of flooding due to equipment failure in Building 1 where damage and loss of service was avoided only because on-site staff discovered the flood before water reached the Data Center. 5) During Hurricane Isabel, it was necessary to shut down all computer systems in Data Center and physically move equipment to 2nd floor. Moving equipment carries associated risks and at least two servers were corrupted during process.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: HMGP, FMA, BRIC, RFC; Existing budgets
Lead Agency/Department Responsible:	ComIT
Implementation Schedule:	Within 1.5 years
ADDITIONAL COMMENTS	
In recent years, the importance of data management to overall City operations has increased the priority of this action. Project is nearing completion. Building 2 construction is in progress. The COMIT Data Center is relocating from the basement of Building 2 to the third floor of Building 2. This work is part of the Building 1, 2 & 11 Phase I Renovation which began in February 2021. The third floor and IT pathways are estimated to be completed in the first quarter of calendar 2022. Installation and turn up of IT equipment is estimated to be complete by the third quarter of calendar year 2022 or sooner.	

VIRGINIA BEACH MITIGATION ACTION 2	
Strengthen the City's Floodplain Management Program with the following actions: **1) Continue participating in the National Flood Insurance Program. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements;** **2) Incorporate floodplain management tools/regulations into existing development review procedures;** **3) Continue participation in the Community Rating System in order to reduce property owner premiums for flood insurance;** **4) Provide specialized training and support Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors;** **5) Prepare educational materials in the permit office on the value of flood insurance, freeboard and NFIP compliance;** **6) Participate in the Severe Repetitive Loss program to mitigate flood-prone structures; and,** **7) Consider changes to floodplain management ordinance to regulate repetitive flood losses and increase ICC availability, limit the size of enclosures beneath elevated structures in coastal high hazard areas, map and regulate a future conditions 100-year floodplain, and regulate Coastal A Zones to Zone V standards.**	
BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City
Cost Benefit:	• The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties. • The large number of flood-prone properties and repetitive flood losses in Virginia Beach merits additional investigation to determine what measures have been taken by property owners to protect structures and what additional measures may have measurable benefits.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.2; Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas. Exceptions are areas behind Brandon Middle School, near Paca Lane/Newtown Road, Thalia Shores, and Thoroughgood neighborhoods.
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: HMGP, FMA, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Public Works
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS

-The City officially entered the CRS program as a Class 7 on May 1, 2019.

- There are currently 8 CFMs within the Planning and Community Development Department and 3 CFMs employed within other City departments. Additionally, one of our CFMs serves as a board member of the Virginia Floodplain Management Association. In 2021, the Planning and Community Development Department sent 5,000 annual NFIP letters to homeowners near and within identified repetitive flooding areas.

- Annual floodplain and flood insurance information is available in the permits office as well as numerous other public offices.

- The Office of Emergency Management applies for and manages elevation and acquisition projects for the severe repetitive loss program and continues to identify structures for future mitigation. Currently, OEM is performing elevations of 2 FEMA grants and acquisitions on 1 FEMA grant. Additionally, the City received an FY19 FMA grant award in November 2022 to elevate 6 residences.

VIRGINIA BEACH MITIGATION ACTION 3	
Create coalition of business owners, including some who have implemented mitigation actions in the past, to promote the value of hazard protection and help identify and implement retrofit/elevation/acquisition projects in the business community.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The hardening of businesses supports their ability to recover from potential disasters, thereby helping sustain citizens' way of life in the aftermath of a hazard event.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1; Goal 2, Objective 2.1; Goal 3
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal
Potential Funding Sources:	Existing Budgets; DHS: BRIC, HMGP 5% Initiative; Private funds
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
Two members of the Virginia Beach Emergency Management Office participated in the Resilient Enterprise Solutions (RES) Home Raising Academy, launched in Hampton Roads in 2020. Various commerce sectors participated in the Home Raising Academy including local government, construction, and real estate. The training curriculum included an introduction to the NFIP, Flood Maps, Elevation Certificates, Outreach, Proactive Selling, Financing & Insurance, and Home Elevation.	

VIRGINIA BEACH MITIGATION ACTION 4	
Better define what is considered a critical facility and update the City's critical facility list annually. Provide emergency power to critical infrastructure, critical facilities, pump stations and critical roadway intersections during extended power outages. Emergency power and quick connect wiring is needed for critical intersections. Generator capability is needed at multiple school facilities used as shelters.	
BACKGROUND INFORMATION	
Site and Location:	Critical Intersections identified by Police Department and Public Works Building 18: Human Resources (Has a partial building generator that supports the IT function). Various Stormwater Pump stations Various Sewer Pump stations Various Public Schools: Those designated as shelters, focusing on the high schools as the top priority.
Cost Benefit:	Maintaining basic city functions in the aftermath of both major and minor events is important for the safety of citizens and the environment. Emergency power is mandatory at the shelters to address access and medical equipment that requires electricity.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Extreme Heat
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$3,500,000
Potential Funding Sources:	Existing Budgets; DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Utilities, Public Works, Sheriff, Emergency Management
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
Generator projects at the Central Plant and EMS Headquarters have been completed. Central Plant Generator- $5.3 million project cost. Work substantially completed June 23, 2021. This included the instillation of 2 (n+1) generators for 100% back-up power of the Municipal Center central heat/cooling plant. This will enable uninterrupted heat and air conditioning to be provided to City Hall, Operations Buildings, School Administration Building, the Police Department (VB Police Head Quarters and 1st Precinct), the Correctional Center, and the Juvenile Detention Center. The Correctional Center Buildings (7A, 7B, and &C) all have whole building generator back-up. Building 21: Fire Administration has a partial building generator for emergency lighting. EMS HQ Generator- $472,000 project cost. Work substantially completed July 13, 2020. The project provided for whole building generator power for the backup emergency communications (911/311) center and backup emergency operations center (EOC) at the EMS Headquarters Building located at 4160 Virginia Beach Boulevard.

VIRGINIA BEACH MITIGATION ACTION 5	
Design or retrofit public safety facilities vulnerable to wind damage and/or flooding.	
BACKGROUND INFORMATION	
Site and Location:	Three EMS volunteer facilities are vulnerable to flooding or wind damage. EMS Rescue 1 is vulnerable to flooding. EMS Rescue 8 and 14 are vulnerable to wind load hazards. EMS Headquarters is not designed for wind load hazard.
Cost Benefit:	EMS Rescue 1, 8, and 14 are volunteer owned public safety facilities built on city land through long term lease agreements and offer critical life-safety operations. EMS Headquarters is a city owned building that houses the backup emergency communications (911 / 311) center and the backup emergency operations center (EOC) along with EMS Administration and Training. Vulnerability to flooding and wind damage could threaten the availability of this capability during a flood or high wind event.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Project dependent
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: HMGP, Virginia CFPF
Lead Agency/Department Responsible:	Public Works and Public Safety Departments
Implementation Schedule:	Long-term, over a 15-year period

ADDITIONAL COMMENTS
The city has conducted formal analyses of critical facilities and HMGP grants were obtained to harden some facilities. As HMGP funds become available through the State, additional grant requests should be prepared and ready to submit for “shovel-ready” projects. Older public safety facilities are incorporating retrofits as repairs are scheduled. New facilities are built to current standards with freeboard making them more resistant to flooding. All are designed to sustain up to 117mph winds.

VIRGINIA BEACH MITIGATION ACTION 6	
Provide educational outreach to residents to increase awareness of vulnerability to multiple hazards and preventative actions that can be taken. Focus on hurricane preparedness, sea level rise and flooding.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	By training community leaders in how to protect hazard-prone properties, the City spreads information on the value of retrofitting directly to those in need at low cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$30,000
Potential Funding Sources:	DHS: HMGP, HMGP 5% Initiative; Operating Budget; FEMA materials available free
Lead Agency/Department Responsible:	Emergency Management and Communications
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The city has multiple programs and strategies for the dissemination of emergency preparedness information, but it is currently coming out of multiple offices and this will assist in streamlining the information. This action is part of Virginia Beach's strategy for continued compliance with the NFIP.	

VIRGINIA BEACH MITIGATION ACTION 7	
Replace, as necessary, and maintain the existing regional interoperable communications system.	
BACKGROUND INFORMATION	
Site and Location:	Citywide and Southside Hampton Roads region
Cost Benefit:	Modern interoperable communications systems support preparedness, response and recovery activities for all hazards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Transportation Hazard-Incident, Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10,000,000
Potential Funding Sources:	DHS: HMGP, others; CIP
Lead Agency/Department Responsible:	ComIT
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The city has modernized much of its communication systems to include interoperability of city systems, as well as regional systems. New systems require maintenance and replacement on a regular basis.	

VIRGINIA BEACH MITIGATION ACTION 8	
Protect Atlantic Ocean and Chesapeake Bay shorelines from storm damage. Continue work with the Army Corps of Engineers and other federal agencies to ensure ongoing maintenance of the Hurricane Protection Project and other maintained beaches within the city.	
BACKGROUND INFORMATION	
Site and Location:	Atlantic Ocean and Chesapeake Bay shorelines, particularly Resort Area and Sandbridge
Cost Benefit:	Severe and frequent shoreline erosion in this economically valuable area merits structural protection on an ongoing basis. Multiple project reports contain detailed information on the costs and benefits of these projects. City continues to provide beach replenishment as funds and projects allow, which continues to provide ongoing storm protection to $3 billion worth of homes and businesses from Rudee Inlet to Fort Story.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Winter Storm; Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High
Estimated Cost:	Estimated $14,000,000 every ten years
Potential Funding Sources:	COE, CIP, Special Tax District, TGIF, SSD, TIF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
In addition to maintaining existing “engineered beaches”, the City should seek additional beaches or shorelines to be considered for structural hardening. The City’s beach restoration program currently focuses on six key areas: Ocean Park Beach Restoration, Cape Henry Beach Restoration, Chesapeake Beach Replenishment, Resort Beach, Sandbridge Beach, and Croatan Beach.	

VIRGINIA BEACH MITIGATION ACTION 9	
Maintain a dam inventory and monitor the condition of dams within the City making improvements when needed. Develop a dam safety plan to address protection, preparedness, response, and rebuilding for high hazard dams and areas in dam inundation zones.	
BACKGROUND INFORMATION	
Site and Location:	Area downstream from dams in Virginia Beach
Cost Benefit:	Infrastructure in dam inundation zones is susceptible to flooding but may not be protected from flooding should a dam failure or breech occur.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5, 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Project location dependent
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, FMA, RFC, HMGP, HMGP 5% Initiative, HHPD
Lead Agency/Department Responsible:	Public Works and Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Virginia DCR is increasingly involved in this action and recent regulatory changes have affected which dams are regulated.	

