Caroline County, Maryland

Hazard Mitigation Plan

Marshyhope Creek

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Chapter 1 Introduction

Chapter Updates

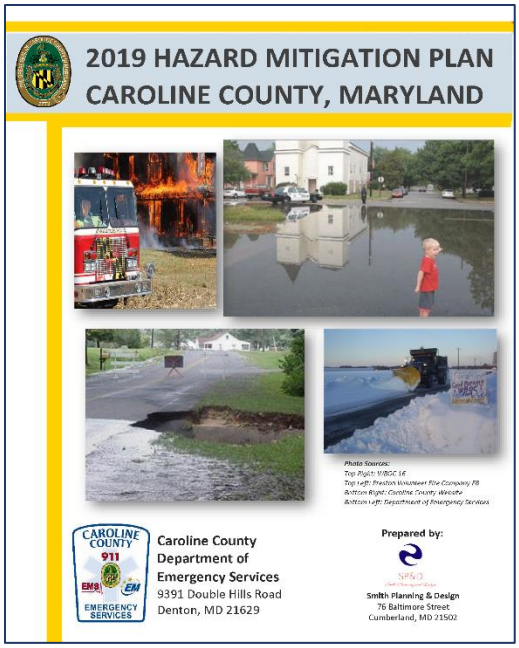
- This chapter was a complete rewrite.
- The Introduction section was expanded upon to discuss the hazard mitigation plan requirement and potential project funding.
- Planning Requirement section provides a further breakdown of required elements as discussed in the FEMA's Local Mitigation Planning Policy Guide effective April 19, 2023.
- The Planning Process portion provides how each of the six phases of the planning process were completed to satisfy the requirements.
- The Hazard Mitigation Planning Committee (HMPC) listing includes member's name, position, and agency as well meetings attended and invites, notes, and draft chapters received.
- Small group meetings and National Flood Insurance Program (NFIP) coordination was discussed.
- Municipal coordination and participation in the plan were documented and detailed in this chapter. All municipalities participated in the plan update process.
- Regional coordination occurred during the planning process and was discussed.
- The Hazard Identification and Risk Assessment (HIRA) was discussed in Phase 2-Develop a Risk Assessment.
- Phase 3- Develop a Capability Assessment and Phase 4- Finalize Mitigation Strategy discussed information provided in Chapters 12 and 13.
- Phase 5- Review of Plan and Plan Revisions reviews the cohesive draft plan. This section also provides information on how the public was included in the plan updated and provided multiple ways to participate.
- Phase 6- Plan Maintenance and Updates provides a synopsis of Chapter 14.
- The last section of this chapter reviews the plan's organization and an overview of updates completed during the plan process.

Introduction

The Hazard Mitigation Plan forms the foundation for Caroline County and its municipalities' long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The purpose of this plan is to identify, plan, and implement cost-effective hazard mitigation measures through a comprehensive approach known as hazard mitigation planning. The Federal Emergency Management Agency (FEMA) requires hazard mitigation plans to be updated every five years. To that end, Caroline County and its ten (10) municipalities present the **2024 Caroline County Hazard Mitigation Plan Update**.

The 2024 Hazard Mitigation Plan has been prepared for Caroline County and its ten (10) incorporated communities. The purpose of this Plan is to identify, plan, and implement cost-effective hazard mitigation measures through a comprehensive approach known as hazard mitigation planning. This document is the result of participation from a cross-section of community members including County and municipal officials, residents, business owners and other agencies.

Caroline County Department of Emergency Services (DES) was awarded a FEMA Hazard Mitigation Assistance Planning Grant to update the 2019 Caroline County Hazard Mitigation Plan Update. DES was the lead agency for this Plan update. In May of 2023, Smith Planning and Design (SP&D) was contracted to assist in the development the 2024 Caroline County Hazard Mitigation Plan Update, in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, and 44 CFR Part 201-Hazard Mitigation Planning.



The Disaster Mitigation Act of 2000 (DMA 2000) was signed by the President on 30 October 2000. The act requires state and local governments to prepare and adopt hazard mitigation plans as a condition for receiving Hazard Mitigation Grant Program (HMGP) assistance after November 1, 2004. The Caroline County Hazard Mitigation Plan was first adopted in 2006 as a long-range strategic plan prepared to fulfill the requirements of DMA 2000 as administered by the Maryland Department of Emergency Management (MDEM) and the Federal Emergency Management Agency (FEMA) Region III.

Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended), Title 44 Code of Federal Regulations (CFR), as amended by Section 102 of DMA 2000, provided the framework for state and local governments to evaluate and mitigate all hazards as a condition for receiving federal disaster assistance. A major requirement of the law is the development of a local hazard mitigation plan.

When applying for certain types of non-emergency disaster assistance, FEMA requires a hazard mitigation plan. These requirements are part of the laws, regulations and policy surrounding hazard mitigation planning.

As defined by DMA 2000-

Hazard Mitigation: any substantial action taken to reduce or eliminate the long-term risk to human life and property from hazards.

Planning: the act or process of making or carrying out plans; specifically, the establishment of goals, policies, and procedures for a social or economic unit.

Approved and locally adopted hazard mitigation plans are necessary for specific FEMA grant project funding eligibility.

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

The County is comprised of mainly rural communities. The ten (10) incorporated municipalities within Caroline County include: the Towns of Denton, Federalsburg, Goldsboro, Greensboro, Henderson, Hillsboro, Marydel, Preston, Ridgely, and Templeville. All incorporated municipalities participated in the Plan update. Representative(s) from each municipality provided information, reviewed draft plan elements, and completed questionnaires.

Purpose

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Natural hazards can take many forms: tornadoes, floods, hurricanes, severe storms, winter weather, droughts, landslides, or earthquakes resulting from natural phenomena. To better prepare to face these natural hazards, communities can plan for and implement mitigation techniques for almost any type of hazard that may threaten its people and property.

The purpose of the Hazard Mitigation Plan is to prevent or reduce loss of life and injury as well as limit damage costs from various hazards through the development of mitigation methods which lessen or eliminate future damage. This is accomplished by reviewing, assessing, and updating the county's vulnerabilities to natural hazards. The result of the assessment will be short-term and long-term strategies that address hazards identified in the Plan. Strategies are an effort to prevent future damage and loss of life of Caroline County residents.

This Plan establishes an ongoing hazard mitigation planning program by:

- Identifying and assessing potential natural hazards that may pose a threat to life and property.
- Evaluating which local mitigation measures should be undertaken.
- Outlining procedures for monitoring the implementation of mitigation strategies.

The Plan update provides guidance to Caroline County officials on local mitigation activities that should be implemented over the next five-year planning cycle. It encourages activities that are most cost-effective and appropriate for mitigating the effects of all identified natural hazards.

Planning Requirements

As an incentive for State and local governments to develop hazard mitigation plans, the federal government requires mitigation planning as a component of eligibility for hazard mitigation project funding. The 2015 Hazard Mitigation Assistance Unified Guidance and Addendum, produced by the Federal Emergency Management Agency (FEMA), states that mitigation plans are the foundation for effective hazard mitigation. As such, local jurisdictions must have a FEMA-approved local hazard mitigation plan at the time of obligation of grant funds in order to be eligible for grant funding under the unified Hazard Mitigation Assistance (HMA) programs. This requirement reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.

Local Mitigation Plans follow a planning methodology that includes public involvement, a risk assessment for various hazards, an inventory of critical facilities and other at-risk structures, a mitigation strategy for high-risk hazards, and a method to maintain and update the Plan. Therefore, the requirements of a local hazard mitigation plan include the development of hazard identification and risk assessment which leads to the development of a comprehensive mitigation planning strategy for reducing risks to life and property.

Additionally, the mitigation strategy section identifies a range of specific mitigation actions and projects that reduce the risks to new and existing buildings and infrastructure. The mitigation strategy also includes an action plan describing how identified mitigation activities will be prioritized, implemented, and administered.

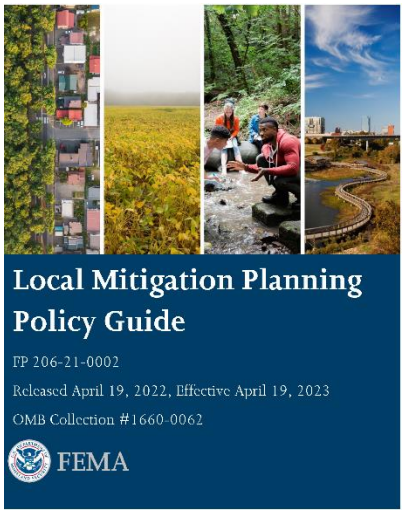
The mitigation plan belongs to the local community. While FEMA has the authority to approve plans for local governments to apply for mitigation project funding, there is no required format for the plan's organization. The following guiding principles informed this plan update.

Focus on the mitigation strategy - The mitigation strategy is the Plan's primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions. A total of sixty-three (63) mitigation actions were developed for this plan update. These action items were identified and prioritized during this plan update and are included in Chapter 13 Capability Assessment & New Mitigation Actions.

Process is as important as the Plan itself - In mitigation planning, as with most other planning efforts, the Plan is only as good as the process and people involved in its development. The Plan should serve as the written record, or documentation of the planning process. In addition to the plan document, a project webpage was developed on the County's website. Content was added to the project website throughout the plan update process. The website served as a hub for public outreach materials, initiatives, and meeting information. Social media was used throughout the plan update process to direct people to the project website, online public survey, and outreach events.

This is our community's Plan - To have value, the plan represents the current needs and values of the community and is useful for local officials and stakeholders serving our community's purpose and people.

Smith Planning and Design, LLC (SP&D), completed a comprehensive review and update of the 2019 Caroline County Hazard Mitigation Plan Update, resulting in a FEMA approved Hazard Mitigation Plan that met the provisions of the Disaster Mitigation Act of 2000. This plan update included a complete plan review process with associated revisions to reflect changes in development, progress in local mitigation efforts, and changes in priorities. In addition, the most current information based on hazard events was incorporated. Finally, integration of related planning documents and data was completed during the update process, including but not limited to, Caroline County Comprehensive Plan, Zoning Ordinance Updates, Emergency Operations Plan, and 2020 U.S. Census Data. In addition, integration of social equity and vulnerability as well as updated climate change information, was prioritized in the Plan Update. The scope of work followed FEMA's Local Mitigation Planning Policy Guide effective April 19, 2023.



Required elements of the local mitigation plan were updated during this planning process and include:

Element A: Planning Process.
Element B: Hazard Identification and Risk Assessment.
Element C: Mitigation Strategy
Element D: Plan Maintenance.
Element E: Plan Update.
Element F: Plan Adoption.
Element G: High Hazard Potential Dams (required for HHPD Grant Program).

Note: FEMA does not require any specific format for the plan or its content, and recognizes that many variations and types of documentation, such as narratives, tables, lists, maps, etc., may meet a requirement. SP&D used various types of documentation throughout the Plan update to meet these requirements.

Planning Process & Preparation

The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages and improve resiliency. The **six phases of the planning process** are essential to the successful update of the Hazard Mitigation Plan.

Figure 1-1: Planning Process

Phase 1- Establish a Planning Team

Hazard Mitigation Planning Committee

In compliance with hazard mitigation planning requirements, extensive public participation was sought and encouraged throughout the mitigation plan update process. As in the past, a Hazard Mitigation Planning Committee (HMPC) was assembled to inform the Plan update. The HMPC included representation from the following sectors:

- Emergency management
- Economic development
- Land use and development
- Housing
- Health and social services
- Infrastructure (including transportation and other community lifelines)
- Natural and cultural resources
- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy
- Communications
- Transportation
- Hazardous Material

As the initial step in the hazard mitigation plan update process, Caroline County organized their resources and ensured that they had adequate technical assistance and expertise to form a hazard mitigation committee. The committee included representatives from key County departments such as Planning & Codes Administration, Emergency Services, Geographic Information System (GIS) mapping, Public Works, Social Services, Health Department, Recreation and Parks, Soil Conservation, and representatives from all the municipalities. In addition, the Caroline County Department of Emergency Service served as the lead agency for the Plan Update and Smith Planning and Design (SP&D) provided technical support. Thus, the Hazard Mitigation Planning Committee (HMPC) was tasked with completing the Plan update. The committee was formed in June 2023 and a series of regular HMPC meetings resulted in the development of an effective and current countywide Hazard Mitigation Plan. The Hazard Planning Committee (HMPC) was tasked with completing the Plan update. The following listing on Table 1-1 includes the members of the committee and the agencies they represent.

Table 1-1: Caroline County Hazard Mitigation Planning Committee

County Representatives						
Name	**Position**	**Agency**	**Attended Meeting 1**	**Attended Meeting 2**	**Attended Workshop**	**Received Invites, Notes, Draft Chapters**
*Mark Sheridan	Director	Emergency Services		X	X	X
Doug Jones	Division Chief	DES-Emergency Management		X	X	X
Samuel Grant	Division Chief	DES-Emergency Management, LEPC	X			X
Daniel Fox	Director/Deputy County Administrator	Finance				X
Matt Kaczynski	Floodplain Manager	Planning and Codes			X	X
Leslie Grunden	Assistant Director	Planning and Codes	X	X	X	X
Megan Gallagher	GIS and Data Coordinator	Planning and Codes		X		X
Jamie Beechey	Director	Recreation and Parks				X
Ryan White	Director	Public Works	X	X		X
Bryan North	Roads	Public Works			X	X
Kelli Schanken	Office Manager	Emergency Services	X			X
Jeremy Goldman	County Administrator	Caroline County				X
Crystal Dadds	Director	Planning and Codes				X
Kathleen Freeman	County Administrator	Caroline County				X
Donald Baker	Sheriff	CCSO		X		X
James A. Henning	Captain	CCSO				X
Don Reed	Computer Network Specialist II	Information Technology				X
Jason Collins	Computer Network Lead	Information Technology				X
Municipal Representatives						
Name	**Position**	**Agency**	**Attended Meeting 1**	**Attended Meeting 2**	**Attended Workshop**	**Received Invites, Notes, Draft Chapters**
Tammy Kelledes	Town Manager	Town of Greensboro	X			X
Helen Knotts	Mayor	Town of Templeville				X
Cindy Burns	Circuit Rider Town Manager	Town of Templeville				X
Stanley Wilcox	Mayor	Town of Marydel				X
Lawrence DiRe	Town Manager	Town of Federalsburg				X
Kristy L. Marshall	Town Manager	Town of Federalsburg				X
Scott Getchell	Town Manager	Town of Denton			X	X
Mark Chandler	Director	Denton Public Works	X	X	X	X
Stephanie Berkey	Clerk	Town of Ridgely				X
Sandy Cook	Mayor	Town of Henderson				X

Name	Position	Agency	Attended Meeting 1	Attended Meeting 2	Attended Workshop	Received Invites, Notes, Draft Chapters
Jamie Yeager	Mayor	Town of Goldsboro				X
Amber Korell	Town Manager	Town of Preston, LEPC	X			X
Sandra Higdon	Commissioner	Town of Hillsboro				X
Sally Campbell	Town Commission President	Town of Hillsboro				X
Ross Benincasa	Town Commission President	Town of Hillsboro				X
Jeannette DeLude	Circuit Rider	Henderson, Marydel & Goldsboro	X			X
State Representatives						
Name	**Position**	**Agency**	**Attended Meeting 1**	**Attended Meeting 2**	**Attended Workshop**	**Received Invites, Notes, Draft Chapters**
Tina Kintop	Public Health Emergency Planner	Health Department				X
Heather Grove	Public Health Emergency Planner	Health Department			X	X
Kristin A. Dietz	Deputy Health Officer	Health Department, LEPC	X		X	X
Bill Hildebrand	MDEM Eastern Shore Liaison	MDEM				X
Shari Blades	Director	Social Services				X
Katie Pedersen	Assistant Director/Emergency Mgmt.	Social Services				X
Trish Chapman		Maryland Department of Health				X
Joshua L. Parker	Director of Environmental Health	Maryland Department of Health			X	X
Additional Representatives						
Name	**Position**	**Agency**	**Attended Meeting 1**	**Attended Meeting 2**	**Attended Workshop**	**Received Invites, Notes, Draft Chapters**
Eric Helm Buehl	Regional Watershed Restoration Specialist	University of Maryland Extension	X		X	X
Michael (Rico) Gestole		Caroline County Public Schools				X
Jeffrey Baggett	Disaster Program Manager	American Red Cross	X			X
Renee Stephens		Delmarva Power				X
Matthew Teffeau		Choptank Electric Cooperative			X	X
John Shepard		Soil Conservation District				X

Source: 2023 Hazard Mitigation Planning Committee

The HMPC was actively involved in reviewing previously identified hazards within the communities identified in the 2019 Caroline County Hazard Mitigation Plan and in the review of the new hazard data gathered during the Plan update process. Hazard data coupled with local knowledge from various committee members was utilized to assess the County's vulnerability to hazards. Following this assessment, the Committee reviewed the status of the 2019 Mitigation Strategies recommendations to reduce and prevent potential damage from these

hazards. Following the Mitigation Strategies review, the HMPC then worked together to update, review, and select the most appropriate and feasible mitigation measures to address the County's hazards for the 2024 Hazard Mitigation Plan update.

A series of meetings were held throughout the Plan update development process. SP&D staff met with key Emergency Services staff members to develop project schedules, obtain data, and review progress. Three (3) HMPC meetings were held, as well as a small group topical meeting for Social Equity. Note, all HMPC members were invited to attend the meetings and all members received meeting notes.

Table 1-2: Hazard Mitigation Planning Committee Meetings

HMPC Meetings	
HMPC Kickoff Meeting	**July 19, 2023** The first meeting was introductory in nature, to explain the overall process being used in developing the plan. This meeting also allowed planning team members an opportunity to review hazards and their impacts to the County. Discussion also included members role, the Municipal & Public Surveys, as well as the Project Website.
HMPC Midpoint Meeting	**September 18, 2023** Members review the Mitigation Status Update, HIRA Results, and Public Survey Result. Members then participated in the Capability Assessment Work Session.
Mitigation Workshop	**January 25, 2024** Members review mitigation action items to determine if they should be included and/ or modified for inclusion in the plan.

In addition to attending meetings, HMPC members received plan update information, draft plan chapters, and surveys throughout the planning process.

Table 1-3: Hazard Mitigation Planning Committee Communications

Date	Types of Communications
July 24, 2023	Kickoff Meeting Notes & PowerPoint
July 24, 2023	HMPC & Municipal Surveys
July 24, 2023	Link to Project Website
July 31, 2023 & August 15, 2023	Utility Outage Data Request
August 14, 2023	GIS Data Coordination
August 14, 2023	Draft Chapters Review
August 21, 2023	2019 Mitigation Action Status Update Form
September 1, 2023	Draft Chapter Review
September 8, 2023	Draft Chapter Review
September 13, 2023	Draft Chapter Review
September 20, 2023	Draft FEMA NFIP Questionnaire
September 21, 2023	Midpoint Meeting Notes & PowerPoint
September 26, 2023	Draft Chapters Review
November 27, 2023	Draft Chapter Review
November 27, 2023	Draft Chapter Review
November 30, 2023	Draft Goals and Objectives
January 16, 2024	Draft Chapter Review
February 14, 2024	Mitigation Action Prioritization Survey
March 5, 2024	Mitigation Workshop Notes
March 27, 2024	Cohesive Draft Chapter

HMPC meeting notes were uploaded on the Department of Emergency Services website under the Hazard Mitigation table following each meeting for public review and are included in Appendix B HMPC Meeting Notes & Municipal Participation Documentation.

Social Equity Meeting

In addition to HMPC meetings, a small group topical meeting was held during the planning process. This topical meeting focused on social equity.

Table 1-4: Small Group Meeting

Small Group Meeting	
Social Equity Meeting	**January 18, 2024** Discussion for integration of social equity into the hazard mitigation plan update.

NFIP Coordination

In addition, SP&D coordinated with the Floodplain Manager to complete the FEMA Region 3 Hazard Mitigation Plan Guidance Checking in on the National Flood Insurance Program (NFIP) – Community Worksheets. The completed worksheets demonstrate the county's capabilities related to floodplain identification and mapping, floodplain management, and flood insurance and are included in Chapter 13 beginning on page 13-18.

- NFIP Community Worksheets Coordination occurred on September 20, 2023, October 25, 2023, and November 27, 2023

Note, the County administers and enforces the floodplain management for unincorporated areas of the County. To be a part of the NFIP, each local community has to join the program and administer the minimum NFIP regulations; however, the State of Maryland requires that each jurisdiction must follow the State Model Ordinance at a minimum, which is more restrictive than the NFIP regulations outlined in the Code of Federal Regulations.

Municipal Coordination

The ten (10) county municipalities, which all participated in the previous planning process, were invited again to participate in the updated planning process and have their mitigation concerns made part of the County Plan. These municipalities include the Towns of Denton, Federalsburg, Goldsboro, Greensboro, Henderson, Hillsboro, Marydel, Preston, Ridgely, and Templeville. Data collection and municipal input was sought throughout the plan update process. Municipalities were invited to all HMPC meetings and municipal outreach materials, including the municipal survey, were distributed to all municipalities. In addition, all municipalities received meeting notes and draft chapters for review and comment. Direct emailing and phone calls were also conducted throughout the process to municipalities to obtain necessary information.

Municipal hazard rankings, capabilities, municipal level data and perspective were obtained from the municipal survey, Appendix B. Mitigation status updates on the 2019 action items were obtained from the Mitigation Action Status Update form as well as direct email, when necessary. This participation culminated into municipal mitigation action items and projects. Plan elements and working draft chapters were distributed to the municipal representatives for review throughout the plan update process. Upon completion of all plan chapters, a cohesive draft Plan was distributed for final review and comment by municipal representatives in March of 2024.

Municipal representatives participated in at least 4, if not more, plan update activities including providing review comments on draft plan chapters. Examples of municipal plan update activities are below. Appendix B includes municipal input.

Table 1-5: Municipal Participation Activities

Documentation of Municipal Plan Update Activities				
Municipality	**Documentation Example #1**	**Documentation Example #2**	**Documentation Example #3**	**Documentation Example #4**
Denton	Attended Meetings 1, 2 Mitigation Workshop– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6
Federalsburg	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2023 & 9/14/2023: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6	Phone Calls & Emails – 1/16/2024 & 2/7/2024 Mitigation Action Items

Municipality	Documentation Example #1	Documentation Example #2	Documentation Example #3	Documentation Example #4
Goldsboro	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Shared Public Survey on social media – 8/29/2023	Email 2/6/2024: Mitigation Action Items
Greensboro	Attended Meeting 1, Mitigation Workshop– Appendix B	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Provided Repetitive Flooded Roadway Information – Chapter 6
Henderson	Attended Meeting 1– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 12/4/2023: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Email 2/6/2024: Mitigation Action Items
Hillsboro	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2023 and 2/20/2024: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Phone Call 2/7/2024: Mitigation Action Items	Email 2/20/2024: Mitigation Action Items
Marydel	Attended Meeting 1– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Email 8/21.2023: Mitigation Action Items
Preston	Attended Meeting 1– Appendix B Email 8/28/2023: Mitigation Actions	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Shared Public Survey on social media & Email to Residents – 8/28/2023
Ridgely	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6	Email 2/20/2024: Mitigation Action Items
Templeville	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2024, 12/4/2024 1/16/2024: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Phone Call & Email 1/16/2024: Mitigation Action Items	Email 1/19/2024: Mitigation Action Items

Regional Coordination

Caroline County participated in various regional planning meetings throughout the planning process which provided key information that assisted with the hazard mitigation plan update, specifically with mitigation strategies. The Caroline County Department of Emergency Services actively participates on the Delmarva Emergency Task Force (DETF). This task force works to ensure that all jurisdictions on the Delmarva peninsula are prepared for hazards, including natural disasters, such as hurricanes, tropical storms, and nor'easters; and man-made disasters involving weapons of mass destruction, or chemical and biological agents. State, county, and municipal emergency management personnel from all of Delaware, Maryland's nine Eastern Shore counties, and the two Virginia counties on the peninsula plan together for a coordinated regional response, including effective communications, resource sharing, shelter and evacuation strategies, and recovery plans. The Eastern Shore counites that participated include Caroline, Dorchester, Kent, Queen Anne's, Somerset, and Worcester counties. The Caroline County Department of Emergency Services attended these meetings and provided an update on the hazard mitigation plan on the following dates: July 19, 2023, and October 18, 2023.

In addition, the Maryland Department of Emergency Management (MDEM) Winter Retreat for all Emergency Services personnel in Maryland. Mark Sheridan, Director of Caroline County's Department of Emergency Services attended MDEM's Winter Retreat at Rocky Gap Casino, Resort & Golf in Flintstone on November 14-15, 2023, and provided a status update on the hazard mitigation plan.

Finally, the Regional Liaison Officer Program supports MDEM's Preparedness and Response goals in addition to their existing operational responsibilities, the program maximizes effectiveness in helping to create a more

resilient Maryland through a network of support for and communication with local jurisdictions. William Hildebrand, Eastern Shore Regional Liaison Officer, releases quarterly reports to Eastern Shore counties.

- MEMA Regional Liaison Officer Report contains information on the Caroline County Hazard Mitigation Plan update process included in Appendix B.
    - March 2023
    - November 2023

Data Collection

The development of the mitigation plan update began with data collection. A project kick-off meeting was held on June 6, 2023, with the Project Manager, and July 19, 2023, with the Hazard Mitigation Planning Committee (HMPC). For HMPC member's reference, hazards previously identified and profiled in the 2019 Plan were reviewed. To obtain a local hazard risk perspective for the update, the HMPC were asked to complete a Local Community Hazard Risk Perspective Survey. Furthermore, to obtain information on municipal related to plans, policies, and projects, a municipal online survey was distributed to all municipalities. The survey requested municipal hazard risk perspective, mitigation action status, current capabilities, and possible new mitigation actions to be included in the Plan update.

Immediately following the kick-off meeting, policy, and regulatory information from each of the communities and the County was collected. This included comprehensive plans including the water resources elements, land use elements, priority preservations elements, zoning ordinances, development ordinances, building codes, and other relevant documents.

Information was collected from the Health Department, Public Works, Emergency Services, and Planning & Codes Administration, Social Services. Also, data and information from several State and Federal agencies were collected including, but not limited to, the Maryland Department of Emergency Management, Maryland Department of Natural Resources, the Federal Emergency Management Agency, Maryland Department of the Environment, and U.S. Army Corps of Engineers.