VIRGINIA BEACH MITIGATION ACTION 10	
Improve and/or update alert, warning and notification capabilities. Potential capabilities include: **1) Utilizing the City's CRM registration portal and additional support services;** **2) Maintenance and addition of sensor installations for data collection as part of the VB StormSense Network to enhance Alexa voice assisted AI and intelligent predictive visualization platform.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Low cost hazard notification through the use of cellular phones and computers can now reach large segments of the population quickly. Notifying residents of low-lying flood-prone areas before flooding occurs helps reduce flood damages to cars, structures, and possessions. Traffic problems associated with evacuations, frequent flooding and other hazard events can cause secondary economic disasters and major disruptions to citizens' lives in Hampton Roads.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Landslide/Coastal Erosion, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$1,000,000
Potential Funding Sources:	DHS: HMGP, HMGP 5% Initiative; Private funds; CFPF
Lead Agency/Department Responsible:	Emergency Management, IT, Communications
Implementation Schedule:	Improvements within 4 years; Ongoing Warning and Notification

ADDITIONAL COMMENTS
Action focuses on keeping up with new types of social media and the most modern methods of communicating with citizens in the event of a disaster. This action includes identification and real-time mapping of frequently flooded roads and will incorporate special planning regarding evacuation routes for persons with disabilities (nursing homes, assisted living facilities, hospitals). VB StormSense sensor network was established within a 3-year period and currently provides real-time water levels from 50 sensors in Virginia Beach at 6-minute intervals, including 10 USGS sensors. The data is currently used by Public Works in addition to 10 USGS Sensors for road closures and street-level flooding. Several sensors have flood levels of Action, Minor, Moderate and Major stages assigned. National Weather Service (NWS) at Wakefield is planning to add a few sensors to their Advanced Hydrologic Predication Service (AHPS). The data is currently accessed internally through mapping applications using mobile devices in near real-time. The system also provides real-time data through Alexa skill. The applications are planned for release in the first quarter of 2022. A subscription service for citizens is in development that will be connected with RAVE alerting system. A predictive visualization system is in early stages of development to support the mitigation goals. In 2019, the City entered into a partnership with WAZE for traffic notification to citizens for road closures due to natural hazards. In 2022 and beyond, Google/Waze is planning to provide the technical capabilities for CVB and their partners in our region to develop and implement communication of safety message templates to all drivers that use the Waze app within a partners geographical boundary. The messages will appear in the language that the user sets their Waze app to display. Qualified partners, such as CVB, may select one safety message to post quarterly in a partner's geographical area. The message will appear in the app when the vehicle is stopped for more than 10 seconds and automatically disappears with the first movement of the vehicle. Waze users may see the message twice per quarter. Waze will share the number of impressions made from the campaign on a monthly basis. Waze will be sharing more information with CVB and their partners about how to participate once they have the results and best practices to share from their launch partners (VDOT, Miami-Dade, LA County DPW, Penn Turnpike, and Mass DOT). - release date TBA. The City also obtained the RAVE alerting system in 2019 which has the ability to create a Smart 911 profile for a caller. The City is currently in the process of training staff on the RAVE alerting system and drafting an updated public alert and warning notification plan.

VIRGINIA BEACH MITIGATION ACTION 11	
Retrofit existing stormwater management system throughout the City into state-of-the-art facilities to minimize flooding after heavy storms while also addressing water quality objectives.	
BACKGROUND INFORMATION	
Site and Location:	Citywide. Over the last year, City commenced or completed actual stormwater and drainage improvement projects in 8 neighborhoods to retrofit aging undersized infrastructure and/or based on analysis by citywide master stormwater modeling in certain watersheds. Capital improvement program projects associated with these neighborhoods include: - Aragona Drainage Improvements - Ashville Park Drainage Improvements - Chubb Lake/Bradford Lake - College Park and Level Green Drainage Improvements - Eastern Shore Drive Drainage - Southern Canal/Lead Ditch - Windsor Woods Drainage
Cost Benefit:	Frequent flooding in the City is a result of numerous factors. Updating stormwater management facilities will help reduce both nuisance flooding of yards, roads and intersections, and more severe flooding that affects structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	To be determined
Potential Funding Sources:	Stormwater Management Program; DHS: BRIC, HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City currently has 36 active projects and programs in the Flood Control Section of the Stormwater Capital Improvement Program (CIP).	

VIRGINIA BEACH MITIGATION ACTION 12	
Mitigate incursion of storm surge and tidal inundation of low-lying areas. Investigate coastal barrier technologies and tidal stream diversion techniques.	
BACKGROUND INFORMATION	
Site and Location:	Shorelines and tidal tributaries Citywide
Cost Benefit:	Costs and benefits of various projects are continuously updated and compared. Projects are prioritized based on those that provide the greatest benefits to existing structures and infrastructure. Possible projects may include, but are not limited to: tide gates, check valves, or road/bridge/structure elevation. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	To be determined
Potential Funding Sources:	Stormwater Management Program; DHS: HMGP
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing and Long Term
ADDITIONAL COMMENTS	
Nor'easters, hurricanes and tropical storms, and some severe thunderstorms produce heavy precipitation in low-lying areas, creating runoff that cannot flow into tidal bodies at high tide. As sea level rises over the long-term, areas affected by this problem are expected to increase. The City of Virginia Beach is developing plans to address both repetitive flooding and projected increases in flooding caused by sea level rise through the City's Comprehensive Sea Level Rise and Recurrent Flooding Response Plan. The plan is an effort between local government and various stakeholders (corporate and individual) to collect, sort, interpret, and understand the data behind how sea level rise is affecting our City and how we should best respond.	

VIRGINIA BEACH MITIGATION ACTION 13	
Elevate, acquire, relocate or retrofit structures in flood prone areas that have suffered repetitive flood damage. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Within the City's flood-prone areas
Cost Benefit:	Benefits for individual structures are based on the average annual damages, which is based on the structure's lowest floor elevation and frequency of flooding. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	$50,000 to $300,000 per structure
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
16 residences are in the process of being elevated with FMA funding at the time of this plan. Additionally, the City received an FY19 FMA grant award in November 2022 to elevate 6 residences.	

VIRGINIA BEACH MITIGATION ACTION 14	
Acquire open space in strategic locations that can provide management benefits for multiple mitigation objectives. Objectives may include but are not limited to: flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites. Incorporation of the Parcel Level Mitigation Program for these projects.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits from open space acquisition can occur in several categories for a single project. A flood-prone area can be set aside for recreation and flood control, for example.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Project dependent
Estimated Cost:	TBD
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USACE; USDA, Agricultural Extension
Lead Agency/Department Responsible:	Agriculture; Parks and Recreation; Public Works; Emergency Management
Implementation Schedule:	Long-term, 5 to 10 years

ADDITIONAL COMMENTS
The Agriculture Reserve Program continues to assist the AG farmers/landowners with the option of preserving their AG land versus selling off for house development options. During Fiscal Year 2021 there were 379.58 acres added to the program. This included acquiring 22 development rights on a total of 6 parcels in the southern watersheds. There is now a cumulative total of 10,366.32 acres and 898 development rights captured in the Agricultural Reserve Program. In addition, there were recent changes to the City's ARP ordinance. These changes allow Virginia Beach to target other sensitive and valuable farmland for not only agriculture and forest land protection but also other valuable green infrastructure functions. Parks and Recreation: No new land acquisition of open space has occurred. The city is attempting to acquire a small piece of non-developable property from a shopping center owner to create water access for a kayak launch as well as provide for bank stabilization and outfall for new stormwater quality facility in the Kempsville section of the city. The 2019 FMA Acquisition grant application included 3 properties that will be demolished and returned to open space, incorporated into an existing city park. The grant was awarded in October 2020 and the acquisition project initiated shortly after.

VIRGINIA BEACH MITIGATION ACTION 15	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means. Prepare Repetitive Loss Area Analyses for CRS credit.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding (Storm Surge)
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	Staff time estimated at $50 per structure x 500 structures = $25,000
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; VDEM; HRPDC
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Through the CRS process each rep loss property was mapped and evaluated for mitigation in 2018.	

VIRGINIA BEACH MITIGATION ACTION 16	
Develop a local hurricane evacuation framework/plan and identify communication networks for evacuation messaging.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The state evacuation plan does not take all local factors into account and may not be sufficient for some residents of Virginia Beach. Local planning will facilitate evacuation when needed and better focus evacuation messaging to reduce confusion, speed evacuation and reduce the number of people in danger.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire, Hazard Materials Incident
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2: Objectives 2.1, 2.2; Goal 3: Objective 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – neighborhoods most in need of evacuation are areas of NRI high hurricane risk, which includes analysis of social vulnerability
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM; HRPDC
Lead Agency/Department Responsible:	Emergency Management, Communications Office
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
While evacuation planning typically focuses on hurricanes and coastal storms, the procedures may be used in other emergencies.	

VIRGINIA BEACH MITIGATION ACTION 17	
Promote and sustain local programs such as the Parcel Level Mitigation Program (PLMP) to provide flood protective actions such as acquisition, flood vents, relocating utilities, elevation etc. to vulnerable flood areas. Utilize grant funding to expand capabilities of PLMP when appropriate and eligible.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide, especially high social vulnerability repetitive flood loss areas
Cost Benefit:	Flood protective actions reduce long-term repair and recovery costs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Flooding due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5; Goal 2: Objectives 2.1, 2.2, 2.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	Cost vary based on each structure's needs. Acquisition and elevation are more costly than small retrofits such as relocating utilities or installing flood vents.
Potential Funding Sources:	Virginia CFPF; DHS: HMGP, BRIC; USACE: FPMS
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

VIRGINIA BEACH MITIGATION ACTION 18	
Monitor and enhance the City's cybersecurity capabilities to protect the City from cybersecurity threats especially during or immediately after a disaster or emergency.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Major cities' operational reliance on cyber technology increases the importance that the technology remains operational during or after a disaster. Disaster-related or disaster-concurrent outages can rapidly increase the costs of damage and the time needed to return to normal operations. Attempted cyberattacks can also increase following a natural disaster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Infrastructure Attack, Active Threat, Complex Coordinated Terrorist Attack, Explosives, Radiological Attack, Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, , Hazardous Materials Incident, Pandemic Flu or Communicable Disease, , Extreme Heat
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD
Potential Funding Sources:	DHS
Lead Agency/Department Responsible:	IT (Cybersecurity)
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

VIRGINIA BEACH MITIGATION ACTION 19	
Facilitate discussions with agencies responsible for providing local transportation to encourage them to evaluate, improve, and/or establish local and regional transportation plans to address the transportation needs of vulnerable populations such as the elderly, college and university students, those with disabilities, visitors, etc. in the event of an evacuation.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The state evacuation plan does not take all local factors into account and may not be sufficient for some residents of Virginia Beach with limited transportation options. Local planning will facilitate evacuation when needed and provide transport options to speed evacuation and reduce the number of people in danger.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire, Hazard Materials Incident, Civil Unrest, Power Outage, Water Utility Disruption / Contamination.
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2: Objectives 2.1, 2.2; Goal 3: Objective 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM; HRPDC
Lead Agency/Department Responsible:	Planning (Transportation), Emergency Management
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
Hampton Roads Transit (HRT) is responsible for providing local public transportation within Virginia Beach. Virginia Beach does not have control over HRT's operation requirements.	

VIRGINIA BEACH MITIGATION ACTION 20	
Review all City rules, regulations, policies, procedures, ordinances and plans to ensure a consistent approach that aligns with hazard mitigation goals, objectives and actions.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Cost is negligible but speaking about hazards with a consistent message informs citizens, and continually reinforces the City's stance on important issues for staff and elected officials.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	n/a
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Many new programs and initiatives over the past 5 years have been implemented across many departments. Public Works stormwater management and erosion and sediment control regulations, CRS goals, floodplain management ordinance revisions, all require similar starting points. The City has made a lot of progress on each of these, but additional review will help with consistency. *Sea Level Wise* calls for ensuring that flood mitigation practices identified in a future Flood Mitigation Plan are incorporated into future Comprehensive Plan and this hazard mitigation plan.	

VIRGINIA BEACH MITIGATION ACTION 21	
Implement the action items and projects outlined in *Sea Level Wise*, particularly the following high priority items*:* **1) identify regional flood risk reduction projects that could be pursued with neighboring jurisdictions, such as the City of Norfolk;** **2) increase freeboard to 3 feet or to a future design flood elevation;** **3) require mechanical and electrical systems to be elevated to design flood elevation (with freeboard);** **4) expand height allowance for buildings outside the SFHA, where property owners want to elevated structures to reduce flood risk;** **5) (paraphrased and combined) include sea level rise and future flooding considerations in designing adequate drainage controls, and in development of subdivision/site plans; and,** **6) develop informational materials on how to renovate historic properties to enhance flood resilience consistent with historic preservation requirements.**	
BACKGROUND INFORMATION	
Site and Location:	Areas subject to future flooding citywide
Cost Benefit:	All of these elements will reduce future flood damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Planning, Emergency Management, Public Works
Implementation Schedule:	Within 4 years of plan adoption
ADDITIONAL COMMENTS	

CHESAPEAKE

CHESAPEAKE MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program and Community Rating System. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements. Consider updates to 2013 floodplain management ordinance to include protection of areas outside the current SFHA subject to future flooding as sea level rises, and additional restrictions on rehabilitation of existing structures in the SFHA such as freeboard and substantial damage requirements. Goal to become CRS Class 6 community.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. Elevating structures to 1.5 feet above the BFE has a benefit cost ratio of 6:1, according to FEMA (*2008 Supplement to the 2006 Evaluation of the National Flood Insurance Program's Building Standards)*. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums. New construction and future development are protected from floods through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storms
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Chesapeake is a CRS Class 7 community.	

CHESAPEAKE MITIGATION ACTION 2	
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. Flood protection may include minor localized flood reduction projects, as well. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood loss areas Citywide
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City is proposing to collect elevation data as part of this action in order to more easily make cost-benefit analyses of these structures. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	In multiple $750,000 phases as grant money becomes available.
Potential Funding Sources:	City CIP; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS

The City of Chesapeake Office of Emergency Management continues to apply for grants for Acquisitions. 5 of the 7 applications are being processed from the 2018 FMA Grant. 2 applications were submitted for houses in 2019 and 3 applications were submitted for houses in 2020. Additionally, stormwater flood protection reduction projects are scheduled for numerous subdivisions in the SFHA.

There are 3,869 structures identified as being within repetitive flood loss areas. Locally funded projects may be creditable under the Community Rating System.

Detailed activities to support this overall mitigation action include:

1. Coordinate with the City Surveyor in Public Works Department to complete Elevation Certificates for structures when doing other survey work in repetitive flood loss areas.
2. Use pictometry to further refine repetitive flood loss area identification and to collect approximate first floor elevation information for structures in those areas.
3. Use Public Works Department expertise to identify retrofit measures for flood-prone structures. This may be creditable under CRS.
4. Regularly crosscheck real estate market with repetitive flood loss list. Purchase of empty structures may be possible at lower cost.

CHESAPEAKE MITIGATION ACTION 3	
Conduct detailed vulnerability review: cross reference locations of existing manufactured homes and manufactured home parks relative to repetitive flood loss areas and new FEMA 100-year floodplains. Review their vulnerability to flood and wind hazards. Implement measures to retrofit, relocate, or acquire vulnerable units. This action may include Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide
Cost Benefit:	While the value of manufactured homes is quite low, the costs to elevate or retrofit them to protect from flood and wind can be low, as well. The costs to determine locations and review vulnerability are minimal versus the cost of additional hazard damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	TBD
Estimated Cost:	Staff time for analysis; approx. $150,000 for retrofit measures such as elevation assistance and tie-downs
Potential Funding Sources:	Virginia CFPF; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: EWP, WPFP, WSP
Lead Agency/Department Responsible:	Emergency Management, with support from GIS and Engineering Division
Implementation Schedule:	within 2 years of plan adoption
ADDITIONAL COMMENTS	
Manufactured homes and their occupants are particularly vulnerable to wind and flood hazards. The cost of minor retrofits can have exponential benefits in reducing the risk to lives. Procedures are in place for prohibiting new manufactured homes in SFHA; this action addresses existing structures.	

CHESAPEAKE MITIGATION ACTION 4	
Protect critical facilities from damage. Measures may include installation of emergency backup power, elevation of structure or components, relocation or retrofit of building components.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens by maintaining operational capabilities post-disaster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High for Jail High for Fire Station #2 Medium for Schools Low for other Critical Facilities
Impact on Socially Vulnerable Populations:	
Estimated Cost:	TBD
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, with GIS and Public Works Engineering Division
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
New Public Safety building/EOC can withstand Category 3 hurricane or earthquake and has multiple redundancy infrastructure built into the building. All community centers and conference center outfitted with generators. The city has also completed the work on two new Fire Stations, Sta #10 in Bowers Hill & Sta #7 in Southern Chesapeake. Sta #10 serves both as a Fire Station and Logics Center for the department, increasing the city's ability to prepare, respond and mitigate following a disaster. Sta #7 is dual use facility, as a Fire Station and a newly added Police Precinct.

CHESAPEAKE MITIGATION ACTION 5	
Flow test and inspect existing City-owned and grant-funded dry hydrants annually to help maintain operability.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Chesapeake has determined that maintaining the highest level of operability for the existing system is more feasible than installing new hydrants.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing Budgets
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Ongoing per annual maintenance schedule
ADDITIONAL COMMENTS	
Installation of additional hydrants has proven challenging. This alternative presents a reasonable cost-effective method for maintaining capacity to fight wildfire. There are currently 56 dry hydrants in Chesapeake, mainly in the southern part of the City. This project is overseen by a Captain in the Fire Department who is assisted by a Supervisor in Public Utilities. Hydrants are regular schedule of maintenance and testing. This is not only done for operational purposes, but for training purposes of field forces, especially new recruits in the field.	

CHESAPEAKE MITIGATION ACTION 6	
Seek and use additional revenue sources and local matching funds for mitigation planning and projects.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Local funding sources for mitigation projects can further the benefits of available federal funding. Untapped and unusual funding sources likewise reduce the burden of mitigation on Chesapeake citizens.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC; Virginia CFPF; American Rescue Plan Act; USACE
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
NEMAC submits recommendations annually to City Council regarding the status of current mitigation projects and this plan, programmatic problems, an inventory of new potential mitigation projects and unmet needs. City Council evaluates those needs against internal funding sources. NEMAC aggressively pursues and seeks public and private grants to support mitigation activities, and enlists a number of other stakeholders in this process. Related resources may address multiple objectives, such as environmental issues, preparedness, sustainability, and blight reduction. NEMAC is prepared to pursue special appropriations and grants that are available after a disaster. City has obtained and continues to apply for FEMA grants for acquiring repetitive flood loss homes and has committed Capital Improvement Funds to mitigate flooding. City has applied for PDM funds for mitigation purposes to install generators at Public Utilities Pump Stations. City uses emergency management grant funds to enhance its Alert and Everbridge system to warn citizens of flooding issues, along with other potential disasters.	

CHESAPEAKE MITIGATION ACTION 7	
Continue to implement a Pre-Disaster Homeowner Tree Preventive Maintenance and Hazard Awareness Program.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	A low-cost effort can bring many benefits to individual property owners and significantly reduce response costs after a disaster. Benefits accrue to the City through reduced response needs, to homeowners through reduced damages, and through reduced vulnerability wildfire.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Tropical/Coastal Storm, Winter Storms, Wildfires
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Approximately $7,500
Potential Funding Sources:	USDA, Soil and Water Conservation District, Va. Tech Agricultural Extension; DOI - LWCF; Virginia CFPF
Lead Agency/Department Responsible:	Parks and Recreation Department, Emergency Management, Development and Permits
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
This program expands on existing programs in the City that focus on the value of trees, particularly healthy old-growth trees, and how to properly care for trees to prevent them from causing additional damage during wind events. Chesapeake has been designated as a “Tree City USA” for over 27 years, protects trees in the Chesapeake Bay Preservation Area, and has a “What is a Tree?” program for schoolchildren in conjunction with the Agriculture Department. The Chesapeake Arboretum is active in tree resource management and will be approached about participating. A “Prune in June” campaign may be considered as a possible focus for this mitigation action. City to hire Urban Forester/City Arborist in 2022. Messaging has gone out to homeowners regarding what to do following a storm on how to care for damaged trees. Public Communications routinely sends messaging regarding pre-storm maintenance. City works with Garden Clubs and the VT Cooperative Extension to craft and disseminate important information.	

CHESAPEAKE MITIGATION ACTION 8	
Improve stormwater management infrastructure. Implement preventive maintenance schedule and system upgrades. Projects typically include replacement and upgrade of existing facilities, enlarging pipes/ ditches to provide for increased capacity and construction of stormwater management facilities/BMPs to provide flood control and water quality compliance. Provide replacement schedule for stormwater management and inspection equipment and vehicles, including purchases of plows for new trucks to assist with dual purpose of snow removal.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Maintaining and improving the stormwater system provides Citywide benefits from both high and low frequency flood events. The preventive maintenance schedule is a relatively new activity that will help sustain the highest level of operability for the existing system. Equipment replacement prevents downtime, purchases can be more cost effective than repair expenses on depreciated equipment, and new equipment provides for potential for use in other natural event responses (such as Winter Storms).
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	$1.8 million
Potential Funding Sources:	Approved and proposed budgets and stormwater utility fees; Virginia CFPF
Lead Agency/Department Responsible:	Public Works/Engineering/Operations
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
While NEMAC recognizes these activities are already ongoing, their importance to maintaining a functioning and effective stormwater system during flood events is critical to hazard management in Chesapeake. Engineering has Master Drainage Plan that identifies watersheds and completed watershed studies identifying system deficiencies and required improvements. Department maintains list of funded and unfunded projects Unfunded projects list is reviewed and updated regularly to ensure flooding and poor drainage areas citywide are addressed. Public Works schedules and provides for regular maintenance and repairs to ensure the existing stormwater system is functioning as intended.

CHESAPEAKE MITIGATION ACTION 9	
Part I. Maximize training and educational opportunities for NEMAC, City staff, elected officials, CERT members and citizen/neighborhood/civic league leaders regarding hazard mitigation, disaster preparedness and the relationship of mitigation to reduced recovery needs. Use modern social media forums such as NextDoor. Provide samples of retrofitting tools and examples of products. **Part II. Accommodate training and related support for at least two staff in the Department of Development and Permits to receive and maintain Certified Floodplain Manager (CFM) certification through the ASFPM.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Many training opportunities are already available through FEMA, VDEM, and other agencies. Costs to provide or make arrangements for the training in Chesapeake are minimal versus the benefits of a well-informed citizenry and highly trained floodplain management staff.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $12,000 over five years
Potential Funding Sources:	Existing budgets, staff time; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management Department of Development and Permits
Implementation Schedule:	Ongoing as opportunities arise
ADDITIONAL COMMENTS	
City Staff in OEM and Development & Permits have taken classes on Floodplain Management. OEM staff have taken classes on CRS. OEM continues to oversee NEMAC. City CERT Coordinator continues to train citizens on Disaster Preparedness and being Response Ready. Citizens are taught how to mitigate before, during, and after a disaster, and not be a burden on emergency resources. The CERT Coordinator and members of CERT conduct outreach initiatives, and since COVID slowed down the ability for CERT to meet, members worked with various groups to provide online training on disaster preparedness. Two Development & Permits personnel and two Office of Emergency Management personnel have attended EMI Floodplain Management Courses. D&P personnel will continue toward CFM certification. OEM and D&P personnel will continue to take classes in NFIP & CRS. OEM and D&P actively take part in CRS / Wetlands Watch Workgroup Meetings	

CHESAPEAKE MITIGATION ACTION 10	
Conduct Hazardous Environmental Action Team (HEAT) program to oversee industrial facilities, particularly hazardous facilities, to discuss hazards and mitigation alternatives.	
BACKGROUND INFORMATION	
Site and Location:	Industrial facilities Citywide
Cost Benefit:	Reduces the likelihood of compounding incidents, thereby reducing response costs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Winter Storm, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$8,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
HEAT Team is tasked with preventing and investigating environmental crimes such as illegal dumping of chemicals and waste, illegal transportation and/or storage of hazmat, chemical releases into atmosphere and waterways, burial of hazmat, and failure to report chemical releases. Team members serve on LEPC and help review emergency plans, hazmat management plans, and TIER II reports that are submitted. Team works closely with Emergency Management Office, DEQ, EPA and USCG. Program reduces illegal handling, storage and discharge of hazmat. Members are committed to educating residents and businesses on negative impacts to the environment of illegal dumping and polluting.	