Phase 2- Develop a Risk Assessment

The next step in the planning process was to identify and profile hazards and assess the County's vulnerability to these hazards. This process involved the HMPC to analyze the County's greatest hazard threats and determine its most significant vulnerabilities. A Hazard Identification Risk Assessment (HIRA) was completed for Caroline County, Maryland. Results from the Hazard Risk Survey completed by HMPC members were integrated into the updated HIRA.

Thirteen (13) natural hazards were identified, and a hazard risk was assigned to each. Only natural hazards are included in this assessment as they lend themselves better to data collection related to geographic extent. FEMA requires natural hazards be identified and assessed. To assess the hazard risk for the thirteen (13) natural hazards identified in this Plan update a composite score method was undertaken. The composite score method was based on a blend of quantitative and qualitative factors extracted from the National Centers for Environmental Information (NCEI), stakeholder survey, and other available data sources.

These included:

- Historical impacts, in terms of human lives and property
- Geographic extent
- Historical occurrence
- Future probability
- Community perspective

Hazard Rankings were determined using a composite score method which included variables such as: (1) injuries, (2) deaths, (3) property damage, (4) crop damage, (5) geographic extent, (6) total annualized events,

(7) future probability, and (8) community perspective. To compute the HIRA composite score for each hazard the following equation is used.

Equation: Composite Score = IN + DT + PD + CD + (GE*1.5) + EV + FP + (CP*1.5)

HIRA results and methodology have been included in Chapter 3 Hazard Identification & Risk Assessment.

Note, Epidemic was changed to Emerging Infectious Disease and is now a new standalone chapter in the Plan update. Furthermore, Dam Failure is a newly identified hazard, and therefore a new chapter was developed to address this hazard.

The Hazard Identification and Vulnerability Assessment was performed in large part using GIS data from County and State sources. Updated hazard event data was added including the National Centers for Environmental Information data, local storm event data, federal and state disaster declarations, and potential future risks. Chapter 3 Hazard Identification and Risk Assessment provides hazard perspectives for the following:

- Hazard Mitigation Planning Committee (HMPC) Perspective – Members Surveyed (Table 3.1)
- Municipal Perspective – Municipalities Surveyed (Table 3.2)
- State Perspective – State of Maryland 2021 Hazard Mitigation Plan (Table 3.3)
- National Perspective – National Risk Index (Table 3.4)

The chapter also provides probability of future events and hazard event data tables.

The update of the HIRA also provided vulnerability analysis text for each identified hazard along with new mapping products. Each hazard identified includes a vulnerability assessment comprised of discussion, data utilization, method, analysis, and assessment results. The probability of future events, along with social equity and vulnerability information was added.

In addition, a description of which assets, including structures, systems, populations, and other assets identified to be hazard prone, are at risk from the effects of the identified hazard(s) was included.

Assets identified for this plan update included:

- People (including underserved communities and socially vulnerable populations).
- Structures (including facilities, lifelines, and critical infrastructure).
- Systems (including networks and capabilities).
- Natural, historic, and cultural resources.

Along with the identification of hazard-prone community assets, the potential impacts on each participating jurisdiction and its identified assets, was updated. Impacts include the effects of climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development.

Finally, the Plan update addressed repetitively flooded NFIP-insured structures by including the estimated numbers and types (residential, commercial, institutional, etc.) of repetitive/severe repetitive loss properties. This is included in Chapter 4 and mitigation actions to address repetitive loss properties is in Chapter 13.

Phase 3- Develop a Capability Assessment

Policy and regulatory information from each of the communities and the County was collected. This included comprehensive plans including the water resources elements and municipal growth elements, as well as zoning ordinances, development ordinances, and building codes and other relevant documents.

Information was collected from public works, planning, emergency management, and GIS departments. Additionally, information from each municipality was requested: Hazard Risk Survey, Capabilities, and Local

Repetitive Flood Locations. Furthermore, data and information from several State and Federal agencies was obtained including, but not limited to, the Maryland Department of Emergency Management, Maryland Department of Natural Resources, the Federal Emergency Management Agency, Maryland Department of the Environment, and the U.S. Army Corps of Engineers.

Chapter 13 Capability Assessment and New Mitigation Actions includes the results from data collection efforts conducted during this Plan update for both the County and its municipalities.

New development trends related to hazard mitigation planning and current capabilities that have been added during the five-year planning cycle have been included in the Plan. Additional information on development trends is included in Chapter 2 County Profile. The capabilities assessment update highlighted current capabilities and identified any gaps. Also, new risk reduction activities completed by various departments, agencies, and organizations that occurred during the past planning cycle was integrated into Chapter 13.

Phase 4- Finalize Mitigation Strategy

To update the status of mitigation actions and projects identified in the previous plan, the HMPC was provided with a fillable form for completion. The information gathered resulted in Chapter 12 2019 Mitigation Action Status.

Figure 1-2: Sample Mitigation Action Status Update Form

Table 12-1: 2019 Mitigation Actions Status Updates

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
Prevention			
1	The NFIP requires structures built within the floodplain to have first floor elevations determined. The County's GIS department could partner with building inspectors/permit administrators to maintain a database of new structures with their first-floor elevations. These elevations can be used with forecasting software such as HAZUS to predict vulnerable structures during a specific hazard event. Currently, Caroline County uses the State's open-source data and HAZUS data has not been utilized.	Planning & Codes	Flood
	Complete Cancelled Delayed (•) Ongoing		
	2023 Status Update: **DPC-Floodplain Coordinator:** Elevation certificates are a requirement for determining whether a structure is built in accordance with the elevation requirements; however, we have not incorporated this elevation information into our GIS data.		
2	Utilizing FEMA's Flood Mitigation Assistance Program create a Flood Mitigation Plan for the County. This plan will assist the county in obtaining Floodplain Management planning points for the NFIP Community Rating System, thereby lowering flood insurance premiums for homeowners.	Emergency Services, Planning & Codes	Flood
	Complete Cancelled (•) Delayed Ongoing		
	2023 Status Update: **DES:** Nuisance Flood Plan was created in July 2020. The NFIP Rating System was not created due to COVID and personnel changes within the county. We will address additional updates and changes that need to be made. **DPC-Floodplain Coordinator:** A Flood Mitigation Plan has not been established; however, this would still be an action we would like to use for future CRS credits.		

Results indicated that seven (7) mitigation actions are "completed," two (2) mitigation action item was "cancelled," fourteen (14) mitigation actions are "delayed," and twenty-four (24) action items are "ongoing." New mitigation action items were developed from this assessment during the plan update process. Additionally, mitigation action items were carried over from the 2019 HMP. A total of sixty-three (63) mitigation action items have been included in the Plan update.

Thereafter, SP&D assisted the HMPC in the update of 2024-2029 Mitigation and Community Resilience Actions to include goals, objectives, and prioritized mitigation action items. A Mitigation Workshop was held on January 25, 2024. During the Workshop, HMPC members were divided into small groups based on four (4) mitigation action categories. Each of the four (4) groups reviewed actions carried over from the 2019 HMP and new mitigation and community resilience ideas developed for this update. At the end of the process, HMPC members identified sixty-three (63) mitigation and community resilience actions for inclusion in the Plan. In addition, Mitigation Workshop participants were asked to identify mitigation and community resilience actions that resonated the most with them and/or had a high likelihood of completion. While there were sixty-three (63) total mitigation and community resilience actions chosen for inclusion in the Plan update, twelve (12) of those were identified for further prioritization.

An online survey was provided to all HMPC members and municipal representatives for prioritizing the twelve (12) mitigation and community resilience actions. The basis for this survey is the STAPLEE evaluation method, which uses standard criteria for evaluation: Social, Technical, Administrative, Political, Legal, Economic, and Environmental, however this evaluation was modified to a user-friendly online survey facilitating participation. As a result of the prioritization survey, five (5) mitigation and community resilience action items were rated as "high" priority, five (5) action items were rated "medium," while the remaining two (2) mitigation action items were rated "low."

Phase 5- Review of Plan and Plan Revisions

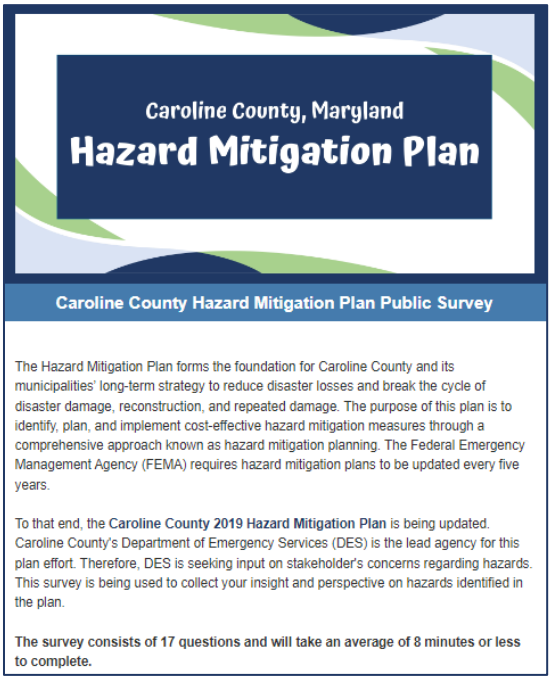
The Plan was assembled, and a cohesive draft document resulted. Each of the natural hazards identified in the Plan was updated and sent to HMPC members for review. Data, text, vulnerability assessments, and mapping

were updated with the best available data. Two (2) new chapters (bold blue text) were developed for the Plan update.

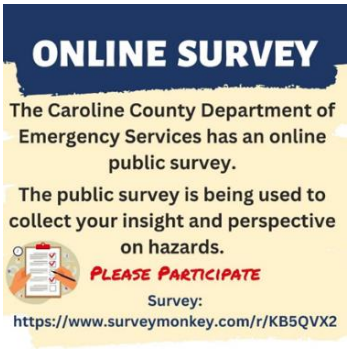
- Chapter 4 Flooding
- Chapter 5 Hurricane
- Chapter 6 Shoreline Erosion & Sea Level Rise
- Chapter 7 Winter Storm
- Chapter 8 Drought & Excessive Heat
- Chapter 9 Severe Weather
- **Chapter 10 Emerging Infectious Diseases**
- **Chapter 11 Dam Failure**

Public Involvement

A press release was featured in the Star Democrat on July 12, 2023 informing the public of the Plan and how to participate in the planning process. The webpage developed for the Plan and an online survey were included in the article. The public online survey was available on the Department of Emergency Management's website and offered throughout the plan update process. The survey focused on the thirteen (13) hazards identified for the Plan update.



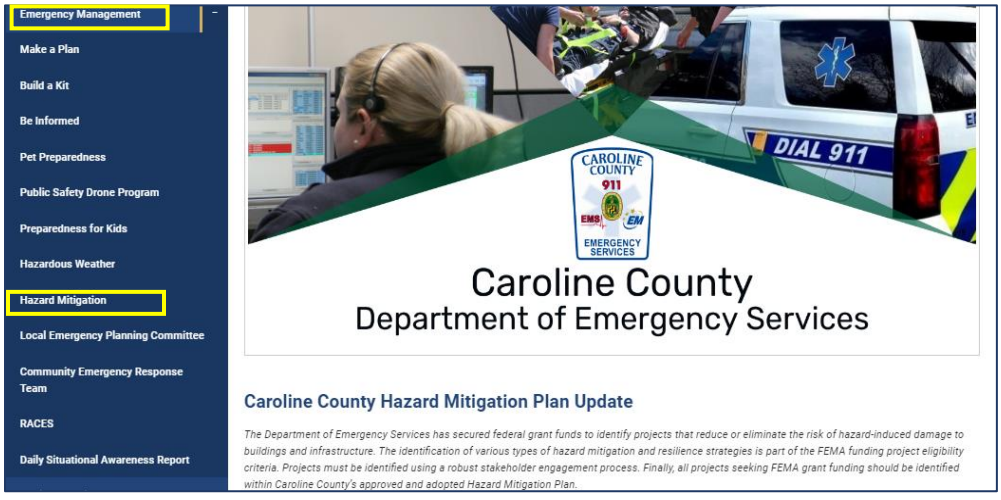
The survey was used to collect the public's insight and perspective on hazards identified in the Plan. Survey results were integrated into each hazard plan chapter and are included in Appendix C Public Outreach Documentation & Survey Results.



Various social media postings were launched throughout the plan update process to encourage public participation. HMPC members were encouraged to post links to the project website and survey on their social media outlets.

To reach socially vulnerable populations, the Department of Social Services and Caroline County Health Department distributed the public survey through their websites and social media platforms. The Health Department indicated that the population with a language barrier has increase in the County. These citizens are utilizing the Health Department more frequently and therefore, their social media posts assisted in providing outreach to these populations.

Working draft plan chapters were available for public review as they were developed on the Caroline County's Department of Emergency Management's webpage under the "Reports and Plans" section. Additional information about hazard mitigation is located under the "Hazard Mitigation" tab.



Caroline County Hazard Mitigation Plan Update
PUBLIC REVIEW & COMMENT FORM

Caroline County has released **WORKING DRAFT** hazard chapters for public review and comment. These hazard chapters are part of the Caroline County 2023 Hazard Mitigation Plan Update. The draft hazard chapters are on the project website: https://www.carolinemd.org/659/Hazard-Mitigation.

By providing valuable written comments in the following format, it allows every comment received to be entered into our comment tracking database, reviewed for inclusion, researched for recommendations, and presented collectively for consideration in the final draft of this plan update.

Please be specific in your comments and provide detailed recommendations to ensure accuracy during our review for consideration. Comments supplied via the following form should be emailed to Michele King, mking@smithp-d.com (if you prefer to mail your written comments, please send a request via email). Thank you for your feedback.

Name: _____

Address: _____

Email: _____

Organization/Affiliation: _____

During the January 16, 2024, Caroline County Commissioners meeting, Mark Sheridan, Department of Emergency Services Director, presented the 2024 Caroline County Hazard Mitigation Plan Update. Mr. Sheridan indicated that the Plan was made available for public review and comment on the Caroline County Department of Emergency Services website.

Additionally, aside from press release distributed in the local newspaper, The Star Democrat, the public was informed about the plan development and process through social media, Facebook (Appendix C).

The formal adoption process included public meetings on ?? and additional a final public review and comment period.

Figure 1-3: Public Outreach

Caroline County Hazard Mitigation Planning, Training, and Outreach Initiatives				
Date	**Meeting, Training, or Outreach Activity**	**Target Audience**	**Materials Provided**	**Comments/Input**
3-Jul-23	Social Media Post on Facebook	Public	Public Survey	Emergency Services and Caroline County Government posted the website link on their Facebook and Instagram pages.
5-Jul-23	Website Content	HMPC & Public	Hazard Mitigation Specific Content	Hazard miitgaiton plan information, public survey link, social media links, and contact information provided.
12-Jul-23	Press Release for Star Democrat	Public	Project Website & Public Survey	Notice about the Hazard Mitigation Plan Update and provided the project website and public survey link.
27-Jul-23	Website Content	HMPC & Public	Kickoff Meeting Notes	Notes discussing the kickoff meeting, surveys and social media posts.
23-Aug-23	Social Media Post	Public	Public Survey	HMPC members were requested to post the public survey link on their social media.
23-Aug-23	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook and Instagram pages.
24-Aug-23	Social Media Post on Facebook	Public	Public Survey	Maryland Department of Health posted the public survey link on their Facebook page.
28-Aug-23	Social Media Post & Residential Email	Public	Public Survey	The Town of Preston posted the public survey link on their Facebook page and did an email blast to residents.
29-Aug-23	Social Media Post	Public	Public Survey	Town of Goldsboro posted the public survey link on their social media pages.
14-Nov-23	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook and Instagram pages.
4-Dec-23	Website Content	Public	Draft Chapters	Chapters for public review and comment on the Hazard Mitigation Webpage. Comment form provided for comments.
22-Jan-24	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook page.
23-Jan-24	Social Media Post	Public	Public Survey	Caroline County Health Department posted the public survey link on their Facebook and website homepage.
29-Jan-24	Social Media Post	Public	Public Survey	The Department of Social Services posted the public survey link on their Facebook page.

Agency Review

The Maryland Department of Emergency Management (MDEM) served as the State review agency. In addition, the following agencies and organizations also received a draft of the Plan for review and comment:

- Maryland Department of Health

- University of Maryland Extension
- American Red Cross
- Soil Conservation District

Once the Plan was reviewed by the HMPC and agencies/organizations listed above, the 2024 Plan was submitted to the Maryland Department of Emergency Management (MDEM) MEMA for initial review and coordination.

MDEM reviewed the Plan in June and July 2024. All revisions made were based on review comments and resubmitted to MDEM. Following approval of the modifications, MDEM submitted the Plan to the Federal Emergency Management Agency (FEMA) for formal review and approval. FEMA is responsible for the final review and approval of the 2024 Plan. Once FEMA approved the Plan, the County received an Approvable Pending Adoption (APA) letter. At that time, the County and municipalities proceeded with adopting the 2024 Hazard Mitigation Plan Update.

Phase 6- Plan Maintenance and Updates

To maintain the Plan, the hazard mitigation plan must be revisited at regular intervals to keep it relevant and to tract progress of mitigation strategies. The Plan update discussed how the Department of Emergency Services will continue to seek public participation after the Plan has been approved and during the Plan's implementation, monitoring, and evaluation.

Chapter 14 Plan Maintenance and Implementation describes the annual update of the Plan and continued public involvement. Annual status reports will be completed on the progress of various mitigation activities. Copies of these status reports will be made available to the public.

Changes in Community Priorities – HIRA to Mitigation Actions

Hazard risk ranking results for this planning cycle indicated that riverine flooding, drought, excessive heat, and thunderstorms were the highest risk hazards to Caroline County, shown on Table 3-9. As such, new and updated mitigation action items were developed and reviewed reflective of these results and changes in community priorities. In fact, thirty-nine (39) of the sixty-three (63) mitigation actions address one or more of these high-risk hazards. Finally, two (2) new hazards, which reflect changes in community priorities, were added during this plan update and include Dam Failure and Emerging Infectious Diseases. New mitigation action items were added to the Plan update for both of these hazards.

Updates to Plan Integration

The plan further describes from that included in the 2019 Plan Caroline County's focus on plan integration. The Hazard Mitigation Plan Guidance: Community Capability Assessment Worksheets, which includes planning and regulatory capabilities were completed for both the County and its municipalities. Capability gaps were identified and included as mitigation actions in Chapter 13, pages 13-9 and 13-10. An example is the recommendation for hazard mitigation plan integration into the County's Comprehensive Plan update, Caroline 2040, and municipal comprehensive plans. Plan integration mitigation action items were added during this Plan update, Table 13-5: 2024-2029 Mitigation Actions.

Review and Incorporation of Existing Plans, Studies, Reports, and Technical Information

Existing plans, studies, reports, and technical information were included as footnotes and hyperlinks throughout the plan document. Examples, to name a few, include the incorporation of local permit data and the new Guidance for Using Maryland's 2018 Sea Level Rise Projections - June 2022. Additionally, new State of

Maryland and Caroline County specific data was used to update and produce mapping products throughout the plan. Maryland iMaps, which serves as a repository for Maryland data as well as Caroline County's updated data was reviewed to ensure the best available data was used for this plan update and has been incorporated throughout.

Organization of the Plan

The following chapters comprise the 2019 Caroline County Hazard Mitigation Plan. Chapter 2 includes the County Profile, while Chapter 3 details the Hazard Identification and ranking process. Chapters 4-11 comprise the hazards identified by the Hazard Mitigation Planning Committee as Not Concerned, Somewhat Concerned, Concerned, or Very Concerned. Chapter 12 details mitigation action items and projects identified in the 2019 Hazard Mitigation Plan that were reviewed by the Hazard Mitigation Planning Committee (HMPC) and representatives from each of the ten (10) municipalities. Chapter 13 details Caroline County and municipal capabilities, goals and objectives, and new mitigation strategies. Finally, Chapter 14 will have implementation details on how the Plan will be maintained and implemented over the next five-year plan cycle. An appendix includes information from the meetings, questionnaires, and a detailed description of potential project funding sources.

This Plan update included various updates and new plan elements and outreach initiatives.

- Developed a new project webpage and added content continuously over the course of the Plan update process.
- Developed and distributed new hazard risk perspective online public survey.
- Conducted a social media campaign in addition to print media.
- Integrated information from the 2021 State of Maryland Hazard Mitigation Plan.
- Future conditions for each identified hazard were added as a new plan element.
- Social vulnerability was added to each identified hazard as a new plan element.
- Two new hazards were added during this Plan update: Emerging Infectious Disease and Dam Failure.
- New Hazard Identification and Risk Assessment (HIRA) completed for Chapter 3.
- Updates to the critical and public facilities prompted the reassessment of all vulnerability analysis presented in Chapter 2. All mapping products including hazard vulnerability maps were updated.
- Historic structures were identified in Chapter 2 and analyzed in hazard chapters, which is a new plan element.
- Nuisance Flooding is a new section included in Chapter 6 and was designed to satisfy requirements in the Maryland House Bill 1427 (2019), §3-1018(b) and (c).
- Added new capabilities to Chapter 13.
- Added new Region 3 HMP Guidance Checking-In on the NFIP- Community Worksheets.
- New mitigation actions were added to Chapter 13.
- Throughout the course of the planning process, the Planning, Training, and Initiatives table was developed and used to document various planning initiatives.

Chapter 2 County Profile

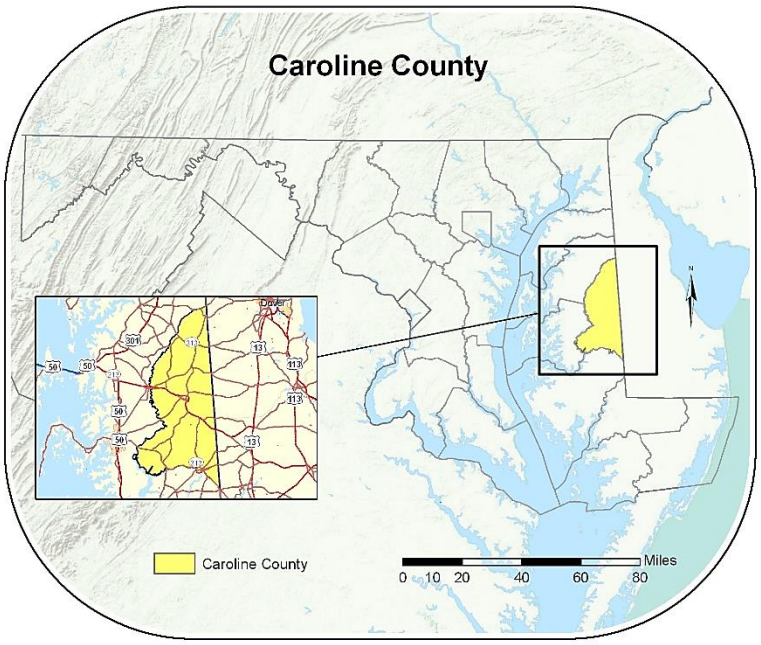
Chapter Updates

- This chapter was expanded to include additional characteristics about the County.
- Climate data has been updated to reflect current conditions. First Street Foundation's Risk Factor provides historic events and current risks, and future projections have also been included in this section.
- The population section was updated with the US Census 2020 data.
- Permit data was updated with the latest building permit information for both the county and municipalities.
- The municipal overview was updated to include floodplain regulations and NFIP participation information.
- The analysis section of Priority Funding Area – Development Patterns was updated to show the PFA polygons in relation to FEMA Special Flood Hazard Area - 1% annual chance flood hazard area and where the intersection occurs.
- Transportation was updated to include MDOT's priority projects, which includes Caroline County.
- New to the chapter are:
    - **Social Equity** which reviews the National Risk Index data, CDC's Social Vulnerability Index, the public's perspective on social vulnerability, and the social equity small group meeting that took place during the plan update.
    - **Critical Facilities** which provide facilities deemed critical and their corresponding community lifeline (where applicable).
    - **Historic Properties** which provide a listing of Maryland's National Register Properties located in Caroline County.

Location

Caroline County is located in the central part of the Eastern Shore and is adjacent to Queen Anne's, Talbot, and Dorchester Counties in Maryland, and Kent and Sussex Counties in Delaware as shown on Map 2-1.

Map 2-1: County Location

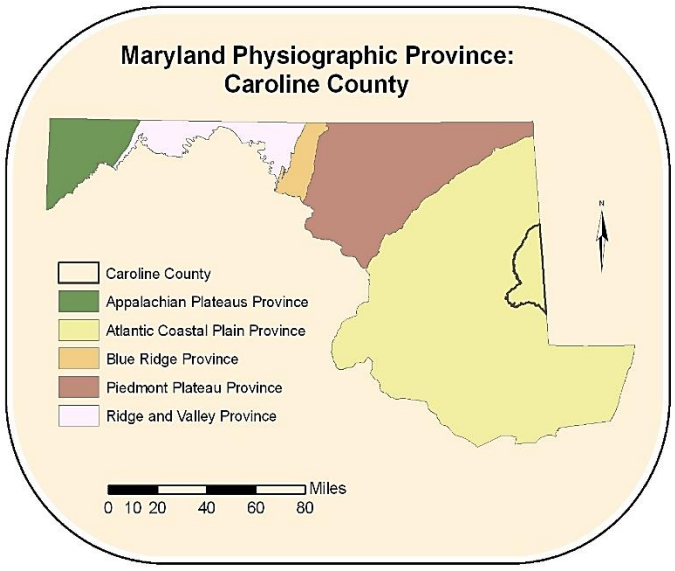


Caroline County was founded in 1773 and was named for Lady Caroline Eden, wife of Robert Eden, Maryland's last Colonial Governor, and daughter of Charles Calvert, 5th Lord Baltimore. Caroline County is one of the smaller counties in Maryland, containing 321 square miles of land. Since the founding of the County, its major industry has been agriculture.

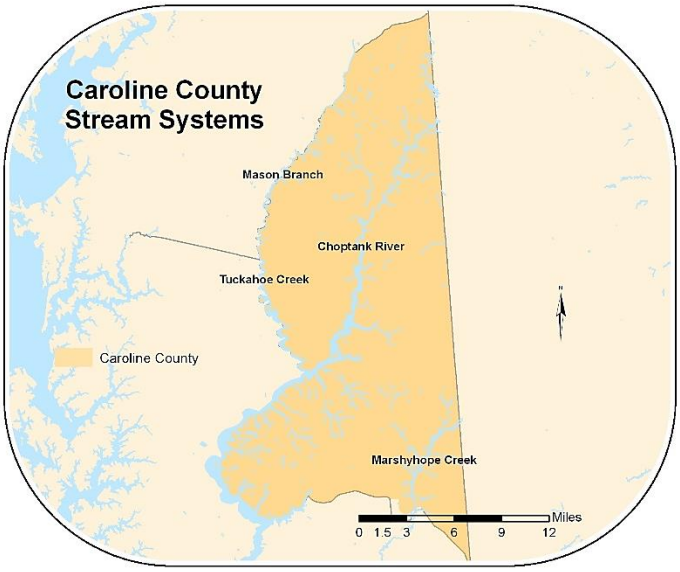
As shown on Map 2-2, Caroline County is located within the Atlantic Coastal Plain Physiographic Province. Mineral resources of this province are mainly composed of sand and gravel, which are used as aggregate material by the construction industry. Plentiful supplies of ground water are available from a number of aquifers throughout much of this region. The Atlantic Continental Shelf contains abundant sand deposits, useful for beach restoration.

The County is situated on the Choptank River and its tributaries, including Tuckahoe Creek, and on the upper stream reaches of Marshyhope Creek, which flows into the Nanticoke River. Stream systems are shown on Map 2-3.

Map 2-2: Provinces



Map 2-3: Stream Systems

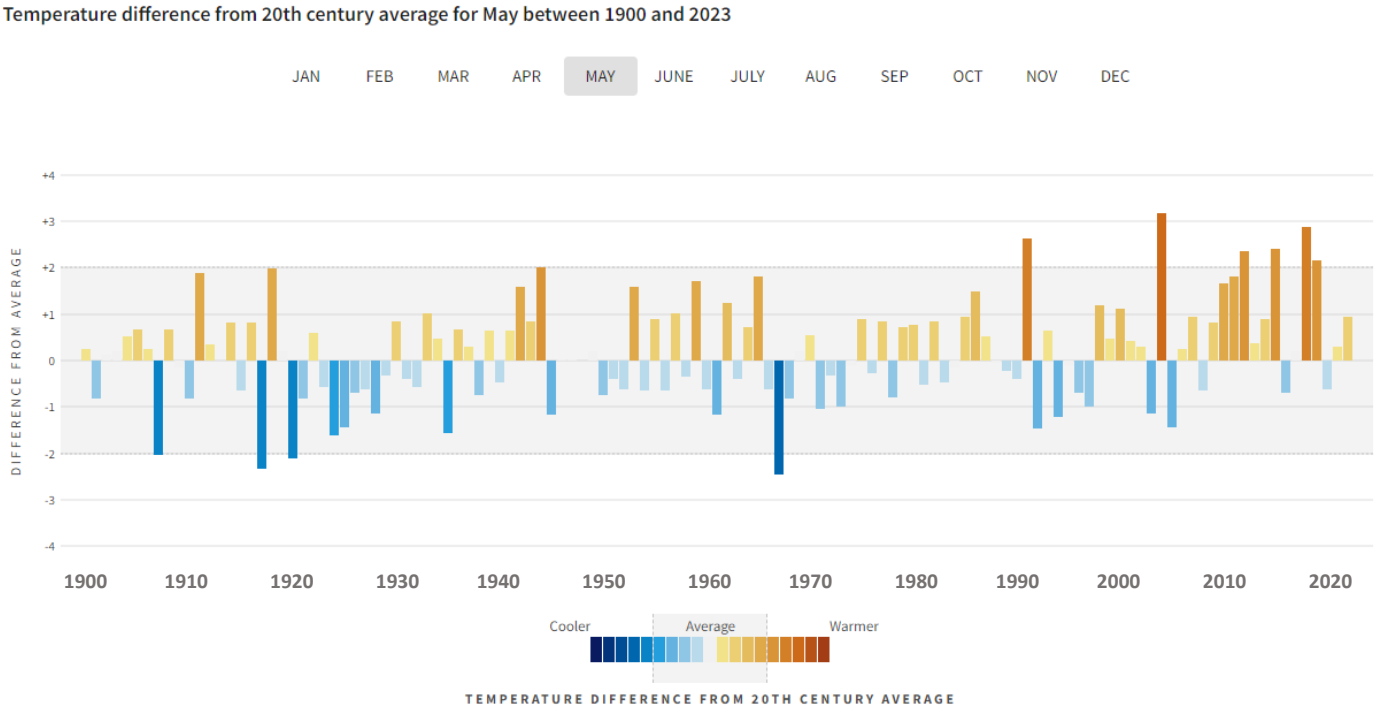


Climate

Caroline County is susceptible to high winds and rain during thunderstorms and some damage due to storm surge and wind during the passage of hurricanes either on or near the Eastern Shore due to its nearly level terrain and low elevation (sea level to approximately 79 feet). The County is also vulnerable to tornados that are occasionally spawned by thunderstorms and hurricanes. The County deals with fog conditions throughout the year, similar to the rest of the Eastern Shore, but much less than in Western Maryland.

Temperatures usually average a few degrees warmer in Caroline County than on the western shore throughout the year. USAFACTS states that in the most recent month, February 2023, the average temperature in Caroline County was 43°F, which is 8°F warmer than average when compared to all Februarys since 1985.[i] Furthermore, the monthly average temperatures have increased by 3.4° F from March 1900 to February 2023. Temperature increases are a result of climate change, which also affects weather patterns, sea level rise, and flooding.[ii]

Figure 2-1: Caroline County Century Average Temperatures



Source: USAFACTS; National Centers for Environmental Information

Caroline County receives an average of 14.2 inches of snow per year. Most of this snow falls during the passage of the occasional mid-latitude winter storm. Due to its nearly level terrain and its proximity to the Atlantic Ocean, Caroline County receives less snowfall on average than counties to the north and west. The following table shows average high and low temperatures and average precipitation for Caroline County.

Table 2-1: Average Temperature and Precipitation by Month

DENTON, MARYLAND: AVERAGE TEMPERATURE (F°) & RAINFALL (in.) BY MONTH												
	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
High Temp	41°	45°	52°	63°	72°	80°	85°	85°	77°	66°	55°	47°
Low Temp	29°	32°	28°	47°	57°	65°	71°	69°	63°	54°	42°	36°
Precipitation	3.4	2.9	3.8	3.5	3.7	3.8	4.4	4.7	3.7	3.3	3.1	3.5

Source: Temperatures: WeatherWX.com – Caroline County, Maryland Climate Averages
Precipitation: USAFACTS - National Centers for Environmental Information, 1900-2023.

First Street Foundation is a non-profit research and technology group dedicated to quantifying and communicating risk by incorporating modeling techniques and analysis.[iii] First Street Foundation's Risk Factor provides historic events, current risks, and future projections based on peer-reviewed research from the world's leading climate modelers. The Risk Factor results for current & future risk in Caroline County are below.

Risk Factor – Caroline County Current & Future Risk

Anticipating Changes in Flood Risk for Caroline County

Deeper floods from major events, like hurricanes, are less likely to occur, but affect more properties than more shallow flood events, like heavy rains. As Caroline County feels the effects of a changing environment, however, events of all kinds will affect more properties within the community.

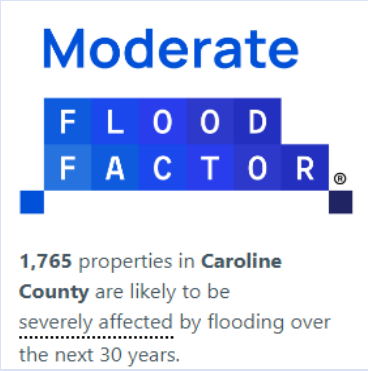
If a low-likelihood storm resulting in severe flooding (a 1-in-100-year flood event), occurred today, it could affect 1,631 properties in Caroline County. This type of event has a 26% chance of occurring at least once over the life of a 30-year mortgage. 30 years from now, an event of this same likelihood would affect 1,765 properties due to a changing environment.

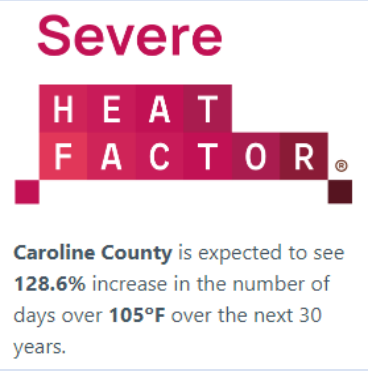
Anticipating Changes in Wind Risk for Caroline County

If an exceedingly rare windstorm (a 1-in-3,000-year storm event) occurred today, it could cause wind gusts of up to 104 mph to reach Caroline County. A hurricane of this severity has a 1% chance of occurring at least once over the next 30 years. In 30 years, an event of this same likelihood would show increased wind gusts of up to 118 mph due to a changing environment.

How many hot days will Caroline County have?

A hot day in Caroline County is considered to be any day above a "feels like" temperature of 105ºF. Caroline County is expected to experience 7 hot days this year. Due to a changing climate, Caroline County will experience 16 days above 105ºF in 30 years.





Source: First Street Foundation's Risk Factor - Caroline County

Population

The 2020 U.S. Census Bureau decennial census indicates a total County population of 33,293. Portions of the County's population that may be more vulnerable to hazards, include:

- Persons 65 years of age and over comprise 16.5% of the total population;
- Households where language other than English is spoken at home, percent of persons 5 year +, 2016-2020, comprise 8% of the population;
- Persons living in poverty comprise 13.1% of the population; and
- Persons living with a disability, under age 65 years, 2016-2020, comprises 8.9% of the county's population.

Caroline County's population growth has mirrored its economic growth. The following table details the U.S. Census Bureau, 2020 population figures for the ten incorporated communities within Caroline County. The municipalities of Denton, Federalsburg, Henderson, and Marydel had a slight increase in population from 2010 to 2020, while the other six (6) municipalities had a minimal decrease. The overall population of Caroline County had an increase of 227 from 2010 to 2020. An emerging trend of note is the increase of 2,414 people in the incorporated areas of the county, while a decrease of 2,187 occurred in the unincorporated areas of the county during the same decade.

Table 2-2: Population Figures

POPULATION						
Municipality	**2000**	**2010**	**2020**	**Rate of Change (2010-2020)**	**Percent of Change (2010-2020)**	**2021 Population Estimates**
Denton	2,960	4,418	4,848	+430	↑ 9.7%	4,712
Federalsburg	2,620	2,739	2,833	+94	↑ 3.4%	2,824
Goldsboro	216	246	211	-35	↓ 14.2%	215
Greensboro	1,632	1,931	1,919	-12	↓ 0.6%	2,590
Henderson	118	146	160	+14	↑ 9.6%	178
Hillsboro	163	161	128	-33	↓ 20.5%	122
Marydel	147	141	176	+35	↑ 24.8%	191
Preston	566	719	673	-46	↓ 6.4%	951
Ridgely	1,352	1,639	1,611	-28	↓1.7%	1,868
Templeville	80	138	113	-25	↓ 18.1%	154
Incorporated	**9,854**	**12,278**	**14,692**	**+2,414**	**↑ 19.7%**	**13,805**
Unincorporated	**19,918**	**20,788**	**18,601**	**-2,187**	**↓ -10.5**	**19,429**
Total Population	**29,772**	**33,066**	**33,293**	**--**	**--**	**33,234**

Source: U.S. Census Bureau, American Community Survey, 2020

According to the 2010 Caroline County Comprehensive Plan, population projections for the unincorporated areas of the County were calculated by the Department of Planning & Codes Administration, Table 2-3. The most current population projections from the Maryland Department of Planning (MDP) is shown in 2-4. The 2010 Caroline County Comprehensive Plan includes more conservative population projections than that of MDP projections. MDP shows the entire County increasing in population from 2025-2045. The largest population growth rate according to MDP is between 2030-2035 and 2040-2045, an increase of 5.5%.

Table 2-3: Population Projections

POPULATION PROJECTIONS – UNINCORPORATED AREAS						
Source	**Estimates**	**2010**	**2015**	**2020**	**2025**	**2030**
MDP	Population	22,727	24,517	26,517	28,170	29,686
	Annual % Increase	1.7	1.7	1.5	1.2	1.1
Caroline County	Population	21,992	23,092	24,477	25,946	27,503
	Annual % Increase	1.0	1.0	1.2	1.2	1.2

Source: 2010 Caroline County Comprehensive Plan

Table 2-4: Total Population Projections for Caroline County

POPULATION PROJECTIONS – CAROLINE COUNTY						
Source	**Estimates**	**2025**	**2030**	**2035**	**2040**	**2045**
MDP	Population	35,550	37,700	40,000	42,200	44,500

Source: Maryland Department of Planning, December 2020

Land Use

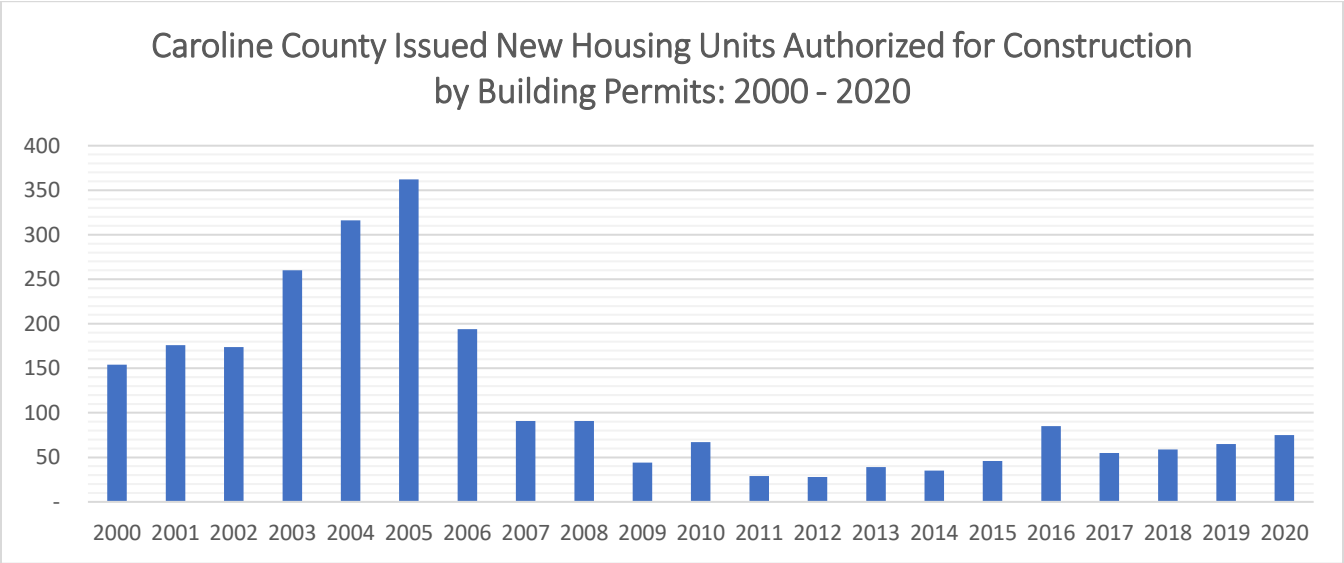
According to the 2010 Caroline County Comprehensive Plan, most residential, industrial, and commercial development is concentrated within or in close proximity to municipalities. Prior to 2000, growth and development largely occurred in unincorporated areas. Growth and development began concentrating in municipalities in 2003 and by the end of 2004, for the first time since at least 1990, municipal growth surpassed growth in unincorporated areas. Development shifts are attributed to several factors, including new State and County laws, market trends, and access to public infrastructure and services. This shift in development correlates well with the County's desire to preserve its rural countryside, and the County will strive to continue this trend. The future vision of the County is to direct growth to existing population centers, preserve agriculture, natural resources, and the rural character of the County. Countywide land use tabulations show a total of 199,854 acres or 97% of the County consisting of unincorporated areas and incorporated areas totaling 6,865 acres, the remaining 3% of the County.

According to the Caroline County 2022 Land Preservation, Parks, and Recreations Plan there is approximately 59,122 acres of forested land in 2010 or 29%. The two largest contiguous forested tracts are in the Idylwild Wildlife Management Area (WMA) north of Federalsburg, and Tuckahoe State Park and Adkins Arboretum north of Hillsboro. Concentrating development in and around existing development will maintain greenways and the natural benefits associated with undeveloped land, such as water absorption and retention.

Permit Data

According to permit data obtained by Maryland Department of Planning-Planning Services Division, housing unit permits are slightly increasing. Since 2010, building permits were declining until a spike occurred in 2016. Building permits declined again in 2017, however have been on the incline since that time; Figure 2-2.

Figure 2-2: Caroline County Issued New Housing Units Authorized for Construction by Building Permits: 2000 - 2020



Source: U.S. Bureau of the Census. Manufacturing and Construction Statistics Division. Residential Construction Branch; Prepared by Maryland Department of Planning. Planning Services Division. 2021.

Table 2-5 provides the breakdown for housing permits issued by jurisdictions and permit type. As detailed in the table, the highest number of building permits issued was between 2015 and 2019. In regard to municipalities, the majority of development has occurred within the Town of Denton.

Table 2-5: Incorporated Areas Housing Permit Data

MUNICIPAL HOUSING PERMIT DATA									
Municipality	**2020**			**2019 - 2015**			**2014 - 2010**		
	Total	**Single Family**	**Multi Family**	**Total**	**Single Family**	**Multi Family**	**Total**	**Single Family**	**Multi Family**
Denton	20	20	-	89	53	36	26	26	-
Federalsburg	1	1	-	2	2	-	3	3	-
Goldsboro	1	1	-	1	1	-	-	-	-
Greensboro	2	2	-	5	5	-	4	4	-
Henderson	-			-	-	-	0	0	0
Hillsboro	-			-	-	-	-	-	-
Marydel	-			-	-	-	-	-	-
Preston	2	2	-	-	-	-	1	1	-
Ridgely	2	2	-	18	18	-	8	8	-
Templeville									
Unincorporated Areas	47	47	-	195	195	-	156	156	-
Caroline County Total	**75**	**75**	**-**	**310**	**274**	**36**	**198**	**198**	**-**

Source: U.S. Bureau of the Census. Manufacturing and Construction Statistics Division. Residential Construction Branch; Prepared by Maryland Department of Planning. Planning Services Division. 2021.

Municipal Overview

Caroline County has a total of ten (10) municipalities. All municipalities, with the exception of Henderson, Marydel, and Templeville, participate in the National Flood Insurance Program (NFIP). Despite the lack of FEMA regulated floodplains, encouraging these municipalities to participate in the NFIP would enable property owners to purchase flood insurance under the NFIP. Due to changing conditions and flooding in areas outside of the FEMA regulated floodplains, encouraging the purchase of flood insurance is a new mitigation action item added during this plan update. The Choptank River is tidal to the Town of Greensboro. Tuckahoe Creek, a main tributary to the Choptank River, is tidal to Hillsboro, while Marshy Hope Creek is tidal to Federalsburg.[iv]

Table 2-6: NFIP Participation

NFIP PARTICIPATION		
Municipality	**FEMA Regulated Floodplain**	**NFIP Participation**
Denton	X	X
Federalsburg	X	X
Goldsboro	X	X
Greensboro	X	X
Henderson		
Hillsboro	X	X
Marydel		
Preston		X
Ridgely		X
Templeville		

FLOODPLAIN REGULATIONS

Caroline County's 2014-4 Floodplain Management Ordinance states the County's Flood Protection Elevation is the base flood elevation plus two (2) feet of freeboard.

The Towns of Denton and Goldsboro's floodplain regulations also requires the Flood Protection Elevation of a base flood elevation plus two (2) feet of freeboard, while Federalsburg, Greensboro, Hillsboro, and Marydel Flood Protection Elevation is the base flood elevation plus one (1) feet of freeboard.

The Towns Henderson, Preston, Ridgely, and Templeville do not have floodplain regulations due to the lack of floodplain or impeding floodplain.

The Choptank River floodplain located within the town limits of Denton and Greensboro is too swampy for most types of development. Although there is some residential development in the floodplain, the majority has generally been above the higher flood levels. Anticipated development is expected to continue at a slow rate. It will probably not occur in the floodplain areas since suitable land for development is available elsewhere.[v]

The Town of Denton, seat of Caroline County, is located on the eastern bank of the Choptank River and near the geographic center of the County. In 1999, the Town encompassed approximately 1,382 acres. Denton has grown its land area by over 149 percent and currently encompasses approximately 3,444 acres distributed upon approximately 1,960 individual parcels of land.[vi] A total of 254.4 acres of floodplain are contained within Town limits.

Federalsburg's location in the southeasterly corner of Caroline County places it near the center of the Delmarva Peninsula. The location of Federalsburg at the head of the tidal waters of the Marshyhope Creek exposes it to a vulnerable potential for floodway overflow from the creek. Floods dating back to the 19th century have inundated parts of the Town. Residential use predominates on the west side of Marshyhope Creek beginning behind the Main Street commercial strip and extending west to beyond University Avenue, the principal north-south connector next to Main Street. In all, residential use makes up about 7% of the land use in the planning area.[vii] There is a total of 294.2 acres of floodplain within the Town's municipal limits.

The Town of Goldsboro is a small rural community in North Caroline County. Goldsboro primarily serves as a rural service center for the surrounding agricultural community. There is some inter-mixture of residential, industrial, and commercial land within Goldsboro, especially along the railroad line and Main Street. There is substantial vacant land (approximately 206 acres) within Goldsboro that will provide opportunities for infill development in the future.[viii] The Town of Goldsboro has a minimum amount of floodplain, 12.1 acres, within town limits.

The incorporated Town of Greensboro, pleasantly situated near the headwaters of the Choptank River, is one of the oldest inland towns on Maryland's Eastern Shore. The need for Greensboro as a marketing and industrial center began to diminish with the advent of new transportation options. As a result, the growth rate declined, and the Town became primarily a residential center. Single-family residential is the dominant land use type in Greensboro, representing 31% of the developed land area in the Town. Land devoted to residential use totals an estimated 196 acres.[ix] Total acreage within the municipal is 684.8, of that a total of 65.0 is floodplain.

A small village midway between Goldsboro and Marydel in northern Caroline County, Henderson was originally known as Melville's Crossroads. The community developed around a stagecoach stop and a post office during the mid-19th century. With the advent of the railroad in 1868, the stagecoach service ended, and the post office moved to the east side of Town near the railroad where this quiet village was renamed Henderson.[x]

Hillsboro is a small rural town in Caroline County, Maryland, which is in the Mid-Shore region near Queen Anne's and Talbot Counties. The Town has witnessed little population growth in the last 50 years however it retains a stable population base. Future population growth is severely limited by the Town's lack of public water and sewerage infrastructure. The Town remains small, rural, and historic. It is mostly comprised of single-family residential dwellings with some multi-family dwellings. At present, several commercial establishments exist at the western edge of Town. No industrial areas exist due to the lack of public infrastructure.[xi] The Town of Hillsboro contains a total of 13.5 acres of floodplain within its municipal border.

Marydel's name is a portmanteau, after its location, being partially located in Maryland and partially in Delaware. Marydel is served by two state arterial routes, MD Route 311 from Henderson, and MD Route 454 from Templeville. The primary north-south transportation route serving Marydel is MD Route 311, a State arterial route that provides links to MD 313 (at Goldsboro) and larger highways including MD Route 404 in Denton. The Town is situated along the Chesapeake railroad right-of-way, which presents an opportunity for

the development of a pedestrian and recreation corridor. No part of Marydel is located within the 100-year floodplain.[xii]

The Town of Preston straddles MD Route 331 about eleven miles east of the Town of Easton and seven miles west of Federalsburg. The Town depends on roadways for communication, commerce, emergency services, and physical access to the surrounding region and beyond. Preston remains a primarily residential community, with a small commercial core. There are no areas within town limits that are within any 100-year floodplain.[xiii]

Ridgely is located in the western portion of Caroline County, Maryland. Most of Ridgely's residential units are located in the "Old Town" portion of the municipality, totaling 301 acres. Ridgely is located on both sides of Central Avenue (MD Rt. 312) and is bounded by Railroad Street to the north, Sunset Boulevard to the west, Sunrise Avenue to the east, and MD Rt. 480 to the south. Ridgely is located in the Choptank Watershed and the Town straddles the Upper Choptank and Tuckahoe Creek Sub-Watersheds. There are no floodplains located within the current corporate boundaries of the Town of Ridgely.[xiv]

The Town of Templeville is a small rural community that is located on the county line of Queen Anne's and Caroline Counties, Maryland. A portion of the incorporated boundaries of the Town lie in both counties. Templeville is located on Maryland Route 302 and Route 454. Residences are built along the roads forming a T-shaped community. Templeville consists of approximately 18 acres in Caroline County and 30 acres in Queen Anne's County for a total of 48 acres. The predominant land use is low-density residential. Templeville has shown very little growth in the last several decades. The town is relatively flat with no major water courses within the current boundaries.[xv]

Priority Funding Area – Development Patterns

State of Maryland 1997 Planning Legislation capitalizes on the state's influence on economic growth and development. This law directs state spending to Priority Funding Areas. Priority Funding Areas are existing communities and places designated by local governments that identify where they want state investment to support future growth.

Growth-related projects covered by the legislation include most state programs that encourage or support growth and development such as highways, sewer and water construction, economic development assistance and state leases or construction of new office facilities.

The Priority Funding Areas law builds on the foundation of planning visions which were adopted as Maryland policy through 1992 legislation (and updated in 2009). Funding for projects in municipalities, other existing communities, industrial areas, and planned growth areas designated by counties receive priority for state funding over other projects. Priority Funding Areas coordinate state and local government efforts to support economic development and new growth.