CHESAPEAKE MITIGATION ACTION 11	
Support and maintain City's new Reverse-911 system. Prepare messages to release to citizens before and after a natural hazard event.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Other methods of notifying citizens require massive amounts of staff time which exceeds budgetary restraints. Reverse 911 quickly and efficiently uses existing infrastructure to notify property owners of appropriate pre- and post-disaster mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$7,500
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The City continues to subscribe to Everbridge (Chesapeake Alert) with enhanced features to allow additional public outreach. Messages have been developed and pre-approved for alerting citizens to potential flooding, and a weather alert component has been incorporated in partnership with NWS, Wakefield. OEM and 911 Dispatch have more trained IPAWS Users, which will allow the City to broadcast WEA messages should an incident occur and notifications are needed quickly.	

CHESAPEAKE MITIGATION ACTION 12	
Prevent sanitary sewer inflows to the system during flood events. Smoke test public and private sanitary sewer infrastructure to determine priorities.	
Site and Location:	Sewer infrastructure Citywide
Cost Benefit:	The consequences and costs of sanitary sewer inflows during a flood event are high for reasons related to human health and damage to infrastructure. Smoke tests are a low-cost alternative to televising all sanitary sewer lines and allow more detailed (and costly) methods to be used only where problems are identified during smoke tests.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$525,000, annually
Potential Funding Sources:	Existing capital budgets
Lead Agency/Department Responsible:	Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Over 10% of the system is checked annually.	

CHESAPEAKE MITIGATION ACTION 13	
Continue lease agreement and maintenance of facilities along the Dismal Swamp Canal Trail to accommodate recreational use of the floodplain.	
BACKGROUND INFORMATION	
Site and Location:	Along the Dismal Swamp Canal
Cost Benefit:	Recreational use of this vast floodplain area is the highest and best use, especially in light of projected sea level rise. Facilities to make this area accessible and enjoyed by so many residents of Hampton Roads and northeast North Carolina are low cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Winter Storm, Tropical/Coastal Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$400,000
Potential Funding Sources:	VDOT, USACE and others, as deemed appropriate
Lead Agency/Department Responsible:	Parks and Recreation
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The Dismal Swamp Canal Trail is a former section of Virginia State Route 17, now a multi-use trail open to bicycling, walking, running, horseback riding, and boating. The north trailhead is located at the intersection of Dominion Blvd. and Old Rt. 17 in Chesapeake, and runs south 8.5 miles, adjacent to the Dismal Swamp Canal. This multipurpose-linear nature trail threads through some of the most uniquely historical and ecologically-significant habitats in the United States. The Dismal Swamp Canal Trail is an historic, environmental and outdoor recreation delight open to walkers, hikers, boaters, bicyclists, and horse owners. Trail improvements have been completed, including paved parking areas and two separate restroom facilities. Trail was recently fully repaved in 2020. The City continues to lease and maintain facilities adjacent to and on the Dismal Swamp Canal Trail. As a sign of the City's commitment to sharing the story of the Dismal Swamp, they have secured funding and designed a Historic Village concept on Glencoe Street (and near the Superintendent's House). The concept includes the move and restoration of a historic schoolhouse previously located on Benefit Road, addition of a Visitor Center and additional structures to share the history of Indigenous communities in the region, maroon communities in the Swamp, the Underground Railroad and its relationship to the Swamp, and the story of the canal with regard to regional trade. Future plans include full restoration of the Superintendent's House in conjunction with the USACE.

CHESAPEAKE MITIGATION ACTION 14	
Continue outreach efforts through a strategically-developed plan to inform and educate citizens before, during and after disasters. Develop pre-approved letters and notification system for structure significantly damaged after any disaster, particularly flood-prone structures with stringent repair requirements.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The organized nature of the approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) involving outreach/marketing professionals from within City government; 3) investigating regional partnerships that could result in additional cost savings through cost sharing; 4) using existing programs and resources to maximum advantage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All, but primarily Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $7,500
Potential Funding Sources:	Existing budgets and staff time; DHS: BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management (lead) Planning & Development Public Communications
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The departments of Public Communications, IT, OEM, Police, and Fire meet as a Workgroup that focuses on messaging to the citizens and public before, during, and after a disaster. Boilerplate messaging is constantly reviewed and updated and can be redefined based on the incident or disaster. Last year the Workgroup worked with VDEM to adjust the “Know Your Zone” color coding to make more sense regarding the zones that were more likely to flood. The Workgroup created direct messaging that goes out strategically at the start of hurricane season. The state provided some basic messaging and key points that the Workgroup enhanced and made Chesapeake specific. The Public Communications and Information Technology departments, routinely tracks website hits, “likes”, shared posts, retweets, etc. to gauge the effectiveness of the campaign and the overall success of the Workgroup.

CHESAPEAKE MITIGATION ACTION 15	
Acquire open space in strategic locations that can provide multi-objective management benefits. Objectives may include but are not limited to: flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites. Acquire repetitive flood loss properties up for sale for via trustee sale.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits from open space acquisition can occur in several categories for a single project. A flood-prone area can be set aside for recreation and flood control, for example.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm, Tornado, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	TBD
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USACE; USDA, Va. Tech Agricultural Extension, DOI – LWCF; Virginia CFPF
Lead Agency/Department Responsible:	Planning & Development; Parks, Recreation and Tourism
Implementation Schedule:	Long-term, 5 to 10 years
ADDITIONAL COMMENTS	
Projects may tie in with the recently adopted Green Sea Blueway and Greenway Plan. Since 2017, the City has acquired Cornland School, a cultural heritage site, and completed task of moving it out of flood-prone location, and is in the process of elevating the school. City is acquiring Newton Neck parcel adjacent to Dominion Boulevard Veterans Bridge and putting it under conservation easement. The park site is adjacent to many flood-prone neighborhoods. Future park design will include flood prevention measures. Parks, Recreation and Tourism is acquiring several FEMA properties, including adjacent to Costa Avenue. Design for Blue Heron Landing Park in Indian River planning area is complete. New design boasts significantly more pervious area than before, along with a significant increase of trees, shrubs, and improved landscaping.	

CHESAPEAKE MITIGATION ACTION 16	
Identify, create database, and plan uses for data regarding vulnerable populations. Uses may include targeted outreach, emergency notification and specialized evacuation planning. Study high social vulnerability repetitive flood loss areas to identify opportunities to support property owners and renters with recommended property-specific flood damage reduction tools and methods.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Outreach and early notification of events to vulnerable populations aids in evacuation, re-entry, sustainability and community resiliency.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$10,000
Potential Funding Sources:	DHS: UASI, BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management (lead) Public Communications
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City continues to work with state Shelter Coordinator to update databases of those with functional needs. The City now has a MIH (Mobile Integrated Health Coordinator), who is also creating a database of vulnerable populations. MIH Team regularly checks on citizens that have medical issues but do not need constant medical oversight. City has databases of those in modular home parks, in high risk areas near chemical facilities, and in repetitive flood areas. These groups can easily be notified using Everbridge should an incident occur. Messaging can also be sent should general information need to go out to the public in these areas.	

ISLE OF WIGHT COUNTY

ISLE OF WIGHT COUNTY MITIGATION ACTION 1	
Acquire, elevate, relocate or retrofit structures in coastal high hazard areas and other flood prone areas that have suffered repetitive flood damage. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Within the VE and AE flood zones along the James River and associated tributaries in Isle of Wight County
Cost Benefit:	Just 17 structures alone in the VE zone suffered damages in 1999 during Hurricane Floyd ($62,000), and 2003 from Hurricane Isabel ($476,483). One structure was recently acquired. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	$3,400,000 (approximately $200,000/property) per phase. Up to 5 phases are planned. One recent acquisition cost $135,000.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing – County has ongoing process to assess needs
ADDITIONAL COMMENTS	
There are 16 properties with structures located in the VE flood zone that are targeted for participation. The project will have to be performed in phases as grant funds are made available. Acquisition and demolition of structures represent land use changes that the County may be able to claim as credits under new Chesapeake Bay Total Maximum Daily Load (TMDL) requirements. Careful tracking of these projects can also contribute significant points to the Community Rating System classification (see Mitigation Action 2).	

ISLE OF WIGHT COUNTY MITIGATION ACTION 2	
Strengthen floodplain management program through the following: **1) Continue participation in the National Flood Insurance Program and the Community Rating System;** **2) Conduct annual outreach to flood prone property owners;** **3) Review all existing environmental ordinances, such as the CBPA, Floodplain and Stormwater Management Ordinances, to ensure they include the best practicable protection measures, including guiding new development away from flood hazard areas; and** **4) Require new development in Coastal A Zones to meet Zone V standards for design and construction.**	
BACKGROUND INFORMATION	
Site and Location:	Countywide, Isle of Wight County
Cost Benefit:	Participation in the CRS at a Class 9 rating would result in 5% premium savings on most flood insurance policies. A Class 8 rating saves property owners 20% on premiums in the SFHA.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
This action is part of the County's Strategy for Continued Compliance with the NFIP, and echoes policies and actions recommended in the Comprehensive Plan.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 3	
Develop and maintain a stormwater drainage plan to address issues in flood-prone areas; prioritize and implement plan recommendations.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Flooding as a result of stormwater accumulation can exacerbate coastal flooding, contributing to flood damages of cars, structures, roads and other infrastructure. Nuisance flooding can result in businesses closed down.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	$250,000 to $3,000,000
Potential Funding Sources:	General funds; DHS: HMGP
Lead Agency/Department Responsible:	Utility Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