The following areas qualify as Priority Funding Areas:

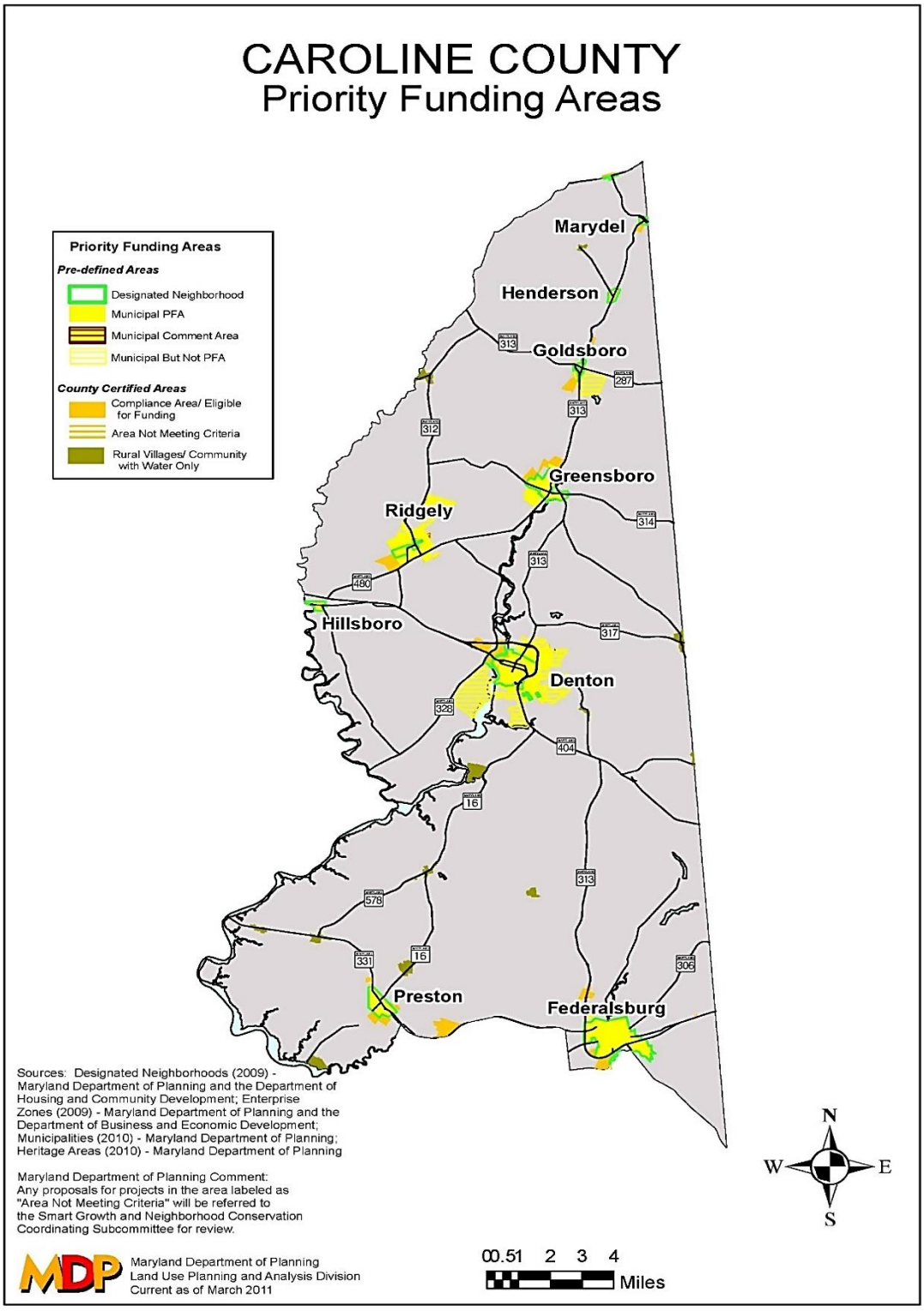
- Every municipality, as they existed in 1997;
- Areas inside the Washington Beltway and the Baltimore Beltway; and
- Areas already designated as enterprise zones, neighborhood revitalization areas, heritage areas and existing industrial land.

The 1997 planning law recognizes the important role of local governments in managing growth and determining the locations most suitable for state-funded projects. Counties may designate areas as Priority Funding Areas that meet guidelines for intended use, availability of plans for sewer and water systems and permitted residential density. Areas eligible for county designation include existing communities and areas

where industrial or other economic development is desired. In addition, counties may designate areas planned for new residential communities which will be served by water and sewer systems and meet density standards.

The review of designated Priority Funding Areas (PFA's) in Caroline County as shown on Figure 2-3 indicate that that while many of these areas are located adjacent to municipalities, there are 11 unincorporated rural villages that are designated PFAs.

Figure 2-3: Priority Funding Areas



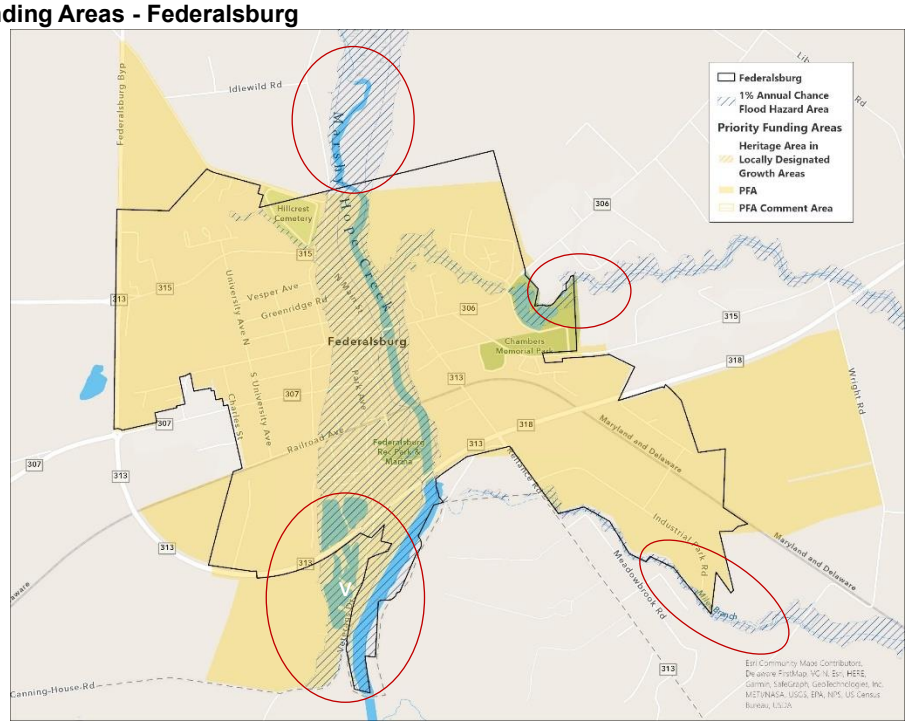
An analysis of the PFA polygons in relation to FEMA Special Flood Hazard Area - 1% annual chance flood hazard area revealed that several of the PFA's within Caroline County intersect with FEMA Special Flood Hazard Areas. Future annexation should exclude hazard prone areas, thereby maintaining open space, undeveloped land and discouraging future development and the extension of public utilities.

The County and municipalities should consider unincorporated future development and town annexations in relation to hazard risk areas. Potential future areas where development should be discouraged due to flood risk are circled in red in the following figures, 2-4 to 2-7.

Note, in those areas circled in red that intersect with the PFA area shown in yellow, development should be prevented to the extent possible. One way this could be achieved is by depicting these areas in the water and sewer plan, as zones where public water and sewer will not be extended. Additional examination of PFAs by the State should be considered, particularly if PFA is lost due to flood risk.

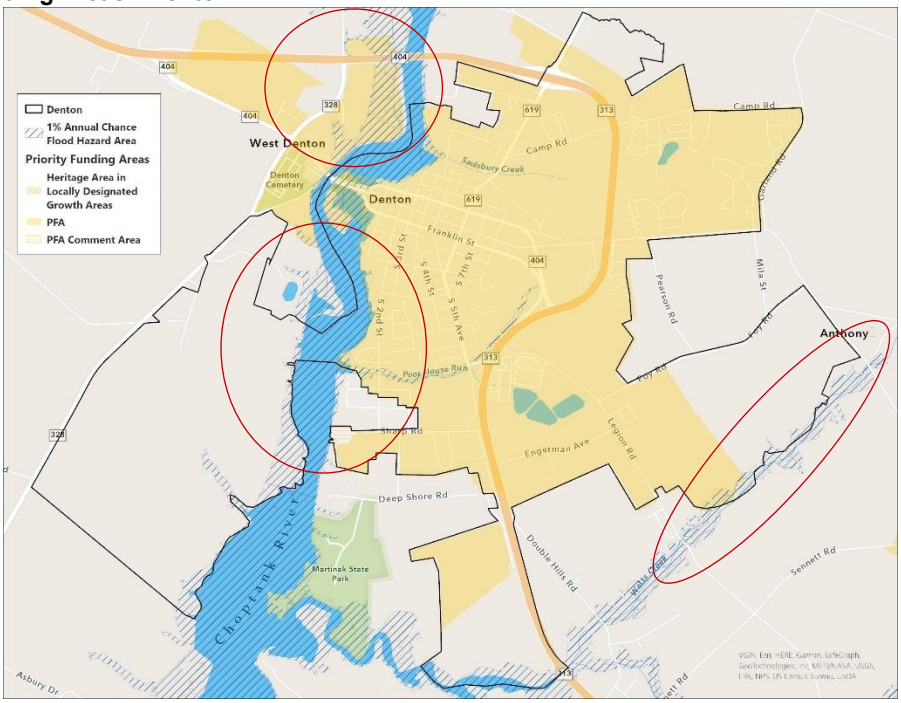
The PFA located near Federalsburg includes land within the 1% annual chance flood hazard area. The Marshy Hope Creek flows through the Town of Federalsburg.

Figure 2-4: Priority Funding Areas - Federalsburg



The PFA located northwest of the Town of Denton, is located within the 1% annual chance flood hazard area. The Choptank River borders the western portion of the Town. The Caroline County Floodplain Ordinance allows for development within the FEMA Special Flood Hazard Areas, 1% annual chance flood hazard area, however development must meet the requirements of the ordinance, which includes two feet of freeboard.

Figure 2-5: Priority Funding Areas - Denton

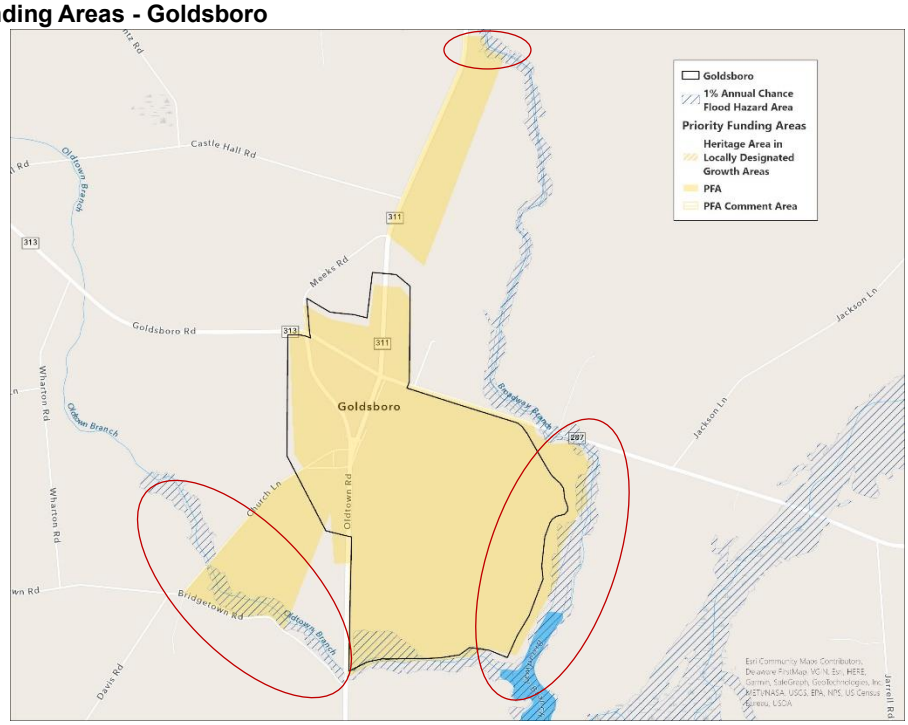


In addition, the PFA located adjacent to Greensboro, on the northwest side, insects with the 1% annual chance flood hazard area. The Forge Branch flows through this PFA area. A detailed flood study of the Forge Branch floodplain would assist in the siting of future development outside of flood hazard risk areas.

Figure 2-6: Priority Funding Areas Greensboro

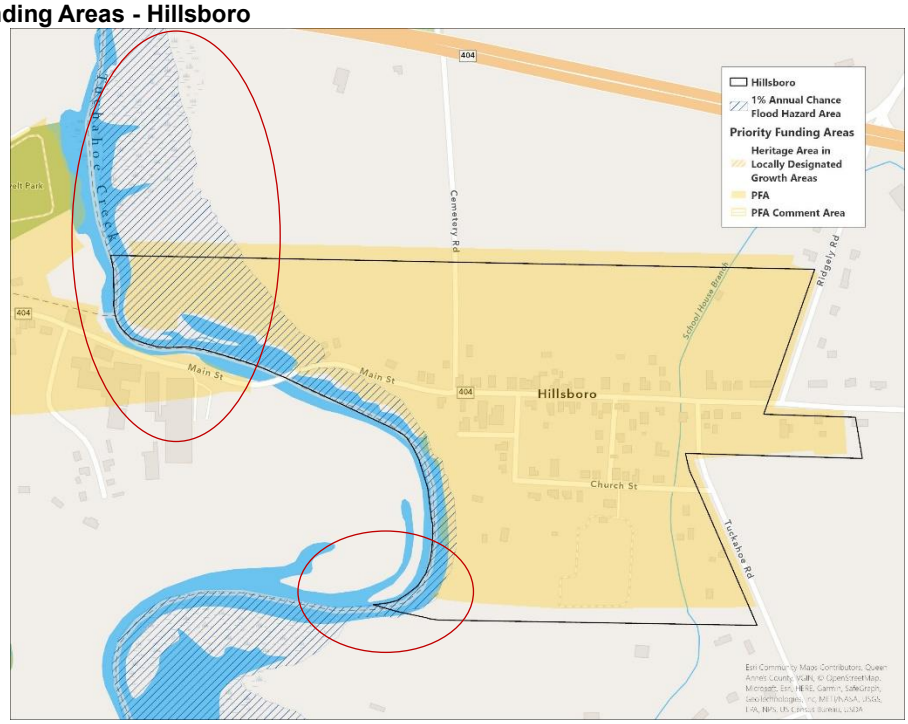
The Town of Goldsboro is not located within the 1% annual chance flood hazard area. However, stream corridors, located on the East Star development site and lands to the south and south-west of Goldsboro are impacted by FEMA's Special Flood Hazard Areas (SFHAs) - 1% annual chance flood hazard area.[xvi]

Figure 2-7: Priority Funding Areas - Goldsboro



The western limit of Hillsboro is located within Tuckahoe Creek 1% annual chance flood hazard area. Tuckahoe Creek, a main tributary to the Choptank River, is tidal to the Town of Hillsboro.

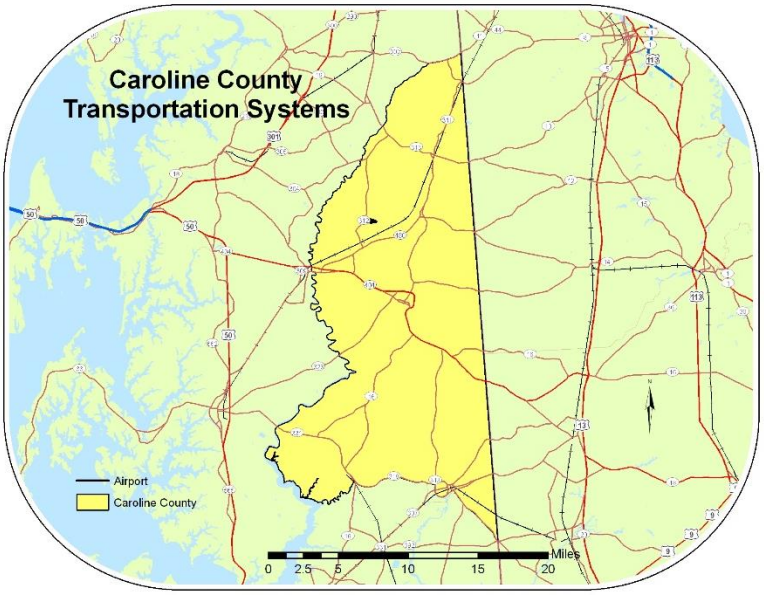
Figure 2-8: Priority Funding Areas - Hillsboro



Transportation

Route 404 is the major east-west highway corridor through Caroline County and connects the County with Route 50 to the west and Route 13 in Delaware. The other major highway is Route 313, which runs north south and connects Caroline County with Route 301 in Kent County and with Route 50 in Wicomico County. A number of other State highways and County roads connect the County seat in Denton with other municipalities and smaller communities within the County. Other transportation routes include the Maryland and Delaware (MDDE) Railroad which connects Federalsburg and Preston with the Norfolk Southern Railroad in Delaware. The Ridgely Airpark, which serves the County, is located just to the north and west of Ridgely off Route 312.

Map 2-4: Transportation



Additionally, Delmarva Community Services, Inc. is a multi-service, non-profit agency that provides transportation for individuals with disabilities, seniors /aging, persons living with poverty, transportation disadvantaged, and medically frail using funding provided by the Maryland Department of Transportation and federal grant programs. The Department of Emergency Services has worked in the past with Delmarva Community Services, Inc. to provide transport to vulnerable populations during hazard events.

The Choptank River in Caroline County has historically been an inland location for small ports for watermen and for barge traffic. A number of landings serve the Choptank and its tributaries as well as Marshyhope at Federalsburg.

Excerpt from:

MDOT Officials Met With Caroline County As Part Of Annual Statewide Tour To Discuss Transportation Priorities

Officials announced funding Caroline County's local priorities, including: $9.3 million in Highway User Revenues for the county for FY 2019 – FY 2024, which includes an additional $841,000 in grants recently awarded by the governor; and highway safety grants funded through MDOT MVA, including more than $12,000 for the Caroline County Sheriff's Office. Because Caroline County officials signed the HUR grant application at the Maryland Association of Counties Summer Conference, the county received those funds two weeks early.

MDOT MTA makes a significant investment in transit in Caroline County by providing $1.1 million in operating and capital grants to support the local transit operation in conjunction with Kent and Talbot counties. These funds provide for: replacement of one medium-duty bus; a Transportation Development Plan; and ongoing preventive maintenance. Additionally, $195,000 in funding is provided to nonprofits that serve the transportation needs of seniors and people with disabilities in the county.

Transportation officials also provided updates on major improvement projects and system preservation projects in Caroline County, including the $65 million replacement of the Dover Bridge, which opened to traffic in June 2018. MDOT SHA is in the final stages of this project and will officially complete it this winter.

Source: https://www.mdot.maryland.gov/tso/pages/newsroomdetails.aspx?newsId=357&PageId=38

Hazard Risk, Social Vulnerability & Future Development

As shown on Table 2-4, Caroline County's population is expected to continue to grow slightly, and future development will take the form of mixed-use development, redevelopment, and in-fill development. A growing population could potentially worsen future drought conditions, particularly in regard to increased demand for water supply. Water quality reports are available annually and include water quality data, information from the EPA, and information regarding vulnerable populations. Regarding drought, vulnerable populations are most likely to be the elderly, children under five, and those without access to regular clean drinking water.

Extreme heat conditions are expected to become more frequent and intense due to changing climate conditions. The need for more cooling centers is one major consideration in terms of future development to meet the needs of vulnerable populations. In addition, Chapter 109 Forest Conservation, Ord. No. 2011-003, protects and enhances the existing forest and other natural resources in Caroline County, specifically to limit or prohibit certain development and other disturbances, and to ensure that such disturbances are subject to and performed pursuant to the restrictions and requirements of chapter 109. Encouraging forest conservation and the establishment of additional forest stands will mitigate and lessens the heat island effect.

According to the National Risk Index, social groups in Caroline County have a "Relatively High" susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S.

According to the County's 2010 Comprehensive Plan, growth is concentrated in existing population and business centers, growth areas adjacent to these centers, or strategically selected new centers. The Smart Growth concept is enacted in the designation of "Priority Funding Areas" (PFAs), which are local areas targeted for growth and eligible for state funding over other projects.

A Priority Funding Area (PFA) is a developed or planned development area within which certain State agencies will prioritize investments to support growth and economic development. PFAs include municipalities that existed on January 1, 1997, existing rural villages, planned communities (or growth areas), industrial areas, and areas served by public water and sewers. Areas annexed by municipalities after January 1, 1997, must meet additional density requirements and have water and sewer service to qualify as a PFA.

Hazard inundation areas are examined in Chapters 4, 5, and 6. According to the 2010 Caroline County Comprehensive Plan, all future growth in the County will be directed to existing developed areas including municipalities, PFAs, and the County's Transfer of Development Rights (TDR) Receiving Area.

In terms of the 1% annual chance flood hazard area, the following municipalities impacted are:

- Federalsburg
- Greensboro
- Hillsboro
- Henderson
- Denton

In terms of hurricane inundation areas, the following municipalities impacted are:

- Hillsboro
- Denton
- Greensboro
- Federalsburg

In terms of shoreline erosion risk areas, the following municipalities impacted are:

- Greensboro
- Denton
- Hillsboro
- Federalsburg

In terms of sea level rise risk areas, the following municipalities impacted are:

- Greensboro
- Denton
- Hillsboro
- Federalsburg

As detailed in Table 2-5: Incorporated Areas Housing Permit Data, minimal development has occurred since the previous planning process, therefore development changes have not affected any of the jurisdiction's overall vulnerability.

In terms of future development, jurisdictions listed in each of the identified hazard inundation areas as well as the unincorporated areas of the county, could potentially be impacted if projected growth is near or around these areas. Towns that intersect with waterways, such as Greensboro, Denton, Hillsboro, and Federalsburg should take into consideration flood locations, soil types, and proper construction techniques to minimize the chance of impacts due to future development.

Future development for the Town of Hillsboro is projected north of town limits. The town eastern border runs along the Tuckahoe Creek. The designated growth area for the Town will consist of agricultural land and residential lots. As mentioned in Chapter 15, the Town enforces flood protection elevations and setbacks. Therefore, future development would not increase vulnerability to flooding, hurricanes, shoreline erosion, or sea level rise for the Town.

The Marshy Hope Creek flows through the Town of Federalsburg, however projected growth for the Town is planned toward the eastern and western areas of town limits. A small area east of the Marshy Hope Creek is also included in the growth area. However, all areas are predominantly planned for agricultural use with minimum residential lots. The Town does enforce flood protection elevations and setbacks, ensuring future development will not increase vulnerability to flooding, hurricanes, shoreline erosion, or sea level rise for the Town.

The Town of Greensboro's projected growth area is predominately to the north and south of town limits. The Choptank River traverses the projected growth area. The Town's Comprehensive Plan acknowledges the environmental constraints and therefore enforces flood protection elevations and setbacks, as detailed in Table 15-1 Planning & Regulatory, page 15-2. As shown in Table 2-2: Population Figures, the Town's population has declined and Table 2-5 lists only 11 housing permits being issued in the past decade. Between the floodplain regulations the Town enforces and limited development pressure, future development would not increase vulnerability to flooding, hurricanes, shoreline erosion, or sea level rise for the Town.

The Town of Denton's Comprehensive Plan states the Town's primary aim is to construct new housing, workplaces, shops, and other facilities within existing urban or suburban areas. This is one of the Town's strategies, which will increase housing, jobs, and community amenities without expanding its footprint into undeveloped lands. The plan also states that the Town has sufficient land within its corporate area to accommodate population growth in the planning period and beyond, however has identified several areas for potential annexation. The areas are north and south of current limits. The Choptank River does intersect with town limits, however, the Town enforces more stringent floodplain regulations. Therefore, if an annexation

occurred, development would not occur in permitted in the hazard inundation areas and the Town's vulnerability to flooding, hurricanes, shoreline erosion, or sea level rise would not increase.

Caroline County's growth management policies are to concentrate population in the existing towns and conserving agricultural and natural resources. Therefore, it is unlikely that new development will occur in areas prone to flooding, without careful consideration of flood hazards during the development review process. However, if the County's population begins to grow, flood impacts could potentially be more widespread. In communities with higher populations, significant flood events will have a higher impact because there is a greater exposure of people and property to floodwaters. Also, higher magnitude flooding in the County produces a greater need for evacuation and emergency response.

The type and age of development play a role in vulnerability to hurricanes. In general, concrete, brick, and steel-framed structures tend to fare better than older, wood-framed structures or manufactured homes. As Caroline County continues to grow and develop, it will be important to ensure that all development is built to code to withstand impacts from flooding and severe wind associated with hurricanes.

Reviewing the County's existing land use along the shoreline, there is minimal development along the unincorporated areas' shorelines. If new development would occur near protective natural habitats or vulnerable shorelines, existing land use regulations will likely protect new structures and infrastructure from the risk of erosion. The Chesapeake Bay Critical Area law requires Caroline County to adopt and implement a Critical Area management ordinance for all land within 1,000 feet of tidal waters. The ordinance is intended to protect both water quality and wildlife habitat, and includes criteria addressing development density, water dependent uses, buffers from waterways, and protections for natural shorelines and wildlife habitats.

In terms of severe winter storms, these types of events do not adhere to geographic boundaries or specific population groups, making it challenging to pinpoint development and demographic trends that could influence this hazard in the future. Current land use and building regulations include standards designed to address and reduce snow accumulation. As Caroline County's population increases, new developments may heighten vulnerability by increasing the number of assets at risk from winter storm impacts. As previously mentioned, all structures face the threat of widespread utility failures, including loss of heat and electricity, as well as potential damage or collapse from fallen trees. To better mitigate the effects of winter storms, property owners and developers should avoid flat roofs and adhere to the latest building codes regarding snow load and insulation. This approach is applicable to Caroline County and all participating municipalities.

The geographic reach of thunderstorm events is considered consistent throughout the County and across all municipalities; the site of development does not inherently alter the risk. By following building codes, Caroline County and the participating municipalities can guarantee that new developments meet current standards. For more details, refer to the Capability Assessment in Chapter 15, which outlines the existing planning and regulations for Caroline County and all involved municipalities.

Caroline County and each municipality is susceptible to tornado events and their adverse effects. Given the undefined geographic range of tornadoes and other high wind occurrences, predicting how future development or shifts in population patterns will affect tornado hazards is challenging. It is crucial for all upcoming developments to adhere to the building codes and wind speed design standards established by Caroline County and municipalities to minimize potential tornado damage as much as possible.

Considering proximity is a major factor in how diseases and illnesses spread, changes in population, demographics, and density may influence the impact of an outbreak, epidemic, or pandemic. Any significant development in Caroline County or in each municipality could potentially impact how susceptible the County is to a widespread disease or public health emergency.

Note: Caroline County is in the process of updating the comprehensive plan. Currently, a citizen survey, Caroline 2040-Citizen Survey, is available for participants to provide input on several plan elements.

A mitigation action that has been added to this plan update includes limited future annexation areas and the expansion of public utilities in high hazard areas, floodplains, see figures 2-4 through 2-7, areas circled in red.

Social Equity

FEMA defines equity as the consistent and systematic fair, just and impartial treatment of all individuals. To ensure that the planning process and outcomes of the local mitigation plan benefit the equity must be central in its development. Inclusive planning processes take time and thoughtful planning to be set up in a way that provides everyone with the resources necessary to meaningfully participate, make progress and benefit from hazard mitigation. Equity is not just an important principle; it is essential to reducing risk to the whole community, particularly for those who face barriers to accessing assistance and for populations that are disproportionately affected by disasters. The whole community includes individuals and communities, the private and nonprofit sectors, faith-based organizations, and all levels of government (regional/metropolitan, state, local, tribal, territorial, insular area and federal). The mitigation plan is an opportunity to counter some of those barriers and intentionally plan for reducing the risk of all communities.

Climate change increases the frequency, duration, and intensity of natural hazards, such as wildfires, extreme heat, drought, storms, and heavy precipitation. Communities are feeling the impacts of a changing climate now. Many of these trends will likely continue for decades. These variations create new risks to state and local governments and challenge pre-existing mitigation plans. They also pose a unique threat to the nation's most at-risk populations by exacerbating the impacts of disasters on underserved and socially vulnerable populations who already experience the greatest losses from natural hazards.

National Risk Index

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state, and federal government; and private industry. The Risk Index leverages available source data for natural hazard and community risk factors to develop a baseline risk measurement for each United States county and Census tract. A community's score is represented by its percentile ranking among all other communities at the same level for Risk, Expected Annual Loss, Social Vulnerability and Community Resilience. For Risk, Expected Annual Loss, Social Vulnerability, and Community Resilience, there is a qualitative rating that describes the community in comparison to all other communities at the same level, ranging from “Very Low” to “Very High.”

According to the National Risk Index, Caroline County has a relatively low risk value. In terms of the social vulnerability specific to the National Risk Index, data from the 2020 Center for Disease Control (CDC) Social Vulnerability Index was used.

CDC Social Vulnerability Index

According to the Centers for Disease Control and Prevention (CDC), every community must prepare for and respond to hazardous events, whether a natural disaster like a tornado or disease outbreak, or a human-made event such as a harmful chemical spill. Several factors, including poverty, lack of access to transportation, and crowded housing may weaken a community’s ability to prevent human suffering and financial loss in a disaster. These factors are known as social vulnerability.

The CDC’s Social Vulnerability Index (SVI) uses fifteen (15) U.S. Census variables to calculate SVI scores that can help local officials identify communities within the county that may need additional support before, during, and/or after disasters. An important aspect relating to the health, safety, and welfare of Caroline County’s communities is social vulnerability. The County recognizes that identifying socially vulnerable populations is an important step in mitigating natural disaster events. According to the CDC, social vulnerability refers to “the

negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters, or disease outbreak." Reducing social vulnerability can decrease both human suffering and economic loss.

The CDC developed a Social Vulnerability Index (SVI) to help local jurisdictions determine their level of vulnerability based on fifteen (15) indicators that are routinely utilized to measure social vulnerability. These indicators are as follows:

Socioeconomic Status
1. Below Poverty
2. Unemployed
3. Income
4. No High School Diploma

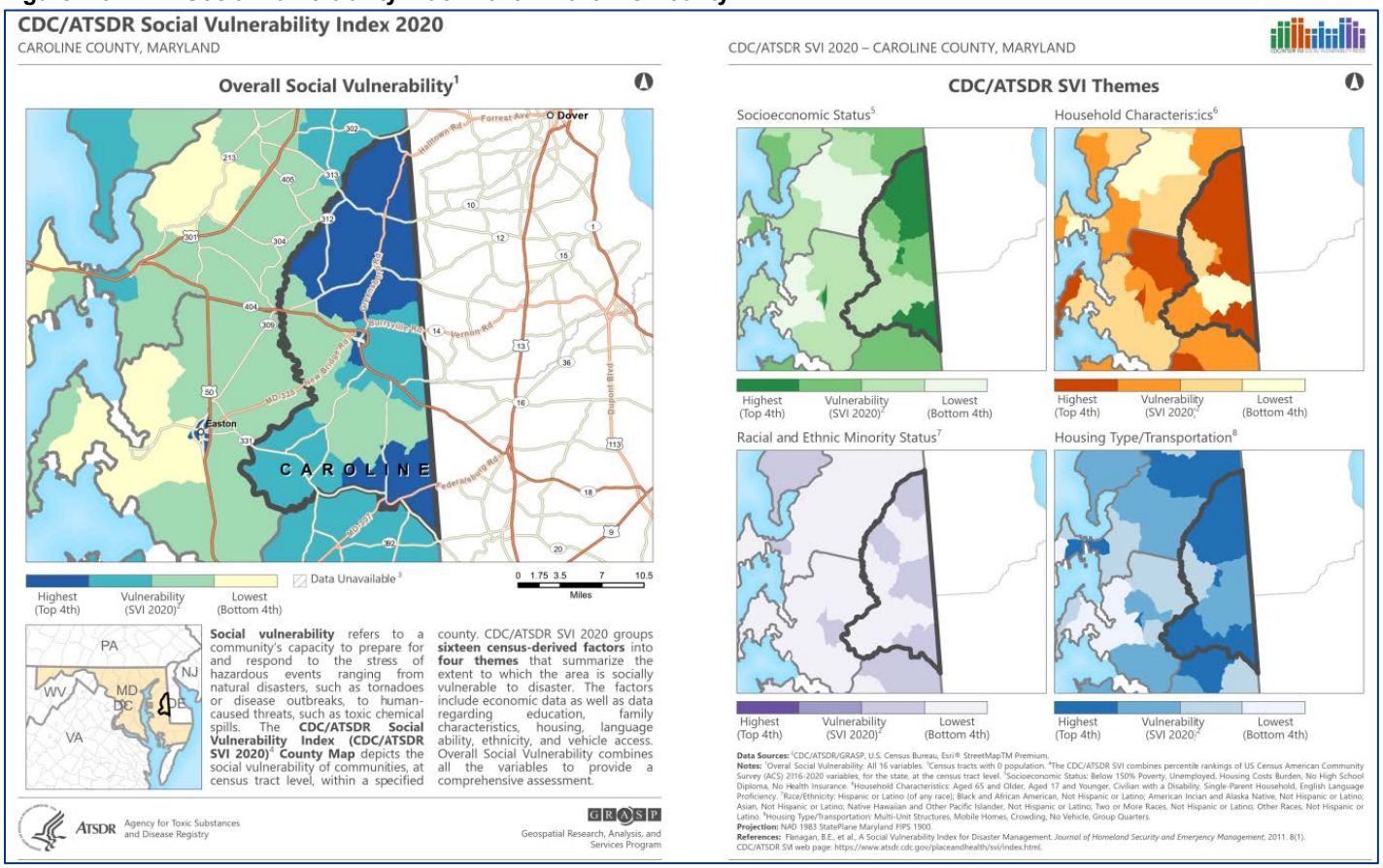
Household Composition & Disability
1. Aged 65 or Older
2. Aged 17 or Younger
3. Civilian with a Disability
4. Single-Parent Households

Minority Status & Language
1. Minority
2. Speaks English "Less than Well"

Housing Type & Transportation
1. Multi-Unit Structures
2. Mobile Homes
3. Crowding
4. No Vehicle
5. Group Quarters

The SVI developed for Caroline County was conducted at the census tract level and is mapped below, Figure 2-9. The darker blue census tracts in the overall map indicate areas of higher social vulnerability while the light green tracts indicate relatively low social vulnerability. As shown on the overall SVI, Figure 2.9, left-hand side, the dark blue areas with the highest social vulnerability are in the north and southeast portions of the County. Contributing factors for higher social vulnerability in Caroline County include socioeconomic status, household characteristics, and housing type/transportation as shown on Figure 2-9, right-hand side.

Figure 2-9: CDC Social Vulnerability Index 2020 – Caroline County

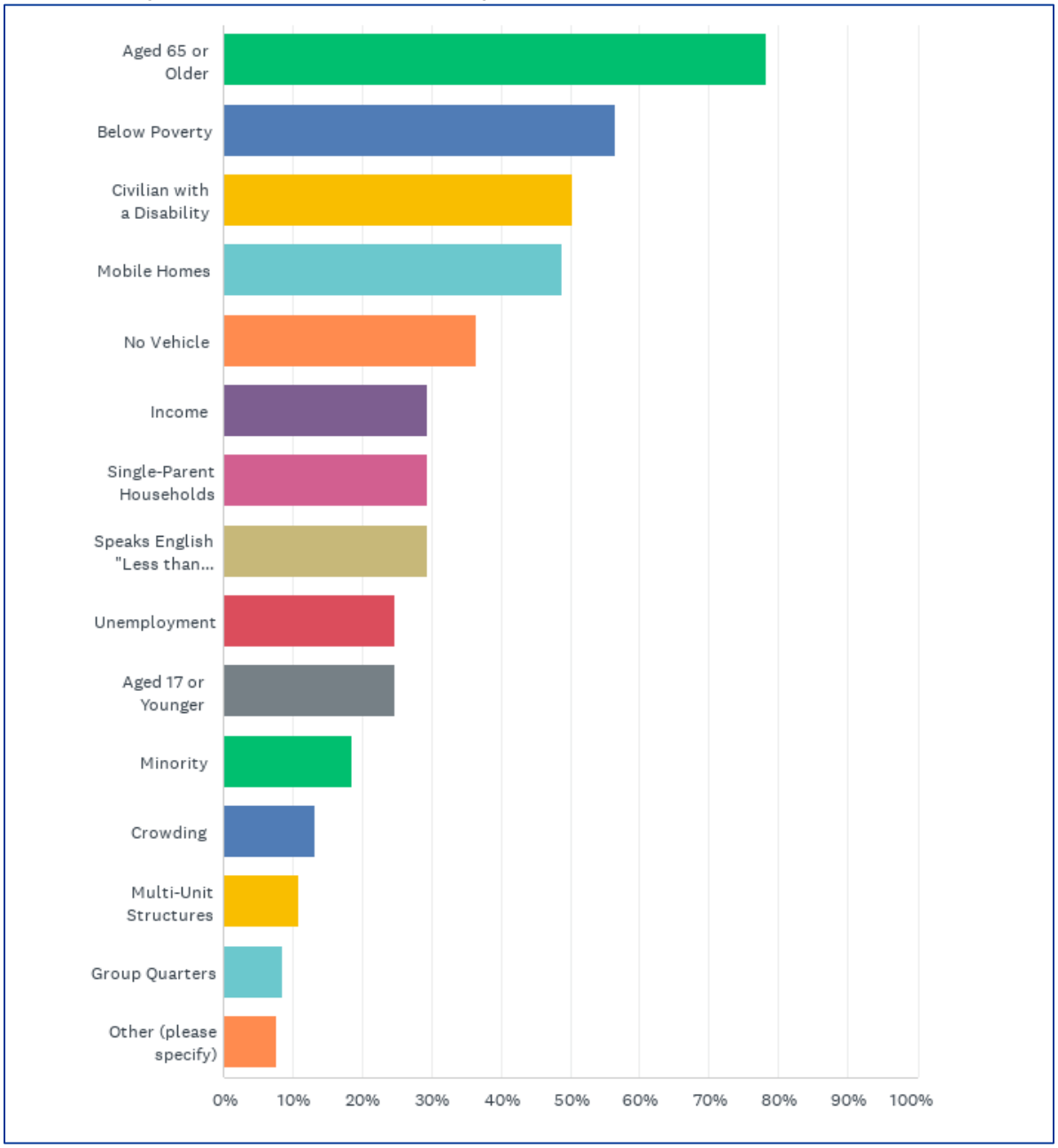


In reviewing Figure 2-9, the northern section of the County has a high social vulnerability as well. This section includes the Towns of Ridgely, Greensboro, Goldsboro, Henderson, Marydel and Templeville. The area with the highest social vulnerability is in the southeastern portion of the County, including the Town of Federalsburg. The Town of Denton is also considered to have high social vulnerability. The Town of Preston, located southwest in the county, is considered to have a moderate social vulnerability index.

Public Survey Response to Social Vulnerability

As part of the public survey, the community was asked to specify which group or groups in the County are particularly at risk for or could be harmed by any of the identified hazard events. Socially vulnerable groups provided as options include socioeconomic status, age, gender, race and ethnicity, and medical issues and disabilities. Seventy-eight percent of the participants indicated that the "Age" group (65 & older) is at risk of the hazards identified in the plan followed by "Below Poverty" at fifty-six percent.

Figure 2-10: Public Survey Response to Social Vulnerability



Social Equity Small Group Meeting

In addition to the public survey social vulnerability information, on January 18, 2024, a small group social equity meeting was held. In attendance was representatives from the Caroline County Health Department (CCHD), Department of Social Services, and Department of Emergency Services. The purpose of the meeting was to discuss integration of social equity into the hazard mitigation plan update. In addition, participants were asked what initiatives and/or projects are slated for the future and what emergency management may integrate or opportunities for collaboration related to social equity and vulnerability. Additional questions asked during the meeting include:

- Has your department, agency, or organization observed shifts in the needs of underserved communities or gaps in social equity?

- Has your department, agency, or organization included social equity and/or vulnerability in any of your planning?
- Do you know of locations/areas of particular social vulnerability concern?
- Do you have any ideas on how Caroline County and/or its municipalities could further reduce risk, particularly for those who face barriers to accessing assistance and for populations that are disproportionately affected by disasters?

Participants indicated that there has been an increase in citizens who utilize the Health Department and experience a language barrier. The populations that speak Spanish and Haitian-Creole have increased in Caroline County. According to the US Census QuickFacts, a total of 8.3% of the population speak a language other than English at home (percent of persons age 5 years+, 2018-2022). Furthermore, the CDC documented that the limited English population was 363 in 2010 and has increased to 614 in 2020. The Caroline County Health Department (CCHD) is actively seeking to hire a certified translator.

Also discussed during the meeting was the lack of transportation. Transportation services are provided in the Towns of Denton and Federalsburg, but not in the towns Goldsboro, Henderson, and Marydel. A mobile food pantry and mobile health unit travels directly to the vulnerable populations to help alleviate the burden on the population that lacks transportation. In addition, both the Caroline County Health Department and Department of Social Services indicated that they work with faith-based communities who assist vulnerable populations.

Shelters were also discussed during the meeting. The County has two (2) designated shelters and two (2) shelter operations trailers. The Department of Emergency Services is working with the Department of Social Services to establish a functional exercise for shelter setup using supplies form shelter operation trailers. The Health Department is currently creating shelter kits. Once completed, the nursing staff will be trained, therefore a drill will be conducted.

In terms of health equity, the Caroline County Health Department (CCHD) is currently working with partnering agencies (CCDES, CCEMS, Choptank Community Health System) on a Caroline County Mobile Integrated Healthcare Program to improve health literacy and improve healthcare outcomes for those with chronic healthcare conditions in the county.

In addition, CCHD has submitted a proposal for Local Health Department funding for overweight, obesity & diabetes strategies to aid in combating the County Health Ranking and Roadmaps 2023 “low” rank that Caroline County currently holds.

CCHD also recently partnered with Caroline County Public Schools to provide food services to the Medical Adult Daycare and ensure adherence to the Federal Child and Adult Food Program (CACFP).

The CCHD Behavioral Health Program has two Mobile treatment Units that provide mental health and substance use disorder treatment throughout the county and to neighboring counties (Kent and Talbot).

Furthermore, the CCHD’s Emergency Preparedness Division has created a Caroline County Healthcare Emergency Preparedness Coalition consisting of Long-Term Care (LTC), Assisted Living Facility (ALF), and other county agencies with a healthcare component. The goal of the coalition is to be a platform to facilitate communication and collaboration for shared goals.

Finally, the Collective Impact Coalition is currently working to create strategic plans to address health equity and address county specific social determinants of health through five committees. The Caroline County Health Department is working to develop sustainable collaborations through partnerships with community organizations and resources.

As a result of the meeting, one (1) new objective and four (4) new mitigation action items were developed.

Objective 11.3

Provide hazard related public awareness materials and notifications in both Spanish and Haitian Creole.

Mitigation Action Items

Utilize results of the Social Vulnerability Index (SVI) mapping intersected with hazard vulnerability to identify vulnerable populations (potentially under-served and/or underrepresented communities). Targeted outreach efforts should be implemented to "bridge the gap" in access to information and services as it relates to natural hazards.

Ensure that all hazards related announcements, information, and materials are accessible to all socially vulnerable groups, including but not limited to those: over the age of 65, under the age of 5, limited English-speaking proficiency, disabilities, and those at or below the poverty line. Coordinate with municipalities on distribution.

Continue shelter operations training program. Hold shelter operations table tabletops followed by functional drill. Planning team include Emergency Services, Social Services, and the Health Department.

Conduct a series of meetings to identify best practices and develop standard operating procedures to be used before, during, and after a hazard event specific to vulnerable populations. Include who and how vulnerable populations will be contacted, how outstanding needs will be relayed to the Emergency Operations Center, and how follow-up contacts will be made during the recovery phase of a hazard incident.

Finally, a strategy for outreach to underserved communities and socially vulnerable populations was established during this Small Group Social Equity Meeting held on January 18th. As housing, healthcare, and social service agencies are examples of organizations that work directly with or provide support to underserved communities and socially vulnerable populations, the Caroline County Health Department (CCHD) and Department of Social Services served as primary points of distribution for outreach materials. These agencies work directly with underserved communities and socially vulnerable populations and those non-profit organizations who serve these communities and populations. Caroline County routinely uses this outreach strategy and has found it to be effective, collaborative, and avoids duplication of services.

For example, the Health Department posted information on the hazard mitigation plan and public survey starting on January 23rd and continued through March 4th, as per Kristin Dietz, Deputy Health Officer. Also, the Department of Social Services

Critical Facilities

The Federal Emergency Management Agency (FEMA) critical facilities definition states: *Typical critical facilities include hospitals, fire stations, police stations, storage of critical records, and similar facilities. These facilities should be given special consideration when formulating regulatory alternatives and floodplain management plans. A critical facility should not be located in a floodplain if at all possible. If a critical facility must be located in a floodplain it should be provided with a higher level of protection so that it can continue to function and provide services after the flood. Communities should develop emergency plans to continue to provide these services during the flood.*[xvii]

The Maryland Department of Emergency Management (MDEM) also includes the following as critical facilities:

- Stormwater/Wastewater Plants/transfer stations
- Gas and Electric power plants/transfer stations
- Any facility, that if service is interrupted, a Community Lifeline is affected.

Community Lifelines defined by FEMA is *a lifeline that enables the continuous operation of critical government and business functions and is essential to human health and safety or economic security. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function.*[xviii]

FEMA has developed a construct for objectives-based response that prioritizes the rapid stabilization of Community Lifelines after a disaster. The integrated network of assets, services, and capabilities that provide lifeline services are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. When disrupted, decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to stabilize the incident.[xix]

Community lifelines include:

As part of the plan update process, critical facilities identified in the 2019 Plan were reviewed and additional facilities were added to ensure all facilities identified as critical by FEMA and MDEM have been included. As a result, a total of 142 critical facilities were identified and analyzed for vulnerability to hazards identified in the plan. The list of the critical facilities and associated community lifeline, where applicable, for Caroline County is provided below.

Changes since the last plan update include:

- A new station for the Ridgely Fire Station 400 was constructed at 101 Sunset Boulevard, Ridgely.
- EMS Station 14 is located at the new Ridgely Fire Station as well.
- Federalsburg EMS Station 11 relocated to 405 University Avenue in Federalsburg.
- Caroline County Sheriff's Office relocated to 9305 Double Hills Road.
- A new community fire hall for the Greensboro Fire Station was constructed at 13781 Greensboro Road. The original station at 116 N Main Street remains in use.
- The Greensboro WWTP relocated to 13875 Greensboro Road, Greensboro. The original location was 13514 Greensboro Rd, Greensboro, which is now pump stations for the WWTP.

Note: All Caroline County core IT equipment in County buildings has surge protection and grounding protection.

For each critical facility type listed, the associated primary community lifeline is identified using FEMA icons.

Critical facilities include:

EOC

- Emergency Services and 911 Communications - 9391 Double Hills Road, Denton, MD 21629

Communication Towers

- American Tower, Inc – Barclay Rd, Marydel, MD 21649
- American Tower, Inc – Benedictine Ln, Ridgely, MD 21660
- Subcarrier Communications Inc. – Bloomery Rd, Federalsburg, MD 21632
- American Tower, Inc – Burrsville Rd, Denton, MD 21629
- Tri Gas & Oil – Federalsburg Hwy, Federalsburg, MD 21632
- C&P Bell Tel Co. – Grove Rd, Preston, MD 21655
- TARA Communication – Hog Neck Rd, Preston, MD 21655
- Muhammad – Idlewild Rd, Federalsburg, MD 21632
- TELECOM Cell Tower – Langrell Rd, Preston, MD 21655
- TELECOM Cell Tower - Laurel Grove Road, Federalsburg, MD 21632
- TELECOM Cell Tower - Laurel Grove Road, Denton, MD 21629
- MD State Highway Administration – Legates Dr, Denton, MD 21629
- Caroline County Soil Conservation District – Legion Rd, Denton, MD 21629
- Tower Co Assets LLC – Main St, Marydel, MD 21649
- Telecommunications Tower – Marsh Creek Rd, Preston, MD 21655
- State of MD MIEMSS – N University Ave, Federalsburg, MD 21632
- Board of Education – Noble Ave, Preston, MD 21655
- American Towers Inc. – Old Line Rd, Goldsboro, MD 21636
- Board of Education – Richardson Rd, Federalsburg, MD 21632
- C&P Bell Tel Co. – Ridgely Rd, Ridgely, MD 21660
- Choptank Electric – River Road, Denton, MD 21629
- TELECOM Cell Tower – Shore Hwy, Ridgely, MD 21660
- TELECOM Cell Tower – Shore Hwy, Denton, MD 21629
- TELECOM Cell Tower – Shore Hwy, Federalsburg, MD 21632
- American Tower – Smithville Rd, Federalsburg, MD 21632
- TELECOM Cell Tower – Sunset Blvd, Ridgely, MD 21660
- TELECOM Cell Tower – Tanyard Rd, Preston, MD 21655
- TELECOM Cell Tower – Tuckahoe Rd, Denton, MD 21629

Fire Stations

- Station 100 - Federalsburg - 208 North University Avenue, Federalsburg, MD 21632
- Station 200 - Preston - 3680 Choptank Rd, Preston, MD 21655
- Station 300 - Denton - 400 S 5th Ave, Denton, MD 21629
- Station 400 - Ridgely - 101 Sunset Blvd, Ridgely, MD 21660
- Station 56 - Marydel - 110 Firehouse Ln, Marydel, DE 19964
- Station 600 - Greensboro - 116 N Main Street, Greensboro, MD 21639
- Station 700 - Goldsboro - 700 Old Line Rd, Goldsboro, MD 21636
- Station 800 - Queen Anne Hillsboro - 13512 1st St, Queen Anne, MD 21657

Note: Stations 56 and 800 are not located in Caroline County, however, assist the county when necessary.