ISLE OF WIGHT COUNTY MITIGATION ACTION 4	
Implement countywide Transportation Plan adopted in 2010 as part of the County Comprehensive Plan; include coordination with the Virginia Department of Transportation to address safety along all evacuation routes, including culvert redesigns and other installations to alleviate flooding.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Safe evacuation routes are mandatory for citizen protection during hazard events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Planning is underway; individual project costs to be determined through planning efforts
Potential Funding Sources:	General funds, VDOT and Federal assistance
Lead Agency/Department Responsible:	Planning and Public Works/Utility Services, VDOT, HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
U.S. 460 is a priority for the County. County added a transportation planner/VDOT liaison to staff.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 5	
Replace, as necessary, and maintain the existing regional interoperable communications system.	
BACKGROUND INFORMATION	
Site and Location:	Countywide and Southside Hampton Roads region
Cost Benefit:	Modern interoperable communications systems support preparedness, response and recovery activities for all hazards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10 million to $14 million
Potential Funding Sources:	DHS: HMGP, HMGP 5 % Initiative, others; CIP
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Replacement is needed and scheduled for near future.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 6	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the County
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Staff time estimated at $50 per structure x 18 structures = $900
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Within 2 years of plan adoption and in conjunction with CRS initial application
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 7	
Identify and address multiple hazards along high traffic evacuation routes throughout county, to include removal of utility poles and burying utility lines.	
BACKGROUND INFORMATION	
Site and Location:	High hazard areas for flood, and other areas of community importance (intersections, evacuation routes, critical facilities, and critical businesses)
Cost Benefit:	Overhead utilities are at risk of failure from several types of hazard events. By burying these lines underground, the vulnerability is dramatically reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm, Tornado, Earthquake, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2; Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	CIP, Private Funds
Lead Agency/Department Responsible:	Public Works, VDOT, HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Burying electrical power lines must be reviewed with Dominion Virginia Power for potential opportunities within the community. Much of Hampton Roads evacuates through Isle of Wight County; therefore, safe, evacuation routes are a high priority for the region as well. New development is required to have underground power lines. VDOT maintains road ROWs and regularly conducts tree trimming.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 8	
Continue use of social media before, during and after hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Minimal cost to reach larger audience more effectively
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2; Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal cost/staff time
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Information
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Other information that we will need to spread and the most effective methods, such as short videos, maps, links, photos, and infographics.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 9	
Obtain StormReady designation through NOAA.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	StormReady helps arm communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

ISLE OF WIGHT MITIGATION ACTION 10	
Continue developing a post-disaster continuity of operations plan to assist in more rapid recovery after a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	By identifying post-disaster processes for almost all County department functions and putting these processes on paper, the plan would aid staff and temporary staff in keeping processes running smoothly and not contributing to additional conflicts.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Landslide/Coastal Erosion, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$25,000
Potential Funding Sources:	Staff time, DHS planning grants
Lead Agency/Department Responsible:	Emergency Management, Planning, Permits & Inspections, Engineering, Public Works
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The County has made progress refining procedures, but there is more work to do to finalize the plan.	

ISLE OF WIGHT MITIGATION ACTION 11	
Formalize a Green Infrastructure Network Plan to preserve the County's large undisturbed forests, preserve scenic landscapes, provide habitat, reduce stormwater runoff, maintain air quality and moderate temperature. Include a riparian buffer protection strategy for those areas in the Blackwater River Watershed which are not protected by CBPA.	
BACKGROUND INFORMATION	
Site and Location:	Watersheds countywide
Cost Benefit:	Protecting land prior to development is critical for long-term protection of land and water resources.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Virginia CFPF
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
These actions are also in the County's Comprehensive Plan.	

SMITHFIELD

SMITHFIELD MITIGATION ACTION 1	
Provide training for member(s) of Town staff to become Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers (ASFPM).	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help Town staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$1,000 for conference attendance, test taking, and ASFPM membership
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Planning and Engineering
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
This action is part of the Town's Strategy for Continued Compliance with the NFIP.	

SMITHFIELD MITIGATION ACTION 2	
Review information required on the Zoning Permit Application to ensure continued compliance with the NFIP.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Identification of floodplain zones during the Zoning Permit review process provides this hazard information to developers and property owners early in the construction process to help ensure compliance with floodplain management regulations.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Planning and Engineering
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The NFIP requires that applicants for a floodplain permit provide certain flood hazard information (e.g., Base Flood Elevation, flood zone, Flood Insurance Rate Map identifying information) on the permit application. Coordination with the County, which administers the building permit, may be required. This action is part of the community's Strategy for Continued Compliance with the NFIP.	

SMITHFIELD MITIGATION ACTION 3	
Identify strategic locations throughout town to remove utility poles and bury utility lines.	
BACKGROUND INFORMATION	
Site and Location:	High hazard areas for flood, and other areas of community importance (intersections, critical facilities, and critical businesses)
Cost Benefit:	Overhead utilities are at risk of failure from several types of hazard events. By burying these lines underground, the vulnerability is dramatically reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storms, Tropical/Coastal Storm, Tornado, Earthquake, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	CIP, Private Funds
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Long-term, over a 10-year period
ADDITIONAL COMMENTS	
Burying electrical power lines must be reviewed with Dominion Virginia Power for potential opportunities within the community.	

SMITHFIELD MITIGATION ACTION 4	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood losses
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

SMITHFIELD MITIGATION ACTION 5	
Waterworks Dam/Smithfield Lake - Examine options to either bring dam into compliance with state regulations at a cost of more than $1.5 million, or decommission dam which may cost less, or as much as two times that, depending on the type of environmental restoration chosen for the lakebed.	
BACKGROUND INFORMATION	
Site and Location:	Waterworks Dam is on the west side of Smithfield.
Cost Benefit:	Actions are mandated regardless of cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Earthquake, Flooding Due to Impoundment Failure
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$250,000 for the study. Mitigation action costs to be determined by study.
Potential Funding Sources:	DEQ, DCR, Town funds
Lead Agency/Department Responsible:	Town Engineer
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
On October 7, 2007, excessive rainfall caused the dam to be topped, resulting in dam erosion and damage to the roadway running along the top of the dam. In 2010, heavy rains weakened the structure. Repair project was put out for bids in October 2017. In 2020, the town was informed they needed to repair the dam to get another operating permit.	

SMITHFIELD MITIGATION ACTION 6	
Increase fuel storage at reverse osmosis water plant, allowing for extended operations during emergency situations.	
BACKGROUND INFORMATION	
Site and Location:	Town's water plant
Cost Benefit:	Due to size of the generator, the most cost effective option is to increase fuel capacity rather convert to natural gas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Estimated $100,000, depending on the size of the tank and ability to locate additional fuel storage
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative; Town funds
Lead Agency/Department Responsible:	Plant Manager
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Currently, the generator at the plant has a 48-hour run time. The town also has the ability to store around 48 hours of water supply in tanks, giving the town a 4-day supply depending on usage.	

SMITHFIELD MITIGATION ACTION 7	
Purchase variable message roadway signs, primarily for traffic control during flood events.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone roadways throughout the Town
Cost Benefit:	Signs will reduce damage by rerouting traffic around flooded areas, and increase availability of public safety staff for more important tasks. Signs will have other uses beyond traffic control for floods, improving the department's ability to get information out to the public and motorists.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$13,000 per sign
Potential Funding Sources:	Highway budget, VDOT; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Town Engineer
Implementation Schedule:	Purchase 1 sign per year for the next 5 years
ADDITIONAL COMMENTS	
Several roadways flood during even higher frequency events, so being able to reroute traffic around these roadways becomes even more critical during major storm events.	

SMITHFIELD MITIGATION ACTION 8	
Change generators at critical facilities from diesel to natural gas.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities throughout the town, including but not limited to: Public Works Maintenance Building, Police Department, and Sewer Pump Stations
Cost Benefit:	Recovery from major disasters requires continuity of operations for the town, to the extent possible.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined based on availability of natural gas and whether individual generators can be converted or will have to be replaced.
Potential Funding Sources:	DHS: UASI, BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Begin work immediately, starting with the oldest and most critical systems
ADDITIONAL COMMENTS	
Delivery of fuel during disasters is problematic and the town wants to improve ability to maintain continuity of operations.	

WINDSOR

WINDSOR MITIGATION ACTION 1	
Provide training for member of Town staff to become a Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers (ASFPM).	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help Town staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$1,000 for conference attendance, test taking, and ASFPM membership
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
This action is part of the community's Strategy for Continued Compliance with the NFIP.	

WINDSOR MITIGATION ACTION 2	
Review information required on the Zoning Permit Application to ensure continued compliance with the NFIP.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Identification of floodplain zones during the Zoning Permit review process provides this hazard information to developers and property owners early in the construction process to help ensure compliance with floodplain management regulations.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town Manager
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The NFIP requires that applicants for a floodplain permit provide certain flood hazard information (e.g., Base Flood Elevation, flood zone, Flood Insurance Rate Map identifying information) on the permit application. Coordination with the County, which administers the building permit, may be required. This action is part of the community's Strategy for Continued Compliance with the NFIP.	

FRANKLIN

FRANKLIN MITIGATION ACTION 1	
Use existing stormwater and drainage studies to prioritize and implement recommended improvements. **Evaluate use of stormwater fee to fund future projects.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on Broad Street ditch, the Armory Drive ditch/ROW, and High Street north of the hospital.
Cost Benefit:	Stormwater drainage minimizes road closures, reduces damage to structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	City is currently completing a planning document that outlines recommended improvements and cost estimates for each.
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, FMA
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 2 to 3 years
ADDITIONAL COMMENTS	

FRANKLIN MITIGATION ACTION 2	
Maintain participation in the National Flood Insurance Program and the Community Rating System (CRS) and explore options for improving rating (currently a Class 9). Partner with Virginia DCR floodplain managers to update Appendix D of the Zoning Ordinance Floodplain Regulations.	
BACKGROUND INFORMATION	
Site and Location:	Flood insurance policyholders in the 100-year floodplain would be the primary beneficiaries. Standard X-Zone policyholders would also benefit up to a maximum 10 percent discount.
Cost Benefit:	Although there are numerous benefits to participation in CRS, the most quantifiable is the premium discounts to flood insurance policyholders. By reducing the amount residents pay in flood insurance premiums, this money is returned to the community and can be spent locally. Furthermore, many CRS communities experience a dramatic increase in the number of policies due to their outreach, which results in a reduction in uninsured losses after a flood. Then, Increased Cost of Compliance funds available to policyholders after a flood can be a valuable mitigation tool.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Medium
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	There is no cost for submitting a CRS application, other than staff time. Additional hours are required for annual reviews and cycle applications every 5 years. FEMA/ISO will provide application assistance.
Potential Funding Sources:	Existing budgets.
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 1 to 2 years
ADDITIONAL COMMENTS	
CRS provides a structured incentive program to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering, protecting the environment, and increasing the flood insurance policy base.	

FRANKLIN MITIGATION ACTION 3	
Compile elevation and flood damage data, including but not limited to: **1) Ensure all flood-prone businesses have based flood elevations posted inside;** **2) Link gauge data and high water mark data in a digital environment to facilitate evacuation, notification and other community flood awareness elements;** **3) Continue to participate in the river gaging program (entered 5 year contract in 2020);** **4) Maintain completed FEMA Elevation Certificates in a publicly-accessible format.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout City's flood hazard areas.
Cost Benefit:	Data will support analysis of costs and benefits of flood mitigation measures, particularly for repetitively flooded structures. Benefits accrue through reduced staff time in preparing mitigation grant applications, and improved accuracy of cost-benefit analyses and evacuation plans.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time; approximately 100 hours.
Potential Funding Sources:	USACE: FPMS (high water marks, structure elevations), HRPDC: LIDAR DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Rescue, Department of Tourism, Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Gathering data to create an accurate cost-benefit analysis can be a particularly daunting part of the grant application process. By compiling data on historic floods and detailed damages in a single location/document, the City will support flood mitigation projects, both structural and nonstructural. Detailed elevation data in the Downtown Business District will assist in both evacuation planning and mitigation prioritization.	