Paramedic Units

- Paramedic 11 – Federalsburg - 405 University Ave N, Federalsburg, MD 21632
- Paramedic 12 – Preston - 3681 Choptank Rd, Preston, MD 21655
- Paramedic 13 – Denton - 9391 Double Hills Rd, Denton, MD 21629
- Paramedic 14 – Ridgely - 101 Sunset Blvd, Ridgely, MD 21660
- Paramedic 16 – Greensboro - 116 N Main St, Greensboro, MD 21639
- Paramedic 17 – Goldsboro - 700 Old Line Road, Goldsboro, MD 21636

Police Department

- Caroline County Sheriff's Office - 9305 Double Hills Road, Denton, MD 21629
- Denton Police Department - 100 N. Third Street, Denton, MD 21629
- Federalsburg Police Department - 104 Morris Avenue, Federalsburg, MD 21632
- Greensboro Police Department - 111 S. Main Street, Greensboro, MD 21639
- Ridgely Police Department - 2 Central Avenue, Ridgely, MD 21660

Hospitals/Medical

Caroline County does not have a hospital; however, the University of Maryland Shore Regional Health does provide outpatient services at the following locations:

- Diagnostics Center - 838 S. 5th Avenue, Denton, MD 21629
- Family Medicine - Denton - 836 S. 5th Avenue, Denton, MD 21629
- Laboratory Services - 838 S. 5th Avenue, Denton, MD 21629
- Rehabilitation Center - 920 B Market Street Denton, MD 21629

Additional medical clinics include:

- University of Maryland Urgent Care – Denton - 8 Denton Plaza, Denton, MD 21629
- Family Practice, Jensen, Christian, Md - 9307 Corkell Road, Denton, MD 21629
- UM Shore Regional Health Diagnostics at Denton - 1140 Blades Farm Road, Suite 102, Denton, MD 21629
- Family Practice, University of Maryland Shore Health System - 1140 Blades Farm Road, Suite 101, Denton, MD 21629
- Choptank Community Health System Inc Denton - 808 S Fifth Avenue, Denton, MD 21629
- Choptank Community Health System Administration - 301 Randolph Street, Denton, MD 21629
- Korah Pulimood, Md - 912 Market Street, Denton, MD 21629
- Preston Family Physician Care - 3683 Choptank Road, Preston 21655
- Tidal Health Primary Care Federalsburg - 3304 Hayman Drive, Federalsburg, MD 21632
- Choptank Community Health Systems Federalsburg, Federalsburg Medical Center - 215 Bloomingdale Avenue, Federalsburg, MD 21632
- Choptank Community Health Systems Goldsboro, Goldsboro Medical Center - 316 Railroad Avenue, Goldsboro, MD 21636
- Heath And Public Services Building - 403 South 7th St., Denton, MD 21629
- DaVita Kidneycare Dialysis Center - 842 South 5th Ave., Denton, MD 21629

Schools (Shelters)

- Caroline County Public Schools BOE - 204 Franklin Street, Denton, MD 21629
- Denton Elementary School - 303 Sharp Road, Denton, MD 21629
- Federalsburg Elementary School - 302 S University Avenue, Federalsburg, MD 21632
- Greensboro Elementary School - 627 N Main Street, Greensboro, MD 21639
- Preston Elementary School - 225 Main Street, Preston, MD 21655
- Ridgely Elementary School - 118 N Central Avenue, Ridgely, MD 21660
- Colonel Richardson Middle School - 25390 Richardson Road, Federalsburg, MD 21632
- Lockerman Middle School - 410 Lockerman Street, Denton, MD 21629
- Caroline Career & Technology Center - 10855 Central Avenue, Ridgely, MD 21660
- Colonel Richardson High School - 25320 Richardson Road, Federalsburg, MD 21632
- North Caroline High School - 10990 River Road, Ridgely, MD 21660
- Benedictine School (Private) – 14299 Benedictine Lane, Ridgely, MD 21660
- Caroline County Early Head Start – 100 N 6th St, Denton, MD 21629

Government

- County Owned
    - Board Of Education - 323 University Ave, Federalsburg, MD 21632
    - Federalsburg Branch Library - 123 Morris Ave, Federalsburg, MD 21632
    - County Historical Society - 3395 Linchester Road, Preston, MD 21655
    - County Commissioners - Historic - Webb Cabin - 23459 Grove Road, Preston, MD 21655
    - Caroline County 4-H Park - 8230 Detour Road, Denton, MD 21629
    - Caroline County Community Center - 107 S 4th St, Denton, MD 21629
    - Board Of Education - 204 Franklin St, Denton, MD 21629
    - County School Maintenance & Transportation - 414 Gay St, Denton, MD 21629
    - Caroline County Public Library - 100 Market St, Denton, MD 21629
    - Caroline County Department of Corrections - 101 Gay St, Denton, MD 21629
    - Department Of Public Works Building - 520 Wilmuth St, Denton, MD 21629
    - Caroline County Courthouse - 109 Market St, Denton, MD 21629
    - Delmarva Community Transit - 10502 Greensboro Road, Denton, MD 21629
    - Dayspring Townhomes - 12050 School St, Ridgely, MD 21660
    - The Caroline Center - 12061 School St, Ridgely, MD 21660
    - Dayspring Townhomes - School St, Ridgely, MD 21660
    - Caroline County Humane Society - 407 W Belle Road, Ridgely, MD 21660
    - Caroline County District Court - 207 S 3rd St, Denton, MD 21629
    - Caroline County Office Building - 411 Franklin St, Denton, MD 21629
- Municipal Owned
    - Denton Town Hall - 4 N 2nd St, Denton, MD 21629
    - Goldsboro Town Hall - 505 Oldtown Road, Goldsboro, MD 21636
    - Preston Town Hall - 105 Back Landing Road, Preston, MD 21655
    - Town Of Federalsburg Community Center - 223 Kinder St, Federalsburg, MD 21632
    - Mayor And Council of Federalsburg - 704 Morris Ave, Federalsburg, MD 21632
    - Federalsburg Town Hall - 118 N Main St, Federalsburg, MD 21632
    - Town Of Preston - 3690 Choptank Road, Preston, MD 21655
    - Denton Self Storage - 24 Engerman Ave, Denton, MD 21629
    - Town Of Denton - Chesapeake Culinary Center - 512 Franklin St, Denton, MD 21629

- Town Of Denton - Fiber Arts Center - 7 N 4th St, Denton, MD 21629
- Denton - Museum of Rural Life - 16 N 2nd St, Denton, MD 21629
- Town Of Denton - 414 High St, Denton, MD 21629
- Old Denton Town Hall - 13 N Third St, Denton, MD 21629
- Hillsboro Town Hall - 22043 Church St, Denton, MD 21629
- Town Of Hillsboro - 22004 Main St, Denton, MD 21629
- Ridgely Rec Field/Park - W Forth St, Ridgely, MD 21660
- Ridgely Town Hall - 2 Central Ave, Ridgely, MD 21660
- Greensboro Town Hall – 113 S. Main St, Greensboro, MD 21639
- Marydel Town Hall - 319 Main St, Marydel, MD 21649

Power Stations

- Choptank Electric Cooperation
  - 6905 Reliance Road, Federalsburg, MD 21632
  - Cemetery Road, Denton, MD 21629
  - 24820 Meeting House Road, Denton, MD 21629
  - Conrail Road, Federalsburg, MD 21632
  - 10384 River Road, Denton, MD 21629
  - River Road, Denton, MD 21629
  - 25245 Beauchamp Branch Rd, Denton, MD 21629
  - 10675 Greensboro Road, Denton, MD 21629
  - 1227 Market St, Denton, MD 21629
  - 4307 Bethlehem Road, Preston, MD 21655
- Delmarva Power & Light Company
  - 821 Camp Road, Denton, MD 21629
  - Pennsylvania Ave, Federalsburg, MD 21632
  - Cemetery Road, Denton, MD 21629
  - 11711 Eveland Road, Ridgely, MD 21660

Water Treatment Plants (WTP)

- Jonestown WTP - 109 Market St, Denton, MD 21629

Water Towers

- Denton - Engerman Ave, Denton, MD 21629
- Denton - Old Camp Rd, Denton, MD 21629
- Denton - N 5th Street, Denton, MD 21629
- Greensboro - Watertower Aly, Greensboro, MD 21639
- Greensboro - Hobbs St, Greensboro, MD 21639
- Henderson - Henderson Rd, Henderson, MD 21640
- Federalsburg - Caroline Dr, Federalsburg, MD 21632
- Preston – Wright St, Preston, MD 21655
- Federalsburg – Industrial Park Rd, Federalsburg, MD 21632

Wastewater Treatment Plants (WWTP)

- Denton WWTP - 650 Legion Rd, Denton, MD 21629
- Federalsburg WWTP - 125 Kerney St, Federalsburg, MD 21632
- Greensboro WWTP Pump Stations - 13514 Greensboro Rd, Greensboro, MD 21639
- Greensboro WWTP - 13875 Greensboro Road, Greensboro, MD 21639
- Ridgely WWTP - 23236 W Belle Rd, Ridgely, MD 21660

Historic Properties

Historic properties in Caroline County were assessed for vulnerability for those hazards with a geographic extent (defined hazard area) and are included in Chapters 4, 5, 6, and 11. Specifically, the State's register of historic properties was assessed for properties within the County and its municipalities. A total of twenty-three (23) properties in Caroline County are registered in Maryland's National Register Properties.

- Athol (Building) - Melville Road, Melville Crossroads
- Brick House Farm (Building) - 24870 E. Cherry Lane, Ridgely
- Castle Hall (Building) - Goldsboro Marydel Road (MD 311), Goldsboro
- Chambers Park Log Cabin (Building) - 233 Kinder Street (In Chambers Park), Federalsburg
- Daffin House (Building) - Tuckahoe Road, Hillsboro
- Denton Armory (Building) - Maple Avenue & Randolph Street, Denton
- Denton Historic District - Denton
- Denton Schoolhouse (Building) - 104 S. Second Street, Denton
- Exeter (Building) - Three Bridges Road, Federalsburg
- Federalsburg West Historic District - Roughly bounded by Railroad Avenue, University Avenue, Bloomingdale Avenue, Denton Road, Idlewild Road, and Marshyhope Creek, Federalsburg, Caroline County
- Jacob and Hannah Leverton House (Building) - 3531 Seaman Road, Linchester
- Leonard House (Building) - 308 N. Main Street, Greensboro
- Linchester Mill (Building) - 3390 Linchester Road (3395 and 3400 Linchester Rd - NR complex), Preston
- Marble Head (Building) - 24435 Marble Head Road, Ridgely
- Memory Lane (Building) - 24700 Williston Road, Williston/Denton
- Nanticoke Lodge No. 172 AF & AM (Building) - 112-116 N. Main Street, Federalsburg
- Oak Lawn (Building) - 13590 Oakland Road (MD 312), Ridgely
- Potter Hall (Building) - 8148 Martin Lane, Williston
- St. Paul's Episcopal Church (Building) - 22005 Church Street, Denton
- The Neck Meetinghouse and Yard (Building) - Hillsboro Denton Road (MD 404), Denton
- West Denton Warehouse/Wharf (Building) - 10215 River Landing Road, Denton
- Williston Mill Historic District - 24729 Williston Road, Denton
- Willow Grove (Building) - Shepherd Church Road, Four Corners

[i] USAFACTS: Climate in Caroline County, Maryland
[ii] National Oceanic and Atmospheric Administration: Climate Change Impacts
[iii] First Street Foundation
[iv] FEMA Caroline County Flood Insurance Study – January 16, 2015
[v] FEMA Caroline County Flood Insurance Study – January 16, 2015
[vi] The Town of Denton Draft 2020 Comprehensive Plan
[vii] Federalsburg 2009 Comprehensive Plan
[viii] Goldsboro Comprehensive Plan 2009
[ix] Greensboro 2010 Comprehensive Plan
[x] FEMA Caroline County Flood Insurance Study – January 16, 2015
[xi] Town of Hillsboro Comprehensive Plan, 2009
[xii] Marydel Comprehensive Plan 2009
[xiii] Town of Preston Maryland Comprehensive Plan 2005
[xiv] The Town of Ridgely 2009 Comprehensive Plan
[xv] Templeville Comprehensive Plan 2009
[xvi] Goldsboro Comprehensive Plan 2009
[xvii] FEMA – Critical Facility
[xviii] FEMA – Community Lifeline
[xix] FEMA – Community Lifeline

Chapter 3 Hazard Identification & Risk Assessment

Chapter Updates

- Hazards and their associated risks were updated and discussed in this chapter from various perspectives:
  - Hazard Mitigation Planning Committee (HMPC) Perspective – Members Surveyed
  - Municipal Perspective – Municipalities Surveyed
  - State Perspective – State of Maryland 2021 Hazard Mitigation Plan
  - National Perspective – National Risk Index
- A more in-depth qualitative and quantitative assessment was completed for this plan update, which includes hazard risk for the eleven (11) natural hazards identified in this plan update.
- The Probability of Future Events was updated to reflect the 2023 Fifth National Climate Assessment.
- The Hazard Risk Analysis & Data section is the new assessment for the plan update. The methodology for this assessment is provided along with the hazard ranking results.
- Hazard event composite and narrative tables have been included in this chapter. Composite tables were incorporated into the hazard chapters.

Introduction

As part of the plan update process, hazards and their associated risks were updated and are discussed in this chapter from various perspectives:

- Hazard Mitigation Planning Committee (HMPC) Perspective – Members Surveyed
- Municipal Perspective – Municipalities Surveyed
- State Perspective – State of Maryland 2021 Hazard Mitigation Plan
- National Perspective – National Risk Index

Each of these perspectives have been further discussed and results presented in Tables 3-1 through 3-4.

In addition to hazard risk perspectives, a more in-depth qualitative and quantitative assessment was completed for this plan update, which includes hazard risk for the eleven (11) natural hazards identified. A composite score method was undertaken. The composite score method was based on a blend of quantitative and qualitative factors extracted from the National Centers for Environmental Information (NCEI) database, and other available data sources. These factors included:

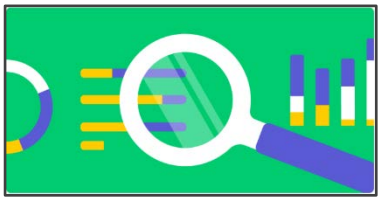
- Historical impacts, in terms of human lives and property;
- Geographic extent;
- Historical occurrence;
- Future probability; and,
- Community perspective.

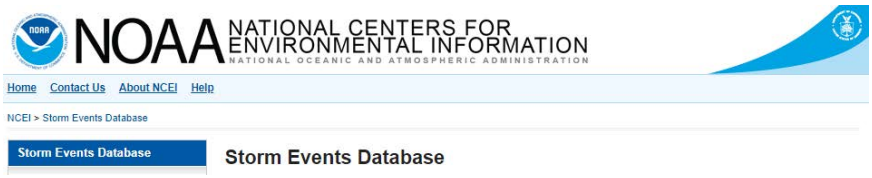
Qualitative

Relating to, measuring, or measured by the quality of something rather than its quantity.

Quantitative

Relating to, measuring, or measured by the quantity of something rather than its quality.





Hazard event data tables are provided in this chapter, however hazard specific composite results are used throughout the plan, specifically in the hazard chapters, 4-11.

Hazard Mitigation Planning Committee

As part of the plan update process, a new Hazard Mitigation Planning Committee (HMPC) including a cross-section of private and public sector members was formed. One of the initial tasks of the HMPC was to complete a hazard identification and risk assessment based upon their agency and/or local community perspective.

HMPC members reviewed previously identified hazards and made minor adjustments for this plan update. Two (2) new hazards were added and are included in Table 3-1. HMPC committee members were asked to complete an online survey, Hazard Mitigation Planning Committee Survey, which provided the opportunity to rate their level of concern for identified hazards. Results from the survey are provided on Table 3-1.

Table 3-1: HMPC Hazard Risk Perspective

HMPC PERSPECTIVE			
Hazard	**Types of Events**	**2019 Level of Concern**	**2023 Level of Concern**
Riverine Flooding	Heavy Rain, Flood, & Flash Flood	Concerned	Concerned
Coastal Flood (Tidal)	Coastal Flooding	Very Concerned	Somewhat Concerned
Hurricanes	Hurricanes, & Tropical Storms	Very Concerned	Concerned
Shoreline Erosion & Sea Level Rise	Shoreline Erosion & Sea Level Rise	Somewhat Concerned	Concerned
Winter Storms	Cold/Wind Chill, Extreme Cold/Wind Chill, Blizzard, Frost/Freeze, Heavy Snow, Sleet, Winter Storm, & Winter Weather	Concerned	Concerned
Drought & Excessive Heat	Drought, Excessive Heat, & Heat	Concerned	Concerned
Thunderstorms	Thunderstorm Wind, High Wind, Lightning, & Hail	Concerned	Concerned
Tornado	Funnel Cloud & Tornado	Somewhat Concerned	Somewhat Concerned
Power Outages	Power Outages	Somewhat Concerned	Concerned
New - Emerging Infectious Disease	Emerging Infectious Disease	N/A	Somewhat Concerned
New - Dam Failure	Dam Failure	N/A	Somewhat Concerned

Source: 2023 Hazard Mitigation Planning Committee

Comparing 2019 and 2023 ranking results, the following hazards remained the same: Riverine Flooding, Winter Storms, Drought and Excessive Heat, Thunderstorms, and Tornado. Rankings changed for the following hazards: Coastal Flood, Coastal Storms, Shoreline Erosion and Sea Level Rise, and Power Outages. Most of the ranking differences are small with the exception of the Coastal Flood, which is likely due to the limited percentage of land impacted by coastal/tidal flooding. Caroline County coastal land area is 37% and is located predominately in the southern portion of the County.

Note: According to FEMA's National Risk Index, specific to the wildfire hazard, the expected annualized frequency value is 0.143% chance per year. The overall risk index rating for the wildfire hazard in Caroline County is "relatively low." Therefore, Caroline County has omitted wildfire, as the aforementioned low risk of this hazard informed this decision. Wildfire was not included in the previous 2019 version of this plan.

Municipal Perspective

In addition to the survey completed by the HMPC, each municipality was given an opportunity to complete a separate municipal survey. Municipalities completed the survey from their perspective, not a countywide perspective. Results for the municipal survey are provided on Table 3-2.

Table 3-2: Municipal Hazard Risk Perspective

MUNICIPAL PERSPECTIVE											
Level of Concern	**Riverine Flooding**	**Coastal Flooding**	**Hurricanes**	**Shoreline Erosion & SLR**	**Winter Storms**	**Drought & Extreme Heat**	**Thunder-Storms**	**Tornado**	**Mass Power Outage**	**Emerging Infectious Disease**	**Dam Failure**
Municipality											
Denton											
Very					X	X			X		
Concerned				X			X			X	
Somewhat	X	X						X			
Not											X
Federalsburg											
Very	X		X								X
Concerned				X	X				X	X	
Somewhat		X				X	X	X			
Not											
Goldsboro											
Very											
Concerned			X		X	X	X		X		
Somewhat	X			X				X		X	
Not		X									X
Greensboro											
Very	X			X							
Concerned		X	X						X	X	
Somewhat						X	X	X			X
Not					X						
Henderson											
Very	X				X	X	X			X	
Concerned			X						X		
Somewhat								X			
Not		X		X							X
Hillsboro											
Very			X								
Concerned											
Somewhat		X		X	X	X			X		
Not	X						X	X		X	X
Marydel											
Very											
Concerned											
Somewhat	X		X		X	X	X	X	X	X	
Not		X		X							X
Preston											
Very											
Concerned											
Somewhat	X	X	X		X	X	X	X	X	X	
Not				X							X
Ridgely											
Very	X						X	X	X	X	
Concerned			X		X						
Somewhat						X					
Not		X		X							X
Templeville											

Very									X		
Concerned		X	X			X	X	X		X	
Somewhat	X			X	X						X
Not											

Source: Caroline County Municipalities, 2023

State Perspective

The Maryland Department of Emergency Management (MDEM) published the 2021 Maryland State Hazard Mitigation Plan Update, which includes the probability and impact of various hazards across the state. As shown on Table 3-3, the State hazard risk perspective specific to Caroline County does not include any high-risk hazards, however, does include four (4) medium high-risk hazards which includes: Drought, Flood, High Wind, and Public Health.

The identification of hazards in the 2021 Maryland State Hazard Mitigation Plan Update are similar to those used by Caroline County. However, rather than grouping all coastal related hazards together, Caroline County has chosen to distinctly profile coastal hazards separately. Results for the State hazard risk perspective for Caroline County are provided on Table 3-3.

Table 3-3: 2021 State Hazard Risk Perspective – Caroline County

STATE HAZARD RISK PERSPECTIVE – CAROLINE COUNTY		
Identified Hazard	**Type of Events**	**State Ranking**
Coastal	Coastal Flooding; Coastal Storms; Storm Surge; Hurricane/Tropical Storm; Nor'easter; Sea Level Rise; Shoreline Erosion; Tsunami	**Medium**
Drought	Drought; Extreme Heat	**Medium-High**
Flood	Flood	**Medium-High**
Thunderstorm	Thunderstorm; Lightning; Hail	**Medium**
Tornado	Tornado	**Medium-Low**
High Wind	Thunderstorm winds; Non-thunderstorm wind	**Medium-High**
Winter Storm	Winter Storm; Extreme Cold; Nor'easter (Snowfall)	**Medium**
Public Health	Epidemic; Endemic; Pandemic; Outbreak; Biological Agent/Toxin	**Medium-High**
Extreme Temperatures	Extreme Cold/Wind Chill; Excessive Heat	**Medium-Low**
Dam Failure	Dam Failure	**Medium-Low**

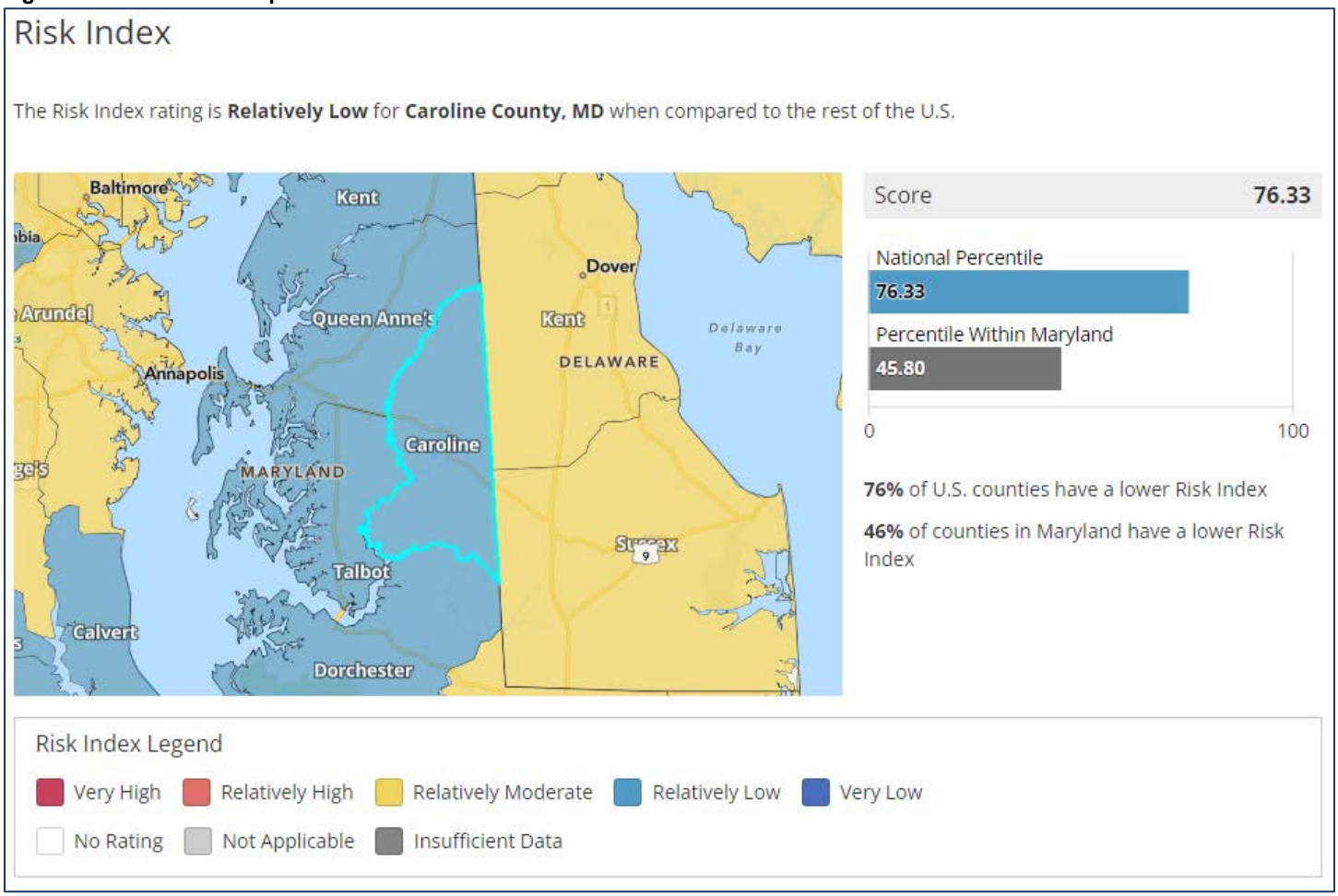
Source: 2021 State of Maryland Hazard Mitigation Plan

National Perspective

Information has been integrated from FEMA's recently updated National Risk Index, which according to FEMA has changed the way risk is assessed. The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards. The Risk Index leverages available source data for natural hazard and community risk factors to develop a baseline risk measurement for each United States county and Census tract.[i]

Using data and analysis from FEMA's National Risk Index, Caroline County's risk index is relatively low compared to other counties in the United States.

Figure 3-1: National Perspective



Source: National Risk Index – Caroline County

According to the National Risk Index report for Caroline County, hazard type risk ratings are calculated using data for only a single hazard type, and reflect a community's expected annual loss value, community risk factors, and the adjustment factor used to calculate the risk value. The report states that low risk is driven by lower loss due to natural hazards, lower social vulnerability, and higher community resilience.

Hazard type risk ratings for Caroline County compared to the rest of the United States are detailed in Table 3-4. The National Risk Index provides risk ratings for 18 natural hazards. Results for the National Risk Index – Hazard Type Risk Ratings perspective for Caroline County are provided on Table 3-4.

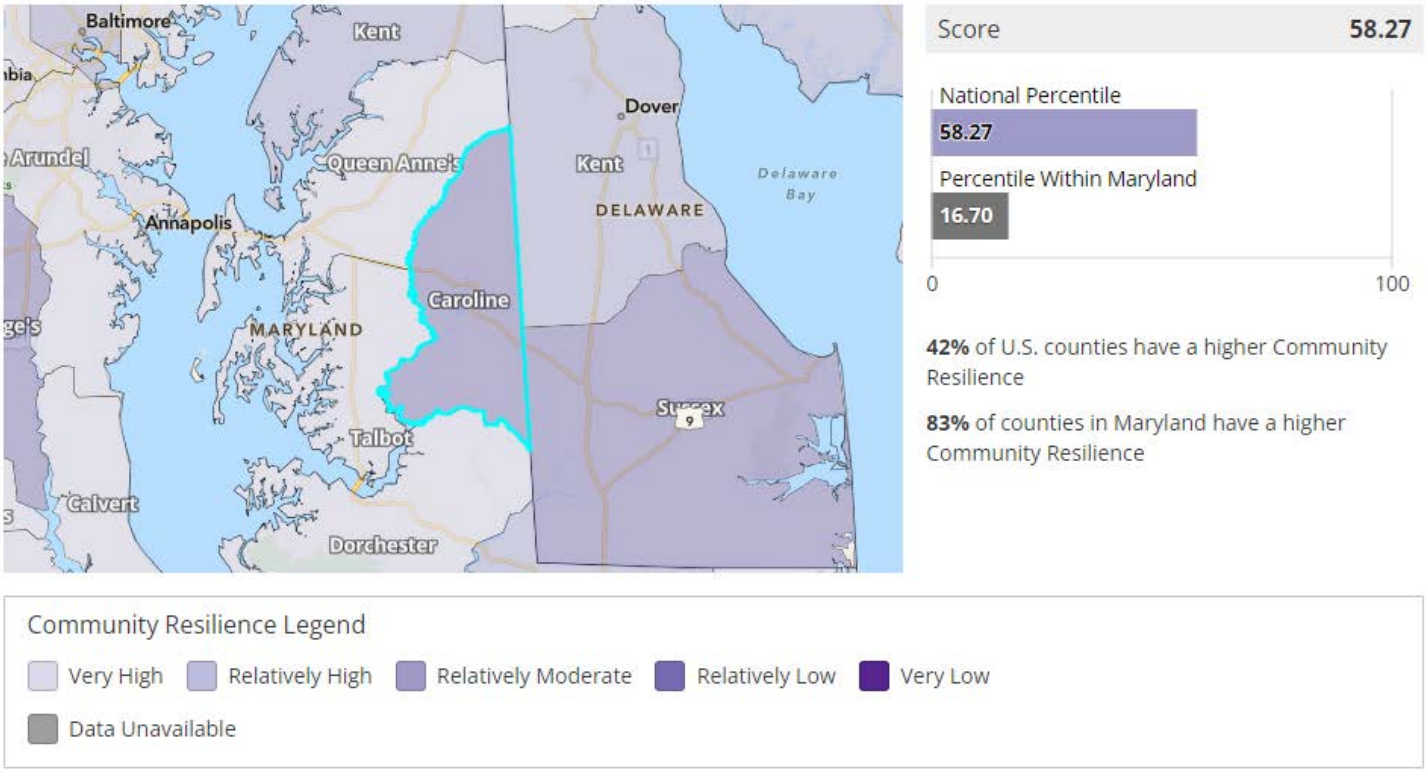
Table 3-4: National Risk Index - Hazard Type Risk Rating Perspective – Caroline County

HAZARD TYPE RISK RATINGS	
Identified Hazard	**National**
Coastal Flooding	**Relatively Low**
Drought	**Relatively Moderate**
Hail	**Relatively Low**
Heat Wave	**Relatively Moderate**
Hurricane	**Relatively Moderate**
Ice Storm	**Relatively Low**
Lightning	**Relatively Low**
Riverine Flooding	**Relatively Low**
Strong Wind	**Relatively Low**
Tornado	**Very Low**
Winter Storm	**Relatively Low**

Source: National Risk Index – Caroline County
Note: Hazards that do not impact or have the potential to impact Caroline County were not assessed in the National Risk Index and are not included in Table 3-4.

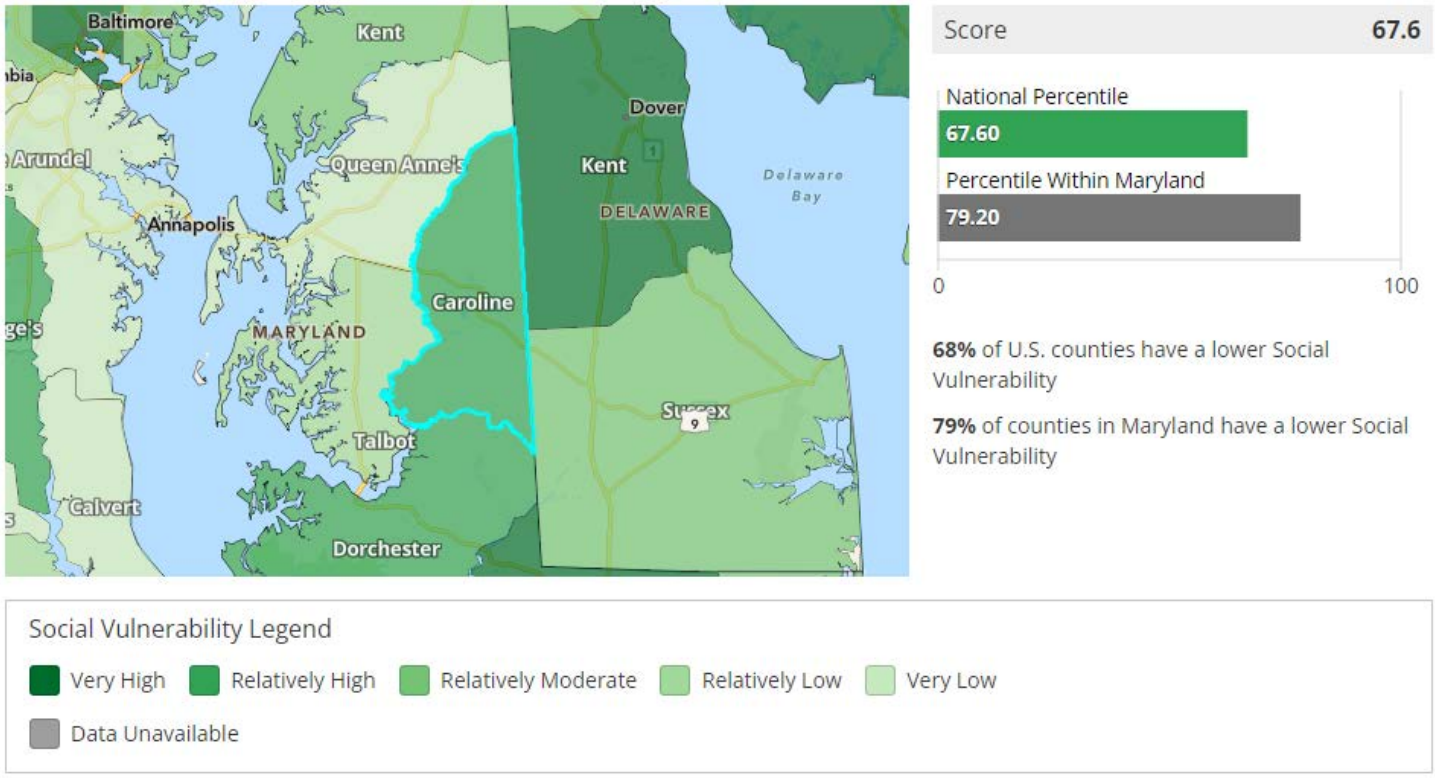
In addition, the National Risk Index provides perspective on both community resilience and social vulnerability. According to the report, communities in Caroline County have a Relatively Moderate ability to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions when compared to the rest of the U.S; Figure 3-2. Also, social groups in the County have a Relatively High susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S; Figure 3-3.

Figure 3-2: National Risk Index – Community Resilience



Source: National Risk Index – Caroline County

Figure 3-3: National Risk Index – Social Vulnerability



Source: National Risk Index – Caroline County

To further focus on the list of identified hazards for this Plan, Table 3-5 presents a list of all federal disaster and emergency declarations that have occurred in Caroline County since 1972, according to the Federal Emergency Management Agency. This list presents the foundation for identifying what hazards pose the greatest risk within Caroline County.

Table 3-5: Presidential Disasters and Emergency Declarations in Caroline County

Presidential Disasters and Emergency Declarations		
Declaration #	**Date**	**Event Details**
DR-341-MD	6/23/1972	Flood
DR-524-MD	1/26/1977	Snowstorm
EM-3100-MD	3/16/1993	Snowstorm
DR-1016-MD	3/16/1994	Snowstorm
DR-1081-MD	1/11/1996	Snowstorm
DR-1303-MD	9/24/1999	Hurricane
DR-1324-MD	4/10/2000	Severe Storm
EM-3179-MD	3/14/2003	Severe Storm
DR-1492-MD	9/19/2003	Hurricane
EM-3251-MD	9/13/2005	Hurricane
DR-1652-MD	7/2/2006	Severe Storm
DR-1875-MD	2/19/2010	Snowstorm
DR-1910-MD	5/6/2010	Snowstorm
EM-3335-MD	8/27/2011	Hurricane
DR-4034-MD	9/16/2011	Hurricane
EM-3349-MD	10/28/2012	Hurricane
DR-4091-MD	11/20/2012	Hurricane
DR-4261-MD	3/4/2016	Snowstorm
EM-3430-MD	3/13/2020	Biological (COVID-19)
DR-4491-MD	3/26/2020	Biological (COVID-19)

Probability of Future Events

The 2023 Fifth National Climate Assessment summarizes the impacts of climate change on the United States, now and in the future. In the Northeast, extreme weather events and other climate-driven changes are shaping mitigation and adaptation efforts, such as coastal wetland restoration and changes in fishing behavior. Many climate impacts in the region have disproportionate impacts on low-income communities and communities of color. Cities and states are implementing climate action plans with innovative approaches that embrace inclusive and equitable processes.[ii]

According to the 2023 Fifth National Climate Assessment, key messages for the Northeast Region include:

- **Key Message 1 - Chronic Impacts of Extreme Weather Are Shaping Adaptation and Mitigation Efforts**
  The Northeast continues to be confronted with extreme weather, most notably extreme precipitation—which has caused problematic flooding across the region—and heatwaves (very likely, high confidence). In response, climate adaptation and mitigation efforts, including nature-based solutions, have increased across the region (high confidence), with a focus on emissions reductions, carbon sequestration, and resilience building (medium confidence).
- **Key Message 2 - Ocean and Coastal Impacts Are Driving Adaptation to Climate Change**
  The ocean and coastal habitats in the Northeast are experiencing changes that are unprecedented in recorded history, including ocean warming, marine heatwaves, sea level rise, and ocean acidification (high confidence). Changing ocean conditions are causing significant shifts in the distribution, productivity, and seasonal timing of life-cycle events of living marine resources in the Northeast (high confidence). These impacts have spurred adaptation efforts such as coastal wetland restoration and changes in fishing behavior (high confidence).
- **Key Message 3 - Disproportionate Impacts Highlight the Importance of Equitable Policy Choices**
  Extreme heat, storms, flooding, and other climate-related hazards are causing disproportionate impacts among certain communities in the Northeast, notably including racial and ethnic minorities, people of lower socioeconomic status, and older adults (very likely, very high confidence). These communities tend to have less access to healthcare, social services, and financial resources and to face higher burdens related to environmental pollution and preexisting health conditions (very likely, high confidence). Social equity objectives are prominent in many local-level adaptation initiatives, but the amount of progress toward equitable outcomes remains uneven (very likely, high confidence).
- **Key Message 4 - Climate Action Plans Are Now Being Implemented**
  In recent years, there have been substantial advances in the magnitude and scope of climate action across all jurisdictional scales (high confidence). Almost every state in the region has conducted or updated a climate impact assessment, developed a comprehensive climate action plan, and enacted climate-related laws since 2018 (high confidence). Innovative approaches to transparent, inclusive, and equitable processes around climate action are being embraced by Tribes, municipalities, and states (high confidence). Although ambitious emissions reduction targets have been put forward, meeting these goals is expected to be challenging (medium confidence).
- **Key Message 5 - Implementation of Climate Plans Depends on Adequate Financing**
  Options for financing mitigation and adaptation efforts have expanded in recent years, providing households, communities, and businesses with more options for responding to climate change (high confidence). Flood insurance allows individuals and communities to recover following extreme flooding events, but many at-risk homeowners lack adequate coverage (high confidence). Although the public

sector remains the primary source of funding for adaptation, private capital has started to invest in a variety of mitigation and adaptation projects, including services for monitoring climate risks and community-based catastrophe insurance (high confidence).[iii]

Hazard Risk Analysis & Data

As part of the Plan Update process for Caroline County, a Hazard Identification and Risk Assessment (HIRA) has been completed. Hazard risk rankings have been assigned to each of the eleven (11) identified hazards. These scores are summarized in Table 3-9. Hazard definitions per the National Centers for Environmental Information (NCEI) are included within each data table and included in Table 3-10. Hazard definitions are also included in each hazard-specific chapter included within this plan.

A **risk** is the chance, high or low, that any hazard will occur and the severity or impact from that hazard.

Hazard Identification and Risk Assessment Method

The following ranking parameters (Tables 3-5 and 3-6) were used to develop the composite risk score, which provides the hazard ranking results (High, Medium, or Low) for the eleven (11) identified hazards. Each parameter was rated on a scale of one (1) to four (4). These parameters, along with their weights, are also included in Table 3-7.

Table 3-5: Ranking Parameters

Ranking Parameters	
Injuries and Death	**Ranking**
Death	4
N/A	3
Injury	2
None	1
Property and Crop Damage	**Ranking**
≥ $2M	4
≥ $501K	3
≥ $50k	2
≥ $0	1
Annualized Events	**Ranking**
≥ 2.51	4
≥ 1.01	3
≥ 0.11	2
≥ 0	1
Probability and Future	**Ranking**
Highly Likely (hazard event is likely to occur more than once every 5 years)	4
Likely (hazard event is likely to occur less than every 5 years, but more often than once every 30 years)	3
Occasional (hazard event is likely to occur once every 15 years)	2
Unlikely (hazard event is likely to occur less than once every 30 years)	1

Community Perspective*	Ranking
Very Concerned	4
Concerned	3
Somewhat Concerned	2
Not Concerned	1

Sources: National Centers for Environmental Information Storm Events Database

** Caroline County Hazard Mitigation Plan Update HMPC Risk Survey. The Community Perspective Ranking is derived from Question 3 of the HMPC Risk Survey, which is: "Please indicate your level of concern for each hazard." Options include "not concerned", "somewhat concerned", "concerned", and "very concerned."*

Table 3-6: Max Geographical Extent

Max Geographical Extent (Hazard Dependent) Ranking								
Ranking	**Coastal Hazards**	**Drought**	**Flood**	**Thunderstorm**	**Tornado & Earthquake**	**Wildfire**	**High Wind**	**Winter Weather**
1	0.00	0	0.00	0-2 events	0-10 events	0	0.00	10"-19"
2	25.00	0.18	10.00	3-5 events	11-17 events	0.4674	60.00	20"-29"
3	50.00	0.3421	20.00	6-8 events	18-22 events	2.1545	74.00	30"-39"
4	75.00	0.49	30.00	>9 events	>23 event	3.9041	95.00	>40"
Calculated Using:	% Coastal Land Area	% Crop Area	% Area in 100-yr Floodplain	Avg number based on: # of events, 2"> hail and lightning events with Injuries/Deaths	Sum of all tornados weighted by F-scale (F1*1.5, F2*2, F3*3, F4*4); Number of Earthquake Events	Average annual acres burned (%)	ASCE Design Wind Speeds	Average Snowfall
Source:	*COASTAL: Risk Area*	*DROUGHT: CDL MD*	*FLOOD: FIRMS*	*THUNDERSTORM: NCDC*	*TORNADO: NCDC EARTHQUAKE: Maryland Geological Survey*	*WILDFIRE: MD DNR Forest Service*	*WIND: ASCE*	*WINTER STORM: National Weather Service*

The weighted risk factors in Table 3-7 were used in the equation below to determine the composite risk score for each identified hazard.

Equation: Composite Score = IN + DT + PD + CD + (GE*1.5) + EV + FP + (CP*1.5)

Table 3-7: Weighted Risk Factors

Weighted Risk Factors		
Injuries	IN	**1**
Deaths	DT	**1**
Property Damage	PD	**1**
Crop Damage	CD	**1**
Geographic Extent (Hazard Dependent)	GE	**1.5**
Events (Annualized)	EV	**1**
Future Probability	FP	**1**
Community Perspective	CP	**1.5**

Hazard Ranking Results

Using the data tables described in the method to populate the parameters, the composite score was determined for each hazard identified in Table 3-9. Hazard Rankings were assigned accordingly using the Composite Score, Table 3-8 below. The highest possible composite score is 28.5.

Table 3-8: Composite Score

Composite Score	
Composite Score	**Hazard Ranking**
0 to 9.9	**Low**
10.0 to 12.9	**Medium-Low**
13.0 to 18.9	**Medium**
19.0 to 22.9	**Medium-High**
> 23.0	**High**

Table 3-9, following, provides the hazard risk ranking update results. Thunderstorm, Drought and Extreme Heat, and Riverine Flood were ranked "High." Winter Storm was ranked as "Medium-High" risk hazards. Coastal Flooding, Hurricanes, Mass Power Outage and Emerging Infectious Disease were ranked as "Medium" risk hazards. Shoreline Erosion and Sea Level Rise, Tornado and Dam Failure were ranked as "Medium-Low" risk hazards.

Table 3-9: HIRA Results

Hazard Risk Ranking Results										
Hazard	Injuries & Deaths		Property & Crop Damage		Geographic Extent	Total Events Annualized	Future Probability	Community Perspective	Composite Score	2023 Hazard Ranking
	IN	DT	PD	CD	GE	EV	FP	CP	CS	
Riverine Flooding	2	1	4	3	1	4	4	3	24	High
Coastal Flood (Tidal)	1	1	1	1	2	2	3	2	15	Medium
Hurricanes	1	1	2	1	2	2	3	3	17.5	Medium
Shoreline Erosion & Sea Level Rise	1	1	1	1	1	1	3	3	12.5	Medium-Low
Winter Storms	1	1	2	1	2	4	4	3	20.5	Medium-High
Drought & Excessive Heat	2	1	1	1	4	4	4	3	23.5	High
Thunderstorms	2	4	3	1	4	4	4	3	28.5	High
Tornado	1	1	2	1	1	1	2	2	12.5	Medium-Low
Power Outages	1	1	1	1	1	1	4	3	15	Medium
Dam Failure	1	1	1	1	1	1	1	2	10.5	Medium-Low
Emerging Infectious Disease	2	4	1	1	1	4	1	2	17.5	Medium

Data Tables

The following data tables are from each hazard profile. These tables are populated with data gathered from the NCEI Storm Events Database.

The data from these tables populated the injuries and deaths, property and crop damage, and total events annualized variables of the composite score. NCEI definitions for each hazard are included as part of the data tables.

Table 3-10 below includes all the hazards included in this plan, along with associated sub-hazards, as well as their definitions. These definitions are included for each hazard data table in this section, as well as in each hazard-specific chapter of this plan update.

Note, events included for each hazard were identified as having impacted Caroline County in the past. Due to the nature of the NCEI Storm Events Database, it is likely that event narratives include hazard impacts to other communities in Maryland.

Table 3-10: Hazard Definitions

Hazard Definitions	
Hazard	**NCEI Definition (as included within the NCEI Storm Events Database)**
FLOOD	
Flash Flooding	Based on NCEI definitions/criteria: Flash Flood (C). A life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam). Ongoing flooding can intensify to shorter-term flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. Flash flooding, such as dangerous small stream or urban flooding and dam or levee failures, requires immediate action to protect life and property. Conversely, flash flooding can transition into flooding as rapidly rising waters abate. The Storm Data preparer uses professional judgment in determining when the event is no longer characteristic of a Flash Flood and becomes a Flood.
Flood	Based on NCEI definitions/criteria: Flood (C). Any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property. If the event is considered significant, it should be entered into Storm Data, even if it only affected a small area. Refer to the Flash Flood event (Section 14) for guidelines for differentiating between Flood and Flash Flood events.
WINTER STORM	
Sleet	Based on NCEI definitions/criteria: Sleet (Z). Ice accretion meeting or exceeding locally/regionally defined warning criteria (typical value is 1/4 or 1/2 inch or more).
Winter Storm	Based on NCEI definitions/criteria: Winter Storm (Z). A winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Normally, a Winter Storm would pose a threat to life or property.
Winter Weather	Based on NCEI definitions/criteria: Winter Weather (Z). A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle). The Winter Weather event can also be used to document out-of-season and other unusual or rare occurrences of snow, or blowing/drifting snow, or freezing rain/drizzle. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.
Cold/Wind Chill	Based on NCEI definitions/criteria: Cold / Wind Chill (Z). (Z). Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -180 F or colder) conditions. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. There can be situations where advisory criteria are not met, but the combination of seasonably cold temperatures and low wind chill values (roughly 15 degrees F below normal) may result in a fatality. In these situations, a cold/wind chill event may be documented if the weather conditions were the primary cause of death as determined by a medical examiner or coroner. Normally, cold/wind chill conditions should cause human and/or economic impact.

Extreme Cold/Wind Chill	Based on NCEI definitions/criteria: Extreme Cold (Z). A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35 degrees F or colder). If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Normally these conditions should cause significant human and/or economic impact. However, if fatalities occur with cold temperatures/wind chills but extreme cold/wind chill criteria are not met, the event should also be included in Storm Data as a Cold/Wind Chill event and the fatalities are direct.
SEVERE WEATHER	
Thunderstorm Wind	Based on NCEI definitions/criteria: Thunderstorm Wind (C). Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if the result in fatalities, injuries, or serious property damage. Storm Data software permits only one event name for encoding severe and non-severe thunderstorm winds. The Storm Data software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.
Hail	Based on NCEI definitions/criteria: Hail (C). Frozen precipitation in the form of balls or irregular lumps of ice. Hail 3/4 of an inch or larger in diameter will be entered. Hail accumulations of smaller size, which cause property and/or crop damage or casualties, should be entered. Maximum hail size will be encoded for all hail reports entered.
Lightning	Based on NCEI definitions/criteria: Lightning (C). A sudden electrical discharge from a thunderstorm, resulting in a fatality, injury, and/or damage.
High Wind	Based on NCEI definitions/criteria: High Wind (Z). Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.
TORNADO	
Tornado	Based on NCEI definitions/criteria: Tornado (C). A violently rotating column of air, extending to or from a cumuliform cloud or underneath a cumuliform cloud, to the ground, and often (but not always) visible as a condensation funnel. For a vortex to be classified as a tornado, it must be in contact with the ground and extend to/from the cloud base, and there should be some semblance of ground-based visual effects such as dust/dirt rotational markings/swirls, or structural or vegetative damage or disturbance.
Funnel Cloud	Based on NCEI definitions/criteria: Funnel Cloud (C). A rotating, visible extension of a cloud pendant from a convective cloud with circulation not reaching the ground. The funnel cloud should be large, noteworthy, or create strong public or media interest to be entered.
EXTREME HEAT	
Heat	Based on NCEI definitions/criteria: Heat (Z). A period of heat resulting from the combination of high temperatures (above normal) and relative humidity. A Heat event occurs and is reported in Storm Data whenever heat index values meet or exceed locally/regionally established advisory thresholds. Fatalities or major impacts on human health occurring when ambient weather conditions meet heat advisory criteria are reported using the Heat event. If the ambient weather conditions are below heat advisory criteria, a Heat event entry is permissible only if a directly related fatality occurred due to unseasonably warm weather, and not man-made environments.
DROUGHT	
Drought	Based on NCEI definitions/criteria: Drought (Z). Drought is a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area. Conceptually, drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. There are different kinds of drought: meteorological, agricultural, hydrological, and social-economic. Each kind of drought starts and ends at different times.

Flood

Table 3-11: Heavy Rain Event Composite

Heavy Rain Events - 1996 –2023		
52 Heavy Rain events - Frequency 1.93		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	
Number of Days with Event and Crop Damage:	0	
Number of Event Types reported:	52	**Heavy Rain**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Heavy Rain (C). An unusually large amount of rain which does not cause a Flash Flood or Flood event, but causes damage, e.g., roof collapse or other human/economic impact. Heavy Rain will no longer be acceptable as a means to record low-impact or isolated flood events.		

Table 3-12: Heavy Rain Event Narratives

Location	Date	Event Narrative
Countywide	July 12, 1996 to July 13, 1996	Tropical Storm Bertha passed through Southeast Maryland the morning of the 13th. The strongest winds remained near the shore, but wind gusts did become strong enough to take down tree branches across the Eastern Shore. Storm totals averaged between 3 and 5 inches. Most of the rain fell during a twelve to eighteen-hour period, there was some urban and poor drainage flooding, but no major problems. Rainfall at Federalsburg was 4.9 inches.
Countywide	August 12, 1996 to August 13, 1996	Storm totals averaged 2 to 3 inches, but since this was spaced over 24 hours, flooding was generally confined to poor drainage locations.
Countywide	October 8, 1996	Heavy rain associated with the remnants of Tropical Storm Josephine affected the Maryland Eastern Shore primarily during the daylight hours on the 8th. Peak wind gusts reached between 30 and 40 mph in most areas. While the heavy rain did cause the usual poor drainage flooding, recent dry weather and foliage still on the trees prevented further flooding. The wind gusts did pull down some small limbs. Storm totals included 2.40 inches in Federalsburg, 1.90 inches in Newark, Delaware and 0.87 inches in Conowingo.
Countywide	October 18, 1996	N/A
Countywide	December 12, 1996	A slow-moving low-pressure system moved from the central Ohio Valley the morning of the 12th to Williamsburg Virginia the morning of the 13th to about 100 miles east of Fenwick Island Delaware the morning of the 14th and then drifted southeast to about 275 miles southeast of Fenwick Island Delaware the morning of the 15th. This produced about 48 hours of continuous rain from the evening of the 12th through the evening of the 14th. Rain became heavy at times during the night of the 13th. Storm totals averaged between two and three inches. Since the rain was spread over an extended period, only some urban and poor drainage flooding occurred. Precipitation totals included 3.76 inches at Newark Delaware, 2.85 inches at the Baltimore-Washington International Airport and 1.86 inches at Salisbury.
Countywide	December 31, 1996	December 1996 was one of the wettest Decembers on record for the Maryland Eastern Shore. Rainfall amounts were three to five inches above normal.
Countywide	May 25, 1997 to May 26, 1997	Storm totals averaged 1.5 to 2.5 inches, with some locally lower amounts.
Countywide	August 20, 1997	Storm totals averaged between 5 to 8 inches across Caroline County.
Countywide	January 23, 1998	Storm totals averaged between 1.25 inches and 2.25 inches across the Maryland Eastern Shore.
Countywide	January 28, 1998	Storm totals ranged from around 3.5 inches in southern parts of Caroline County. In Caroline County most, roads were littered with tree limbs.
Countywide	February 4, 1998 to February 5, 1998	In Caroline County, along tidal sections of the Choptank River, a couple of roads were closed on the 5th.
Countywide	February 23, 1998	Storm totals included 2.40 inches in Federalsburg.
Countywide	March 8, 1998 to March 9, 1998	Storm precipitation totals included 1.50 inches in Federalsburg.
Countywide	March 31, 1998	Continuing a trend that has persisted all year long, March 1998 was unseasonably wet across the Delmarva Peninsula. Monthly precipitation totals on a county weighted average were between 5.2 and 6.3 inches, a departure of about 2.0 to 2.5 inches above normal.