FRANKLIN MITIGATION ACTION 4	
Work with the Department of Tourism and property owners to identify and implement wet and dry floodproofing projects to protect structures from future flood events. Floodproofing projects should be viewed from a holistic perspective while considering available technology and the building's age. Current floodplain management ordinance regulates floodproofing and residential elevations. Identify projects by providing flood audits to business owners. Mitigation projects may include acquisition, elevation, mitigation reconstruction projects, and retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Downtown Franklin
Cost Benefit:	Initial flood audits conducted by a structural engineer, together with detailed first floor elevations, will aid in prioritizing mitigation projects to ensure that implemented projects maximize the reduction in average annual flood damages and reduce economic strain on businesses and the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$2,500 to $10,000 per structure
Potential Funding Sources:	DHS: HMGP, RFC ACE: FPMS HRPDC SBA loans
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Investigate the potential for "peer-to-peer" mentoring with other communities that have implemented historic downtown flood mitigation projects. Potential communities in the region with successful downtown flood mitigation projects include Grundy and Staunton, Virginia and Belhaven, North Carolina. The HRPDC can assist.	

FRANKLIN MITIGATION ACTION 5	
Conduct community disaster awareness campaign through the City's email newsletter to interested citizens, social media platforms through City of Franklin, Franklin Fire & Rescue and Franklin Police pages, and the cable Public, Education and Government (PEG) Channel. Address mitigation actions for multiple hazards, including purchase of flood insurance.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	For low cost, the City can distribute information on a variety of hazards to interested citizens on a regular basis. Benefits accrue when citizens aware of hazards begin to take actions to protect lives and property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate/Low
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Minimal costs for staff time. Materials are available from FEMA and other agencies for free.
Potential Funding Sources:	Existing budgets. DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Rescue, American Red Cross
Implementation Schedule:	Within one year.
ADDITIONAL COMMENTS	

FRANKLIN MITIGATION ACTION 6	
Increase protection and access/egress for critical facilities and infrastructure, primarily as a result of flooding. Elevate or floodproof new critical facilities; retrofit, relocate or repurpose existing facilities, or develop alternative options with close localities, and protect existing power line infrastructure. Mitigation projects may include acquisition, elevation, mitigation reconstruction projects, or retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on: 1. Evaluating relocation of main fire station out of the Special Flood Hazard Area (100-year floodplain); 2. Regionally, along power line right-of-ways; and, 3. Wastewater treatment plant mitigation or relocation.
Cost Benefit:	Benefits are reduced response times, longevity of critical infrastructure and reduced downtime for utilities after a disaster. The fire station was constructed in 1979 and was flooded in 1999 and 2006. The wastewater treatment plant was built in the 1950s and is also located in the Special Flood Hazard Area and is subject to regular inundation. Recently completed Franklin Southampton shared Water/Sewer Study outlines costs and benefits of various alternatives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Relocation of Fire Station estimated at +$9 million. Relocation or Mitigation of Wastewater Treatment Plan estimated at +$70 million
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, FMA; ACE: FCW, SFCP Dominion
Lead Agency/Department Responsible:	Fire Station – Franklin Fire & Rescue Public Works, with Franklin Power & Light, and Dominion
Implementation Schedule:	Within 1 to 2 years
ADDITIONAL COMMENTS	
Existing power lines in the floodway and floodplain are current issues of concern. Some power lines are outside of the City but provide power to the City and there is concern that power outages during floods could be extensive. The City is actively raising electrical panels and other equipment to higher locations, and is evaluating raising the substation. The City should move forward with identification of available, non-flood-prone sites for a new Fire Station.	

FRANKLIN MITIGATION ACTION 7	
Reduce the prevalence of hazardous trees by: **1) Conducting routine inspection and tree-trimming maintenance conducted by Public Works on a yearly basis; and** **2) coordinating with the Beautification Committee to prepare and distribute guidelines for property owners on how to properly care for aging trees, especially at the onset of hurricane season. Use PEG channel for distribution.**	
BACKGROUND INFORMATION	
Site and Location:	Franklin is a designated "Tree City USA" and the Beautification Committee administers an ordinance regulating tree pruning on publicly owned property.
Cost Benefit:	Benefits accrue through reduced damages to people, structures and vehicles. Reduced power outages get the City back to full operability faster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	VDOF Urban and Community Forestry Assistance, VDOT Transportation Enhancement Grants
Lead Agency/Department Responsible:	Public Works tree trimming team
Implementation Schedule:	within 1 year
ADDITIONAL COMMENTS	
Tree failure has been identified by citizens as a significant hazard concern. During high wind events, trees that have not been properly pruned represent a hazard to people, structures, power lines, and vehicles. City continuously share Department of Forestry guidelines with the public.	

FRANKLIN MITIGATION ACTION 8	
Coordinate with CSX to regulate and manage the amount, types and times of hazardous materials transport through Franklin, and in preparing for potential hazardous material incidents.	
BACKGROUND INFORMATION	
Site and Location:	CSX rail lines
Cost Benefit:	Through the low-cost exchange of transport information with the railroads, Franklin officials can maximize preparedness, and reduce potential damage from an incident occurring during peak travel times or special events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.5; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Minimal
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Fire and Rescue
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Currently, staff are working with CSX to determine what hazardous materials travel through Franklin. The nearby Town of Boykins in Southampton County has passed an ordinance prohibiting overnight or longer-term parking of hazardous materials rail cars within town limits.	

FRANKLIN MITIGATION ACTION 9	
Continue upgrades to radio system to increase interoperability between departments and neighboring communities.	
BACKGROUND INFORMATION	
Site and Location:	Citywide and Neighboring Agencies
Cost Benefit:	Improved response capability builds community sustainability and increases citizen confidence in City services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$1.6 million
Potential Funding Sources:	ARPC; DHS: BRIC, HMGP, HSGP
Lead Agency/Department Responsible:	Police; Fire and Rescue
Implementation Schedule:	Within 2 to 3 years
ADDITIONAL COMMENTS	
Franklin is working on this action currently using ARPA funds. Goal is to connect departments on local and regional levels.	

FRANKLIN MITIGATION ACTION 10	
Expand offside capabilities to city departments and citizens. Install citywide wireless network that will allow users to have access to computer network in a mobile environment. Provide signage for residents/travelers on how to connect to network.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Improves response capability, thereby reducing damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$330,196
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, HMGP 5% Initiative, HSGP
Lead Agency/Department Responsible:	Police
Implementation Schedule:	2 years
ADDITIONAL COMMENTS	
Install a citywide wireless network that will allow emergency responders to access internet, street level maps of city, HAZMAT information, pre-fire plans, and VCIN/NCIC for law enforcement. Interoperable communications of information exchanged via secure instant messaging. Allows interoperability of outside agencies responding to an incident within the City of Franklin. Several systems have been tested in recent years, but none found adequate for designated purposes.	

FRANKLIN MITIGATION ACTION 11	
Upgrade existing GIS system to incorporate wetlands, NFIP flood maps and other risk information into the site plan review process for new development. Incorporate risk from tidal surge and rising sea levels on rivers and consider how floodplains will change over time.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	A very low cost mitigation action with the benefit of raising awareness of flood hazards at a time when the (readily available) information can be used in the development process to protect new structures and infrastructure.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Community Development, Clerk's Office, Revenue Office
Implementation Schedule:	Immediately
ADDITIONAL COMMENTS	
Currently, staff are working with Clerk's Office, Revenue Office and GeoDecisions on overall GIS use/system. Currently have a wetlands test layer.	

FRANKLIN MITIGATION ACTION 12	
Help businesses develop multi-disaster recovery plans.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Disaster recovery plans minimize or eliminate disruptions to the local economy and may reduce the need for insurance claims or business assistance after events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$30,000
Potential Funding Sources:	DHS: HSGP
Lead Agency/Department Responsible:	Community Development, with Chamber of Commerce, Franklin Southampton Economic Development and Department of Tourism, HRPDC
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Businesses with disaster recovery plans in place will reduce or eliminate the impact of future disasters on themselves and Franklin's local economy. The identification of potential hazard mitigation measures (i.e., building retrofits/elevation, secondary storage facilities, backup systems) should be encouraged. Staff are currently working with agencies and departments listed above to identify additional strategies and methods to include economic relief, recovery and incentives to bring in new businesses. Relocation of Community Development is also under consideration to provide continuity of permitting operations.	

FRANKLIN MITIGATION ACTION 13	
Identify and repair or demolish unsafe, unsanitary or hazardous housing and other structures, including those in repetitive flood loss areas. Mitigation projects may include acquisition, relocation, elevation, mitigation reconstruction projects, and/or retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Unsafe housing increases the potential for loss of life and property due to several hazards. By identifying housing vulnerable to natural hazards and prioritizing those structures for repair or demolition, average annual damages due to hazards can be reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Tornado, Hazardous Materials Incident, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Costs vary based on structure needs. Generally, costs for demolition start at about $10,000 per structure, while rehabilitation and elevation together start at approximately $100,000 per structure.
Potential Funding Sources:	ARPA; HUD: CDBG DHS: BRIC, FMA, HMGP, RFC (CDBG funds may be applied as a non-Federal match to DHS grant funds)
Lead Agency/Department Responsible:	Community Development & Franklin Fire
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
Community has an ongoing housing needs assessment that must be partnered with this initiative. City is planning action in the near future using ARPA and CDBG funds.	

FRANKLIN MITIGATION ACTION 14	
Verify the geographic location of identified NFIP repetitive loss structures, and determine if those properties have been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Costs are being reevaluated.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

SOUTHAMPTON COUNTY

SOUTHAMPTON COUNTY MITIGATION ACTION 1	
Protect existing and future critical facilities from damage due to flooding, tropical storm, earthquake and tornado. Projects may include: **1) Modify floodplain management ordinance to require new public safety buildings be located outside 500-year floodplain and that a detailed flood study be conducted to determine limits of the 100- and 500-year floodplains for proposed public safety buildings near approximate A Zone floodplain;** **2) continue mapping water and sewer lines countywide, including the towns, in order to identify problems and retrofit/upgrade needs in order to protect utilities from damage and provide continuity of operations during disaster;** **3) Retrofit new Sheriff's Office and EOC to protect from flooding, including access and egress; and,** **4) Ensure retrofitted Courthouse is protected from flooding.**	
BACKGROUND INFORMATION	
Site and Location:	To be determined
Cost Benefit:	The current EOC is subject to flooding which can hinder response efforts during flood events. Benefits accrue by increasing response capabilities and reducing average annual flood damages and predicted downtime for critical public safety structures and lifelines.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Earthquake
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	County Administrator's Office
Implementation Schedule:	Within 3 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 2	
Consider amendment to subdivision ordinance that requires solicitation to the Virginia Department of Forestry for wildfire mitigation comments on proposed major subdivisions in the County.	
BACKGROUND INFORMATION	
Site and Location:	To be determined
Cost Benefit:	During the site plan review process, comments regarding smart wildfire avoidance techniques, such as defensible space, can be incorporated into the project design.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	VDOF
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 3	
Protect repetitively flooded structures, including the County courthouse, from flood damage. Modifications could include floodproofing retrofits, elevation of structure and/or critical components, acquisition, relocation or repurposing the structure. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Average annual flood damages would be reduced through mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; HSGP
Lead Agency/Department Responsible:	County Administrator's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 4	
Complete five remaining countywide drainage studies that prioritize drainage maintenance requirements and stormwater management projects to minimize flooding problems. Implement recommendations.	
BACKGROUND INFORMATION	
Site and Location:	One study proposed for each County planning area (Newsoms has been completed)
Cost Benefit:	The exact nature of flooding problems merits additional study before the costs and benefits of individual flood mitigation projects can be calculated with accuracy, and in order to determine which drainage maintenance projects maximize benefits from reduced flooding. Much of the County has only been studied to show approximate A Zone floodplains.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	$250,000
Potential Funding Sources:	DHS: BRIC, HMGP, HSGP; USDA: WPFP
Lead Agency/Department Responsible:	County Administrator's Office
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
Many storm drainage ditches were constructed in the 1930's and are not maintained.	

SOUTHAMPTON COUNTY MITIGATION ACTION 5	
Institute web-based educational program to provide multi-hazard structural protection techniques to property owners. Include information on responsible tree pruning.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost benefit:	Low-cost protection measures help citizens help themselves.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 2, Objectives 2.1, 2.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approximately $2,500 annually
Potential Funding Sources:	DHS: BRIC, HGSP, HMGP, HMGP 5% Initiative; American Red Cross; FEMA materials available at no charge
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 1 year
ADDITIONAL COMMENTS	
Particular life/safety concerns were identified, specifically related to driving on roads that have been or could be flooded, and promoting water conservation techniques during widespread power outages.	

SOUTHAMPTON COUNTY MITIGATION ACTION 6	
Verify the geographic location of all NFIP repetitive losses, and make inquiries as to whether the properties have been mitigated, and if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Average annual flood damages are reduced through mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; HSGP
Lead Agency/Department Responsible:	Community Development; HRPDC, VDEM
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 7	
Maintain Certified Floodplain Manager (CFM) certification and training for two County employees.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2
Priority (High, Moderate, Low):	High.
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$1,000 per person
Potential Funding Sources:	Department training funds
Lead Agency/Department Responsible:	Department of Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 8	
Enact tree preservation or landscape ordinance for new construction in all zoning designations.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Tree protection and landscape requirements mitigate effects of erosion and can contribute to stormwater management for new construction by requiring greater pervious areas and retention of existing landscaped areas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Landslide/Coastal Erosion, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5, 1.6, Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time only
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	County Administrator/Public Works Department/Community Development Department
Implementation Schedule:	within 3 years of plan adoption
ADDITIONAL COMMENTS	
County is adopting new zoning designation with landscaping requirements. Tree preservation and landscaping are also addressed in proposed solar energy ordinance now under consideration.	

SOUTHAMPTON COUNTY MITIGATION ACTION 9	
Encourage Litter Control Council and citizen groups to become more involved in roadside clean-ups to keep roadside ditches clear of debris.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Citizen involvement in ditch maintenance reduces costs to VDOT for ditch maintenance.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.5, 1.6, Goal 2, Objective 2.1; Goal 3, Objective 3.3
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$5,000
Potential Funding Sources:	Grants for Litter Control Council
Lead Agency/Department Responsible:	Public Works (staff liaison to Litter Control Council)
Implementation Schedule:	Over the next 5 to 7 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 10	
Increase use of Reverse 911 by citizens. Registration for the service is required and is currently advertised primarily on county web site.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Reverse 911 has a cost to the County, but increased users are needed to make the system as cost-effective as possible.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.4, 1.5, Goal 2, Objective 2.1, Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$2,500
Potential Funding Sources:	To be determined.
Lead Agency/Department Responsible:	Sheriff's Office
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
Sheriff's Office has plans in place for advertisement.	

SOUTHAMPTON COUNTY MITIGATION ACTION 11	
Include hazard mitigation priorities in budget preparation discussions and other County functions, such as comprehensive land use planning.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The process for funding other mitigation actions included in this plan must begin with countywide budget priorities. There is no cost to including a discussion of the hazards and vulnerability to which the county is exposed, but the benefits accrue as mitigation actions get implemented.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Director/Coordinator of Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Funds for mitigation efforts are necessary. Some costs are minimal (e.g., direct mail, web updates), some are expensive (e.g., structural mitigation, relocation of critical facilities). It is important for all County staff to look at hazard mitigation as a set of on-going actions rather than as a hard copy plan on the bookshelf. County Comprehensive Plan is currently undergoing revision and hazard mitigation-related goals and objectives will be incorporated.	

SOUTHAMPTON COUNTY MITIGATION ACTION 12	
Implement drainage plan for Newsoms area. The plan was created through a DHCD grant that is currently funded and underway until early 2023. Seek additional funding sources.	
BACKGROUND INFORMATION	
Site and Location:	Newsoms
Cost Benefit:	Drainage study and plan are completed and provide steps necessary to fix drainage problems and repair damaged homes.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$50,000 - $500,000, per plan, which was broken into several geographic areas, so phased implementation is feasible.
Potential Funding Sources:	DHS: HMGP
Lead Agency/Department Responsible:	Director/Coordinator of Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Three more phases of the plan are anticipated.	

SOUTHAMPTON COUNTY MITIGATION ACTION 13	
Develop long-term housing plan, including consideration of adopting the Property Maintenance Section of the USBC to address existing housing deficiencies. Long-term plan should include housing for displaced populations in the incorporated and unincorporated parts of Southampton County in the event of a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Countywide, with particular focus on flood-prone and socially vulnerable population centers in the towns.
Cost Benefit:	Disaster resilience is only achieved when the hardest hit citizens can return to a new normal, safe from repeat events. By focusing on population centers and identifying future housing needs for socially vulnerable populations, the County will reduce future costs and uncertainty in a post-disaster scenario.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 14, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High/Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; DHS: BRIC, HMGP; HUD: CDBG; Virginia Department of Housing and Community Development; HRPDC
Lead Agency/Department Responsible:	Sheriff's Office, Community Development, Social Services
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 14	
Conduct additional watershed mapping for the Blackwater and Nottaway Rivers, similar to the recently completed effort on the Meherrin River.	
BACKGROUND INFORMATION	
Site and Location:	Blackwater and Nottaway River watersheds
Cost Benefit:	Better mapping facilitates better regulation of stormwater and other development-related impacts in the watersheds.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	TBD
Potential Funding Sources:	USACE, Silver Jackets, County General Fund
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

SURRY COUNTY

SURRY COUNTY MITIGATION ACTION 1	
Increase staff resources for emergency management.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Insufficient staffing increases the demands on existing staff and can be problematic in program administration during disasters.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1..3, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$60,000 to $80,000 per position
Potential Funding Sources:	County Budget and Staffing Plan; DHS
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 2	
Establish signage notifications for additional high water marks along creeks and rivers in floodprone areas.	
BACKGROUND INFORMATION	
Site and Location:	To be determined.
Benefit Cost:	Signage that notifies drivers about how high the water is helps reduce water rescues and save lives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.5; Goal 2; Goal 3: Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	<$5000
Potential Funding Sources:	Staff, VDOT
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 3	
Protect critical facilities and infrastructure. Measures may include retrofitting of existing buildings and facilities as shelters, stormwater management or drainage improvements, elevation or relocation of structures or facilities out of hazard-prone locations. Continue to install the necessary electrical hook-up, wiring, and switches to allow readily-accessible connections to emergency generators at key critical public facilities.	
BACKGROUND INFORMATION	
Site and Location:	County facilities throughout the County
Benefit Cost:	Continuity of operations after a hazard event is dependent upon operational utilities, shelters, communications and medical services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	CIP, DHS: HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Public Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 4	
Distribute brochures and use other means to educate the public regarding preparedness and mitigation. Conduct annual preparedness days for hazards to include floods, wind, and earthquakes. Use social media to quickly and effectively inform the public.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Damage from hazard events is reduced when citizens are prepared and knowledgeable about mitigation techniques to protect their lives and property, and preparedness techniques for staying safe when events happen.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time; less than $2500 annually
Potential Funding Sources:	DHS materials; CIP
Lead Agency/Department Responsible:	Public Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 5	
As part of continuing participation in the NFIP and a new application to the Community Rating System, request list of NFIP repetitive flood losses to ensure accuracy. Review will include verification of the geographic location of each RL property and determination if mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501. Update flood ordinance to clarify freeboard requirement.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Community Rating System participation may reduce flood insurance premiums throughout the County.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.1; Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	Staff time investment in CRS application is significant.
Potential Funding Sources:	VDEM
Lead Agency/Department Responsible:	Department of Planning and Zoning
Implementation Schedule:	within 2 years of plan adoption
ADDITIONAL COMMENTS	
Discussions with VDEM and the regional PDC's may transfer some of the repetitive flood loss monitoring to VDEM in the future.	

SURRY COUNTY MITIGATION ACTION 6	
Improve GIS and 911 capabilities with better data collection, integration and functionality.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Emergency Management and hazard response functionality are improved with high level data integration and geographic/spatial data.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 3: Objectives 3.2, 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Public Safety Answering Points (PSAP) Operations Grant
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 7	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Winter Storm, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2: Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Public Safety; Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT

TOWN OF CLAREMONT MITIGATION ACTION 1	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Winter Storm, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2: Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 2	
Protect critical facilities and infrastructure. Measures may include retrofitting of existing buildings and facilities as shelters, stormwater management or drainage improvements, elevation or relocation of structures or facilities out of hazard-prone locations.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Continuity of operations after a hazard event is dependent upon operational utilities, shelters, communications and medical services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP; Virginia CFPF; USACE: FPMS
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 3	
Continue to work with VDOT to develop an alternative ingress/egress to Claremont Beach.	
BACKGROUND INFORMATION	
Site and Location:	Claremont Beach
Benefit Cost:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; DHS: HMGP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 4	
Review NFIP repetitive loss and severe repetitive loss property list to ensure accuracy. Verify location of each property and determine if that property has been mitigated and by what means.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.1, 1.2; Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Approximately 5 hours staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	within 1 year of data receipt
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 5	
Distribute brochures and use other means to educate the public regarding preparedness and mitigation.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Prepared and knowledgeable citizens can help reduce damage from events and protect their own property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Minimal, as many materials are readily available from American Red Cross, FEMA and other entities
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF DENDRON

TOWN OF DENDRON MITIGATION ACTION 1	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects. **Distribute materials that teach residents about mitigation measures for protection of their own lives and property from a wide range of hazards.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

PLAN MAINTENANCE PROCEDURES

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2022 UPDATE

Section 8 was updated to modify the scope and to include all 25 communities participating in this planning process.

INTRODUCTION

This section discusses how the *Mitigation Strategy* will be implemented by the communities and how the overall Hazard Mitigation Plan will be evaluated and enhanced over time. This section also discusses how the public and participating stakeholders will continue to be involved in the hazard mitigation planning process in the future. This section consists of the following three subsections:

- IMPLEMENTATION
- MONITORING, EVALUATION AND ENHANCEMENT
- CONTINUED PUBLIC INVOLVEMENT

IMPLEMENTATION

44 CFR Requirement
Part 201.6(c)(4)(i): The plan will include a plan maintenance process that includes a section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

In addition to the assignment of a lead department or agency, an implementation time period has been established for each mitigation action in order to assess whether actions are being implemented in a timely fashion. Each community will seek funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in each *Mitigation Action Plan*.

44 CFR Requirement
Part 201.6(c)(4)(ii): The plan maintenance process will include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Emergency Management officials in each community will be responsible for determining additional implementation procedures beyond those listed within the *Mitigation Action Plan*. This includes further integrating the Hazard Mitigation Plan into other local planning documents such as comprehensive, resilience or capital improvement plans, when appropriate. The members of the planning committees for each community remain charged with ensuring that the goals and strategies of new and updated local planning documents (such as Comprehensive Plans and Zoning Ordinances) are consistent with the goals and actions of the Hazard Mitigation Plan, and that those planning documents will not contribute to an increased level of hazard vulnerability in the region.

Opportunities to integrate the requirements of this Plan into other local planning mechanisms will continue to be identified through future meetings of each community's mitigation planning committee and through the five-year review process described in this section.

Each community will integrate the tenets of this mitigation plan into relevant local government decision making processes or mechanisms. The primary means for integrating mitigation strategies into other local planning documents will be accomplished through the revision, update, and implementation of the Mitigation Action Plan that requires specific planning and administrative tasks (i.e., plan amendments, ordinance revisions, capital improvement projects). In addition, each community will incorporate existing planning processes and programs addressing the impacts of climate change, resiliency programs, flooding and sea level rise hazard mitigation into this document by reference.

MONITORING, EVALUATION AND ENHANCEMENT

Periodic revisions and updates to the Plan are required to ensure that the goals of the Plan are kept current, taking into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with changing federal, state and local regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to the *Mitigation Action Plan*.

The Hazard Mitigation Planning Working Group will continue to meet at least annually and following any disaster events warranting a re-examination of the mitigation actions, thus continuously updating the Plan to reflect changing conditions and needs within the communities. An annual report on the Plan will be developed and presented to elected officials through HRPDC in order to report progress on the actions identified in the Plan and to provide information on the latest legislative requirements. The report may also highlight proposed additions or improvements to the Plan. The report will be released to the media and made available to the public via appropriate methods, such as the HRPDC web site.

Each community has designated a lead person and agency responsible for the monitoring, evaluation and enhancements to the plan. Those position titles and agencies are shown in Tables 2.2a and 2.2b as rows marked with an asterisk. The individuals are the primary contacts moving forward with plan implementation.

ANNUAL PROGRESS REPORTS

Each community's hazard mitigation planning committee will be responsible for producing an annual progress report to evaluate the Plan's overall effectiveness. As part of the contract for preparing this

plan, the contractor is providing a mitigation action plan spreadsheet in Appendix F that lists all mitigation actions for each community and the region. Updating this spreadsheet with status information will allow periodic progress checkups that can feed into the annual progress reports.

FIVE-YEAR PLAN REVIEW

At a minimum, the Plan will be reviewed and must be updated every five years by the hazard mitigation planning committees as required by DMA 2000. The purpose of the review and update is to determine whether there have been any significant changes that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, the increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the content of the Plan.

The plan review provides community officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented. Each community will be responsible for reconvening and conducting the five-year review, although it is expected that the HRPDC will again lead the effort to update the plan in five years. During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals and actions address current and expected conditions?
- Has the nature or magnitude of hazard risk changed?
- Are current resources adequate to implement the Plan?
- Should additional local resources be committed to address identified hazard threats?
- Are there any issues that have limited the current implementation schedule?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Has the committee measured the effectiveness of completed hazard mitigation projects in terms of specific dollar losses avoided?
- Did the community, agencies and other partners participate in the plan implementation process as proposed?

Following the five-year review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and plan amendment process outlined in this section. Upon completion of the review and update process, the Plan will be submitted to the VDEM State Hazard Mitigation Officer for review and approval. The State Hazard Mitigation Officer will submit the Plan amendments to FEMA for final review as required by DMA 2000.

DISASTER DECLARATION

Following a state or federal disaster declaration, the hazard mitigation planning committee will reconvene and the Plan will be revised as necessary to reflect lessons learned or to address specific circumstances arising from the event. Community committees may find it necessary to convene following localized emergencies and disasters, or when pursuing funding for a specific mitigation project, in order to determine if administrative changes to the Plan are warranted.

REPORTING PROCEDURES

The results of the five-year review will be summarized by the committee in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include a brief progress report for each mitigation action, including the identification of delays or obstacles to their completion along with recommended strategies to overcome them. Any necessary revisions to the Plan must follow the plan amendment process outlined herein.

PLAN AMENDMENT PROCESS

Upon initiation of the amendment process, the community(ies) will forward information on the proposed change(s) to interested parties, including affected municipal departments. Information will also be forwarded to the VDEM. This information will be disseminated in order to seek input on the proposed amendment(s) for not less than a 5-day review and comment period.

At the end of the 5-day review and comment period, the proposed amendment(s) and all comments will be forwarded to HRPDC for final consideration. The committee, or the AHAC in temporary stead of convening the entire Steering Committee, will review the proposed amendments along with the comments received from other parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan.

IMPORTANT: Minor revisions to the plan may be approved by each community's Chief Administrative Officer, while substantial amendments and addendums must be approved by the community's elected governing body.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered by the committee:

- There are errors, inaccuracies or omissions made in the identification of issues/needs in the Plan;
- New issues/needs have been identified which are not adequately addressed in the Plan;
- There has been a change in data or assumptions from those upon which the Plan is based.

Upon receiving the recommendation from the committee and prior to adoption of the Plan, each community's governing body will hold a public hearing. The governing body will review the recommendation from the committee (including the factors listed above) and any oral or written comments received at public hearing(s). Following that review, the governing body will take one of the following actions:

- Adopt the proposed amendments as presented;
- Adopt the proposed amendments with modifications;
- Refer the amendments request back to the committee for further revision; or
- Defer the amendment request back to the committee for further consideration and/or additional hearings.

CONTINUED PUBLIC INVOLVEMENT

44 CFR Requirement
Part 201.6(c)(4)(iii): The plan maintenance process will include a discussion on how the community will continue public participation in the plan maintenance process.

Public participation is an integral component of the mitigation planning process. As described above, significant changes or amendments to the Plan will require a public hearing prior to any adoption procedures.

Other efforts to involve the public in the maintenance, evaluation and revision process will be made. These efforts differ by community based on each community's individual needs, public response and whether the community has been recently affected by a hazard event. Examples of how communities in Hampton Roads already engage the public during the interim planning period, or of how they may choose to approach this task in the future, include:

- Advertise meetings of the committee in local newspapers, public bulletin boards, web sites, social media and City buildings. Designating a diverse community mitigation committee through official resolution of the governing board, and then scheduling regular meetings of the committee and advertising those meetings aggressively has worked well for some communities.
- Designate willing citizens and private sector representatives as official members of the planning committee. While real estate, financial and construction industry leaders are natural partners in mitigation planning, look beyond these to include business leaders, large employers, and representatives of local military installations and transportation hubs, such as the Port of Virginia. Cultural institutions, like Jamestown-Yorktown Foundation, are an important component in the economy of Hampton Roads and their collections are vulnerable to many of the hazards discussed in the plan. Neighborhood groups, civic leagues and other citizen groups are a valuable source of mitigation ideas for specific areas.
- Engage elected officials and planning commission members in the process, beyond simply providing updates or reports. Elected officials have a responsibility to protect the health, safety and welfare of their constituents and their support is critical to successful implementation of the Mitigation Action Plan in every Hampton Roads community.
- Use local media to update the public about any maintenance or periodic review activities taking place. The media have moved beyond traditional print and televised media and their social media presence can be valuable in disseminating information about upcoming meetings or activities. Local non-profits can also be invaluable in spreading the word about mitigation planning meetings open to the public.
- Use questionnaires, open houses, fairs and other community events to obtain ongoing public comments on the Plan and its implementation. Many local emergency managers effectively use community events to inform and advise the public on preparedness and evacuation, but the venues can also be valuable for informing the citizenry about the components of effective mitigation, how their community is implementing their Mitigation Action Plan and gathering information from the public to inform the next plan revision.
- Use community web sites, social media and list-servs to advertise any maintenance or periodic review activities taking place. Periodic surveys on social media can be a fun way to raise awareness.
- Hold area-specific meetings on a regular basis to solicit feedback from neighbors. Such meetings, held in public venues, can be used to distribute literature, educate citizens on

mitigation actions they can implement on their own, and solicit input on how the mitigation process can be more effective for their area or neighborhood.

- Integrate mitigation action plans, goals and objectives, and other plan elements into other community planning objectives. When a community's comprehensive or resiliency planning process includes similar team members and incorporates or references pieces of the hazard mitigation plan, the public gains familiarity with the links between the plans and the ways in which the efforts complement each other.
- Maintain hard copies of the Plan in public libraries, on the web, or other appropriate venues. While many citizens are engaged in community affairs through computer technology, keeping hard copies of the plan in public venues with a business card or other contact information for providing feedback or answering questions is an old-fashioned but necessary way of reaching a much larger segment of citizens.

Table 8.1 provides summary feedback from individual community's committee leaders indicating how they anticipate their community will include the public in the 5-year period following adoption.

TABLE 8.1: INCLUDING THE PUBLIC DURING PLAN IMPLEMENTATION PERIOD								
SUBREGION	COMMUNITY	Advertise committee meetings	Designate citizens, private sector reps as members of committee	Use local media to update public on maintenance activities	Use questionnaires, open houses to obtain public comment	Use web sites to advertise maintenance activities	Maintain copies of the plan in libraries, on the web, or other venues	Other
Peninsula	Hampton	✓	✓	✓	✓	✓	✓	annual update to Council
	Newport News	✓	✓	✓	✓	✓	✓	
	Poquoson	✓	✓	✓	✓	✓	✓	
	Williamsburg	✓		✓		✓	✓	
	James City County	✓	✓	✓	✓	✓	✓	
	York County				✓		✓	
Southside	Norfolk				✓	✓	✓	annual update to Council
	Portsmouth	✓		✓	✓	✓	✓	
	Suffolk						✓	
	Virginia Beach	✓		✓		✓	✓	
	Chesapeake		✓	✓	✓	✓	✓	
Western Tidewater	Isle of Wight County	✓		✓	✓	✓	✓	
	Smithfield	✓		✓			✓	
	Franklin	✓		✓		✓	✓	
	Southampton County				✓	✓	✓	
	Surry County	✓		✓		✓	✓	

OPPORTUNITIES FOR IMPROVEMENT

The 2022 plan update process represents the second time that the FEMA-recommended mitigation planning process in the Hampton Roads region has been addressed on such a large regional basis. Some previous plans were regional in nature but covered a smaller geographic area with many shared traits. As such, several opportunities for improving the plan and planning process are outlined below in **Table 8.2**, primarily as suggestions or strategies that may enhance the planning process effectiveness for either individual communities in the coming 5-year period of implementation, or for future updates of the entire plan.

TABLE 8.2: OPPORTUNITIES FOR IMPROVEMENT

Mitigation Planning Step	Opportunities
Phase I: Organize Resources Step 1. Get Organized Step 2. Plan for Public Involvement Step 3. Coordinate with Other Departments & Agencies	1. Continue to distribute Memorandum of Intent to Participate for all communities in the early stages of the planning process. 2. Engage public information officers, resiliency officers, equity officers, web site managers and other community communications specialists from each community throughout the process. 3. Ensure representatives from small communities are drawn into the planning process with multiple opportunities for comment and participation. 4. The survey in the 2022 update process was issued immediately prior to another regional survey going out with similar questions. This shortened time period for response, unfortunately. Such conflicts are hard to foresee in such a large study area. 5. The regional planning authority should continue to ask and rely on communities to reach out to large businesses, military installations, educational and medical institutions, neighborhood associations, non-profits, utilities and other groups to spur their involvement in the process, but communities need to provide documentation of these “asks” that is then included in the plan.
Phase II: Assess Risk Step 4. Identify the Hazards Step 5. Assess the Risks	1. Virtual meetings limited the feedback received after presentation of HIRA to the committee. 2. Distributing small elements of the assessment to the committee for review may increase participation and feedback. 3. Provide more detailed assessment/review of the dam safety data and help communities focus mitigation action plan on dam reconstruction/repair/removal.
Phase III: Develop Mitigation Plan Step 6: Review Mitigation Alternatives Step 7: Draft an Action Plan Step 8: Set Planning Goals	1. Provide a review form for each community to document their review and approval of each plan section. 2. “Office Hours” with consultant worked well for developing each community action plan but did not include all stakeholders. Reassess this approach once COVID restrictions are lifted.