Location	Date	Event Narrative
Countywide	May 8, 1998	A series of low-pressure systems that passed through the Middle Atlantic States and then stalled offshore gave the Maryland Eastern Shore nearly five days of continuous rain from when it started early in the morning on Friday the 8th until it exited the state from north to south on Tuesday the 12th. Storm totals averaged between 2.0 to 3.0 inches. Storm totals included 3.09 inches in Conowingo (Cecil County), 2.80 inches in Salisbury, 2.14 inches at the Baltimore -Washington International Airport and 2.00 inches in Federalsburg (Caroline County).
Countywide	October 8, 1998	The storm total in Federalsburg was 3.1 inches.
Countywide	January 3, 1999	Doppler Radar storm total estimates for the entire event averaged between 1.0 and 2.0 inches across the Maryland Eastern Shore.
Countywide	January 15, 1999	There was some poor drainage flooding, but no serious problems were reported. The storm total in Federalsburg was 2.1 inches.
Countywide	January 31, 1999	January 1999 finally broke a string of unseasonably dry months that prevailed during the second half of 1998. Along the Eastern Shore, January monthly precipitation totals averaged around 200% of normal. On a county weighted average, precipitation monthly totals ranged from 5.8 inches in Kent County to 6.8 inches in Caroline County and was about 3 inches above normal.
Countywide	March 21, 1999 to March 22, 1999	No serious flooding or damage was reported. Storm totals included 1.5 inches in Federalsburg.
Central Portion	July 22, 1999	Storm totals included 3.08 inches in Denton.
Countywide	August 25, 1999	A warm front that slowly moved through the Eastern Shore during the evening of the 25th helped trigger thunderstorms with heavy rain. Radar estimated storm totals ranged from one to three inches.
Countywide	September 30, 1999	Courtesy of Hurricane Floyd, September 1999 went down as one of the wettest Septembers on record. In the state of Maryland, the statewide monthly average rainfall of 9.02 inches was the third wettest September on record since 1895. Monthly county weighted rainfall amounts averaged even higher along the Eastern Shore, all in the double digits.
Countywide	December 13, 1999 to December 14, 1999	Storm totals included 1.20 inches in Federalsburg (Caroline County).
Countywide	March 21, 2000 to March 22, 2000	Storm totals included 3.6 inches in Federalsburg (Caroline County).
Federalsburg	June 27, 2000	Thunderstorms dropped heavy rain across southern Caroline County during the late afternoon of the 27th. Storm totals averaged between 1 and 3 inches and caused considerable poor drainage flooding. No serious injuries were reported. The storm total from Federalsburg was 2.80 inches.
Countywide	September 30, 2000	September 2000 continued the trend of unseasonably wet weather for the Maryland Eastern Shore. On a county weighted average, September monthly rainfall totals were all above average and ranged from 4.9 inches in Cecil County to 6.7 inches in Caroline County. Normal monthly rainfall is around 3.7 inches.
Countywide	September 25, 2000 to September 26, 2000	Storm totals included 3.20 inches in Federalsburg (Caroline County).
Countywide	March 21, 2001	Storm totals included 2.20 inches in Federalsburg (Caroline County).
Countywide	May 25, 2001 to May 26, 2001	Storm totals included 2.5 inches in Federalsburg (Caroline County).
Countywide	October 10, 2002 to October 11, 2002	Two-day storm totals were 3.90 inches in Federalsburg (Caroline County).
Countywide	February 22, 2003	Storm totals included 1.50 inches in Federalsburg (Caroline County).
Countywide	May 16, 2003	Storm totals included 3.40 inches in Federalsburg (Caroline County).
Countywide	June 20, 2003	Storm totals included 1.60 inches in Federalsburg (Caroline County).
Countywide	September 18, 2003	Storm totals included 3.40 inches in Federalsburg (Caroline County), 3.13 inches in Denton (Caroline County).
Countywide	February 6, 2004	Storm totals included 1.20 inches in Federalsburg (Caroline County).
Countywide	April 12, 2004 to April 13, 2004	Specific storm totals included 2.50 inches in Federalsburg (Caroline County)
Countywide	May 20, 2005	Specific storm totals included 4.30 inches in Federalsburg (Caroline County).
Countywide	October 7, 2005 to October 8, 2005	Remnants of Tropical Storm Tammy produced very heavy rain across the Maryland Eastern Shore from the late evening on the 7th into the afternoon of the 8th. Doppler Radar storm total estimates averaged between three and six inches with the highest amounts in Caroline County.
Federalsburg	March 16, 2007	Precipitation storm totals included 3.00 inches in Federalsburg (Caroline County).
Federalsburg	April 15, 2007 to April 16, 2007	The gusty northwest winds on Monday the 16th caused scattered power outages for both Delmarva Power and Choptank Electric Cooperative. Storm totals included 5.63 inches in American Corner (Caroline County), 3.80 inches in Federalsburg (Caroline County).
Denton & Greensboro	December 11, 2008 to December 12, 2008	Event precipitation totals included 3.16 inches in Greensboro and 3.12 inches in Denton.
Choptank	November 12, 2009 to November 13, 2009	Event precipitation totals included 2.99 inches in Denton (Caroline County), 2.90 inches in Greensboro (Caroline County)

Location	Date	Event Narrative
Mt. Zion	March 13, 2010	Event precipitation totals included 3.47 inches in Greensboro and 3.03 inches in Denton.
Hillsboro	September 19, 2016	The remnants of tropical storm Julia and a frontal boundary interacted leading to several rounds of rainfall over the region. Two three quarters of an inch of rainfall was measured.
Greensboro	September 19, 2016	The remnants of tropical storm Julia and a frontal boundary interacted leading to several rounds of rainfall over the region. Over five and a half inches of rain was measured with 4 inches in two hours.
American Corners	September 19, 2016	The remnants of tropical storm Julia and a frontal boundary interacted leading to several rounds of rainfall over the region. Just over 5 inches of rain was measured with 4 inches in 3 hours.
Williston	September 19, 2016	The remnants of tropical storm Julia and a frontal boundary interacted leading to several rounds of rainfall over the region. Three and a half inches of rain fell in 90 minutes.
Greensboro	September 29, 2016	A slow-moving frontal boundary coupled with tropical moisture advecting northward ahead of the front led to rounds of heavy showers in Maryland from the 27th into the next couple of days. Several occurrences of both nuisance and flash flooding were also reported. Three inches of rain fell.
Federalsburg	September 29, 2016	A slow-moving frontal boundary coupled with tropical moisture advecting northward ahead of the front led to rounds of heavy showers in Maryland from the 27th into the next couple of days. Several occurrences of both nuisance and flash flooding were also reported. Four and a half inches of rain fell.
2023 HMP Update		
Hillsboro	August 5, 2022	Scattered thunderstorms developed across the Delmarva peninsula resulting in locally heavy rainfall and isolated wind damage. Mesonet station TS817 storm total rainfall near Tuckahoe
Hillsboro	August 6, 2022	Scattered thunderstorms developed across the Delmarva peninsula resulting in locally heavy rainfall and isolated wind damage. CoCoRaHS station MD-CL-10 storm total rainfall 5.8 miles west-southwest of Denton.

Source: National Center for Environmental Information (NCEI), 2023.

Note: No property damage was reported in the National Environmental for Center Information.

Table 3-13: Flood Event Composite

Flood Events Caroline County from January 1996 – June 2023		
8 Flood events – Frequency 0.30		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	2	$1.050M
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	8	**Flood**

Source: National Center for Environmental Information (NCEI), 2023.
Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone.
Based on NCEI definitions/criteria: Flood (C). Any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property. If the event is considered significant, it should be entered into Storm Data, even if it only affected a small area. Refer to the Flash Flood event (Section 14) for guidelines for differentiating between Flood and Flash Flood events.

Table 3-14: Flood Events Narratives

Location	Date	Event Narrative	Property Damage
Countywide	September 1, 2006	The combination of the remnants of Tropical Storm Ernnesto and a large high-pressure system over eastern Canada produced heavy rain and strong winds along the Maryland Eastern Shore. Actual storm totals included 5.50 inches in American Corner (Caroline County), 4.90 inches in Federalsburg (Caroline County),	Not Available
Hillsboro	December 9, 2009 to December 10, 2009	The heavy rain caused flooding along the three main waterways in Caroline County and forced traveling detours into the 10th. The Tuckahoe Creek flooded near Maryland State Route 404 in Queen Anne and Hillsboro. In Federalsburg, flooding along the Marshy Hope Creek flooded the marina and park. Sheds, outbuildings, and fields were flooded. Roadways were also closed in Ridgely and Denton. Event precipitation totals included 2.80 inches in Federalsburg, 2.59 inches in Denton and 2.58 inches in Greensboro.	Not Available

Location	Date	Event Narrative	Property Damage
Dessard	August 28, 2011	In Caroline County, about two dozen homes and businesses were damaged by flooding and wind. Flooding occurred along the Choptank River in Greensboro. Flooding also occurred along Marshyhope Creek in Federalsburg. Flooding rains forced the closure of sections of Maryland State Routes 313, 619, 314 and 480. In all the combination of wind and flooding rain closed twenty roadways in the county. Auction Road near Harmony was the hardest hit and took weeks to re-open. Event rainfall totals included 11.68 inches in Denton, 10.50 inches in Hickman and 9.58 inches in Greensboro.	$250.00K
Choptank	October 29, 2012	The heavy rain that fell across Caroline County not only caused poor drainage flooding but exacerbated the tidal flooding along Chesapeake Bay. Event precipitation totals included 10.55 inches in American Corner, 9.93 inches in Greensboro and 8.93 inches in Denton.	$800.00K
Newton	May 2, 2016	High water was reported near Rabbit Hill Rd and Route 309.	Not Available
Denton	May 2, 2016	Heavy rain from thunderstorms resulted in some high water on roadways with no road closures.	Not Available
Choptank	September 29, 2016	Intersection of Waterstreet and Choptank roads closed due to flooding	Not Available
2023 HMP Update			
Greensboro	May 19, 2018	Head rain led to flooding along the Choptank River. The Greensboro gage along the Choptank River exceeded flood stage, due to 3 to 5 inches of rainfall over three days, resulting in minor flooding on the Greensboro Carnival Ground and a few backyards along the river.	Not Available

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-15: Flash Flood Event Composite

Flash Flood Events Caroline County from January 1996 – June 2023		
19 Flash Flood events – Frequency 0.70		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	1	
Number of Days with Event and Property Damage:	4	$7.360M
Number of Days with Event and Crop Damage:	2	$1.01M
Number of Event Types reported:	19	**Flash Flood**

Source: National Center for Environmental Information (NCEI), 2023.
Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone.
Based on NCEI definitions/criteria: Flash Flood (C). A life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam). Ongoing flooding can intensify to shorter-term flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. Flash flooding, such as dangerous small stream or urban flooding and dam or levee failures, requires immediate action to protect life and property. Conversely, flash flooding can transition into flooding as rapidly rising waters abate. The Storm Data preparer uses professional judgment in determining when the event is no longer characteristic of a Flash Flood and becomes a Flood.

Table 3-16: Flash Flood Event Narrative

Location	Date	Event Narrative	Property Damage
Western	June 20, 1996	N/A	Not Available
Countywide	September 16, 1999 to September 17, 1999	In Caroline County, towns near rivers (Denton, Federalsburg, Greensboro, and Hillsboro) bore the brunt of the damage. Six roads and thirty bridges needed repairs. About 20 people were in shelters throughout the county. A dam break near Harmony closed Maryland State Route 16. Other dam failures or spillovers occurred on Lake Bonnie near Goldsboro, Crouse Mill in Tuckahoe State Park and Chambers Lake near Federalsburg. Three schools suffered water damage. Large pieces of roadways collapsed on Maryland State Route 480 and Second Street in Denton. Infrastructure damage alone was estimated as high as 2.5 million.	$3.25Million
West Portion	July 15, 2000	Doppler Radar Storm total estimates reached between 3 and 4 inches around western Caroline County. Storm totals included 2.7 inches in Federalsburg (Caroline County).	Not Available

Location	Date	Event Narrative	Property Damage
Countywide	June 17, 2001	Showers and thunderstorms associated with the remnants of Tropical Storm Allison dropped heavy rain across Caroline County during the early morning of the 17th. The heavy rain caused flash flooding of streams as well as damage to crops in the county. Forty-one roads had washouts and eleven roads were closed. Three roads remained closed at the start of the work week (the 18th) and one bridge needed to be inspected for possible damage. Five percent of the agricultural land within the county was damaged by the flooding. No serious injuries were reported. Storm totals included 7.50 inches in Denton, 5.80 inches in American Corner and 4.80 inches in Federalsburg. The remnants of Allison had lesser effect elsewhere across the Maryland Eastern Shore, where Doppler Radar storm total estimates were mainly between one and two inches.	$10K
Southern Portion	August 11, 2001	Doppler Radar storm total estimates reached between 3 and 5 inches across southern Caroline County. Along the Caroline and Talbot County border, Maryland State Route 328 was flooded near Tuckahoe Creek. Federalsburg (Caroline County) reported 3.50 inches of rain.	Not Available
Southern Portion	June 25, 2006	Repeating thunderstorms with torrential downpours dropped up to around one foot of rain across southern parts of Caroline County. This caused extensive roadways, field and stream flooding. The hardest hit was Federalsburg where 11.5 inches of rain fell. An emergency was declared the morning of the 25th. About 40 people were evacuated along Marshyhope Creek where the worst flooding occurred. President George W. Bush declared Caroline and County a disaster area.	$5M
Northeast Portion	June 26, 2006	Slow moving thunderstorms with heavy rain caused roadway, low lying area and creek flooding mainly in the eastern parts of Caroline County. Doppler Radar storm total estimates averaged between two and five inches for the day. A Skywarn spotter reported 4.61 inches of rain for the calendar day in Denton (Caroline County).	Not Available
Ridgely	August 25, 2007 to August 26, 2007	Thunderstorms with torrential downpours caused flooding of smaller streams, fields and poor drainage areas in west central Caroline County. Doppler Radar storm total estimates were 3 to 5 inches.	Not Available
Baltimore Corner	August 22, 2009	Torrential downpours from nearly stationary thunderstorms caused major damage to several roads and properties in Ridgely, Greensboro, and Goldsboro in Caroline County. A rainfall measurement from Ridgely came in with a storm total of 9.55 inches of rain. In Ridgely, seven roads including Maryland State Road 480 were closed due to flooding and three (Central Avenue, Holly Road and Peaviner Road) of them are expected to be closed for a while due to roadway damage.	$110K
Ridgely	August 22, 2009	Thunderstorms with torrential downpours rapidly caused flash flooding of smaller streams and roadways in central Caroline County. Event precipitation totals included 13.13 inches in Ridgely and 6.65 inches in Denton.	Not Available
Denton	August 28, 2009	Thunderstorms with heavy downpours caused flash flooding within the Choptank River Basin in Caroline County. A couple of roadways were closed in Ridgely and also between Ridgely and Denton.	Not Available
Marydel	August 27, 2011 to August 28, 2011	Hurricane Irene produced heavy flooding rain, tropical storm force wind gusts and caused one wind related death across the Eastern Shore. Tropical storm force wind gusts overspread the Eastern Shore during the afternoon and early evening of the 27th and persisted into the afternoon of the 28th. Peak wind gusts averaged 50 to 60 mph. The strongest winds associated with Irene occurred at two distinct times. The first surge occurred during bands of heavier rain during the evening and late night of the 27th. The second peak occurred during the late morning and early afternoon of the 28th when skies were clearing, and deeper mixing of the atmosphere brought stronger winds to the ground. The rain associated with Irene overspread the Eastern Shore between 7 a.m. EDT and Noon EDT on the 27th, fell at its heaviest from the late afternoon of the 27th into the early morning of the 28th and ended around Noon EDT on the 28th. Event precipitation totals averaged 6 to 12 inches and caused widespread field and roadway flooding. Because the flash flooding and flooding blended into one, all flooding related county entries were combined into one under flood events. On August 25, Maryland Governor Martin O'Malley declared a state of emergency in preparation for Irene. In Caroline County, sections of Maryland State Routes 287, 313, 31 and 311 were among twenty roadways that were closed. Two dozen homes were damaged by the flooding and wind. About 5,500 homes and businesses lost power.	Not Available
Harmony	August 26, 2012	Thunderstorms with torrential downpours caused flash flooding in western Caroline County. Doppler Radar storm total estimates were around 8 inches.	Not Available
Harmony	August 26, 2012	Thunderstorms with torrential downpours caused small stream and drainage flash flooding in northern Caroline County. Doppler Radar storm total estimates were around 7 inches. Event precipitation totals included 5.30 inches in Denton.	Not Available
Dessard	September 2, 2012	Thunderstorms with torrential downpours caused flash flooding in Federalsburg. A few roadways were flooded and closed.	Not Available

Location	Date	Event Narrative	Property Damage
Mt Zion	June 7, 2013	Heavy rain caused flash flooding along several roadways and along small streams in Caroline County from the late afternoon through the night of the 7th. High water led to several road closures near Denton; including River Road, the intersection of New Bridge Road and Saulsbury Road, and the intersection of Burrsville Road and Baker Road. A section of Sunset Boulevard in Ridgely and a stretch of American Corner Road in Harmony were also closed for a time due to flooding. In addition, four trees were downed in the county due to the combination of heavy rain and saturated ground. The locations for the downed trees are as follows: County Farm Road near Denton, the intersection of Craft Road and Seaman Road in Preston, and the intersection of Jarrell Road and Drapers Mill Road in Goldsboro. Event precipitation totals included 5.52 inches in Denton, 5.18 inches in Greensboro, 5.05 inches in Hillsboro, and 2.78 inches in Newton.	Not Available
Hillsboro	July 12, 2013	Thunderstorms with torrential downpours caused flash flooding of creeks and roadways in southwestern Caroline County near the Tuckahoe River. Event precipitation totals included 3.42 inches in Henderson, 2.66 inches in Greensboro and 1.80 inches in Federalsburg. Doppler Radar storm total estimates reached 4 inches in the heaviest band in the county.	Not Available
Denton	September 29, 2016	Three to five inches of rain fell mostly in a short duration. Flooding closed River landing road.	Not Available
2023 HMP Update			
Denton	August 11, 2018	Several areas of flash flooding occurred due to heavy rain. Rainfall totals of 1 to 3 inches were reported in northeastern Maryland. Additionally, severe thunderstorms impacted the area. Flash flooding occurred on Route 404 to the south of Denton.	Not Available

Source: National Center for Environmental Information (NCEI), 2023.

Hurricanes

Table 3-17: Tropical Storm Event Composite

Tropical Storm Events Caroline County from January 1996 – June 2023		
4 Tropical Storm events – Frequency 0.15		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	1	$135,000
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	4	**Tropical Storm**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Tropical Storm (Z). A tropical cyclone in which the 1-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph). A Tropical Storm should be included as an entry when these conditions are experienced in the WFO's (Weather Forecast Office) CWA (County Warning Area).		

Table 3-18: Tropical Storm Event Narrative

Storm Event	Date	Event Narrative	Property Damage
Tropical Storm Isabel	September 18 to September 19, 2003	Storm totals included 3.40 inches in Federalsburg (Caroline County), 3.13 inches in Denton (Caroline County)	Not Available
Tropical Storm Hanna	September 6, 2008	Tidal flooding occurred during the early evening as the surge averaged two to three feet and affected mainly Talbot and Caroline Counties. Peak wind gusts included 37 mph in Ridgely (Caroline County). Precipitation totals included 1.99 inches in American Corner (Caroline County), 1.61 inches in Denton (Caroline County). The storm surge was estimated to reach 4 feet above normal in the Choptank River in Caroline County.	Not Available
Tropical Storm Irene	August 28 to August 29, 2011	Hurricane Irene produced heavy flooding rain, tropical storm force wind gusts and caused one wind related death across the Eastern Shore. Preliminary damage estimates were around three million dollars and approximately 85,000 homes and businesses lost power. Power was not fully restored until September 1st. The combination of heavy rain and wind closed numerous roadways across the Eastern Shore and downed thousands of trees. Some schools were unable to open on Monday August 29th. There was a temporary ban on harvesting shellfish along Chesapeake Bay because of the excessive runoff. Some tomato, corn, watermelon, and cantaloupe crops were destroyed. It was estimated that 30,000 chickens were also killed by the effects of Irene. Tropical storm force wind gusts overspread the Eastern Shore during the afternoon and early evening of the 27th and persisted into the afternoon of the 28th. Peak wind gusts averaged 50 to 60 mph. The strongest winds associated with Irene occurred at two distinct times. The first surge occurred during bands of heavier rain during the evening and late night of the 27th. The second peak occurred during the late morning and early afternoon of the 28th when skies were clearing, and deeper mixing of the atmosphere brought stronger winds to the ground. The rain associated with Irene overspread the Eastern Shore between 7 a.m. EDT and Noon EDT on the 27th, fell at its heaviest from the late afternoon of the 27th into the early morning of the 28th and ended around Noon EDT on the 28th. Event precipitation totals averaged 6 to 12 inches and caused widespread field and roadway flooding. Because the flash flooding and flooding blended into one, all flooding related county entries were combined into one under flood events. On August 25, Maryland Governor Martin O'Malley declared a state of emergency in preparation for Irene In Caroline County, sections of Maryland State Routes 287, 313, 31 and 311 were among twenty roadways that were closed. Two dozen homes were damaged by the flooding and wind. About 5,500 homes and businesses lost power.	$135K
2023 HMP Update			
Tropical Storm Isaias	August 4, 2020	Tropical Storm Isaias brought high winds, heavy rain, several tornadoes, and coastal flooding to the mid-Atlantic region, becoming the most impactful tropical cyclone to impact most of the region since Sandy in 2012. A couple reports of downed trees and road closures were received. Observations from surrounding counties suggest it is very likely sustained tropical storm force winds occurred.	Not Available

Source: National Center for Environmental Information (NCEI), 2023.

Note: No hurricanes or tropical depressions were reported in the National Environmental for Center Information for Caroline County.

Coastal Flood

Table 3-19: Coastal Flood Event Composite

Coastal Flood Events Caroline County from January 1996 – June 2023		
4 Coastal Flood events – Frequency 0.18		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	5	**Coastal Flood**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Coastal Flood (Z). Flooding of coastal areas due to the vertical rise above normal water level caused by strong, persistent onshore wind, high astronomical tide, and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Coastal areas are defined as those portions of coastal land zones (coastal county/parish) adjacent to the waters, bays, and estuaries of the oceans. Farther inland, the Storm Data preparer determines the boundary between coastal and inland areas, where flood events will be encoded as Flash Flood or Flood rather than Coastal Flood. Terrain (elevation) features will determine how far inland the coastal flooding extends.		

Table 3-20: Coastal Flood Event Narrative

Storm Event	Date	Event Narrative
Coastal Flood	09/06/1996	The remnants of Hurricane Fran moved through West Virginia on the 6th reaching northwest Pennsylvania the morning of the 7th. The strong south to southeast winds accompanying it caused tidal flooding along Chesapeake Bay. Flooding also extended inland along tidal sections of rivers and creeks that drain into the bay. The tide gage at Tolchester Beach in Kent County reached 4.8 feet above mean low water. This was a tidal departure of 2 to 2.5 feet above normal. One man was injured in Queen Anne's County in Chester. The Kirwin Creek flooded, and he received an electrical shock while fighting the flood waters in a restaurant. Elsewhere in Queen Anne's County parts of Maryland State Route 18 were closed in Chester, Grasonville, and Queenstown. Many restaurants in Chester were closed due to flooding. Twelve homes in the county had flooding in their crawl spaces, two had flooding up to the first floor. In Talbot County, flooding was reported in St. Michael's. Flooding in Oxford was reported as the worst since Hurricane Hazel in 1954. Town Creek spilled over as did the Tred Avon River. Waterfront restaurants and homes in low lying areas were flooded. Many people were encouraged to evacuate to the second floor of their establishments. Bank Street was closed. A few people were evacuated. In Easton, the Easton Point Marina parking lot was flooded with two feet of water. Flooding extended inland to tidal sections of rivers in Caroline County. The Marshyhope Creek flooded in Denton. The Choptank River flooded within the Daniel Crouse Memorial Park.
Coastal Flood	02/04/1998	The strongest northeaster of the winter brought heavy rain, damaging winds and minor tidal flooding to the southern half of the Maryland Eastern Shore. The strongest winds occurred during the afternoon and evening of the 4th, although gustiness continued through midday on the 5th. The heaviest rain occurred also at about the same time as lighter rain persisted well into the 5th. The combination of the strong winds and heavy rain made it easier for the trees to be knocked down because of the loose ground. Minor tidal flooding started during the afternoon high tide on the 4th and persisted in some areas through the 6th. The combination of the heavy rain, strong winds and higher than normal tides caused the worst problems the afternoon of the 4th with several road closures in each county. In Talbot County, flooding was reported along low-lying areas of Neavitt, Oxford, Saint Michaels, and Unionville during the afternoon of the 4th. Roadway flooding was also reported in Trappe. A few roads were closed, and minor outages were reported because of the downed trees. In Caroline County, along tidal sections of the Choptank River, a couple of roads were closed on the 5th. Minor small stream flooding was reported in Greensboro and Preston. The Marshyhope River also overflowed its banks and caused some minor flooding on hiking and bike trails in Federalsburg. The heavy rain and high winds contributed to the collapse of a warehouse in Federalsburg. About a dozen trees were knocked down by the high winds from around 3 p.m. EST on the 4th into the early morning hours of the 5th. Storm precipitation totals included 2.5 inches in Federalsburg. The heavy rain might have also damaged the 275,000 acres of winter wheat planted across the lower Eastern Shore, especially if precipitation continues above normal for the rest of the winter.

Storm Event	Date	Event Narrative
Coastal Flood	10/29/2012	Post Tropical Storm Sandy caused an initial estimate of $5 million dollars in damage in the Eastern Shore of Maryland. Most of the damage was due to flooding caused by excessive rainfall, as up to 13 inches of rain were reported, and due to the high winds, which caused trees and wires to come down across the state. Delmarva Power, which serves portions of the Eastern Shore counties, reported over 30,000 households without power during the peak of the storm. The majority of residents had power returned by the morning of the 30th. Hundreds of roads were closed due to numerous downed trees and flooding. No direct deaths were reported on the Eastern Shore of Maryland due to the storm. Tropical Storm Sandy formed in the Caribbean Sea on the 22nd of October. After drifting slowly southwest into the 23rd, Sandy turned to the north and intensified to a hurricane on the 24th just before making landfall in Jamaica during that afternoon. Hurricane Sandy continued to the north and intensified to a strong category two hurricane before making landfall again in Cuba shortly after Midnight EDT on the 25th. Hurricane Sandy emerged on the other side of Cuba during the morning of the 25th and proceeded to drift northwest as a category one or two hurricane as it moved through the Bahamas on the 25th and 26th. Overnight on the 26th, Hurricane Sandy (Category 1) started to move toward the north-northeast, a motion that continued into the evening of the 28th. From there, Sandy's motion became driven by two factors. An anomalously strong blocking ridge over the Canadian Maritimes prevented Sandy from escaping to the east. Simultaneously, an approaching and deepening middle latitude trough was about to capture Sandy. The combination of the two, turned Sandy to the north overnight on the 28th and then to the northwest on the 29th. Hurricane Sandy received one last jolt of tropical energy as it passed across the Gulf Stream during the morning of the 29th. The lowest recorded central pressure of 940 millibars (27.76 inches) occurred when Category 1 Hurricane Sandy was about 110 miles southeast of Atlantic City at 2 p.m. EDT on the 29th. As Sandy continued to move northwest and interact with the mid latitude trough, its interaction continued to make it less tropical, but did not weaken it much. Sandy continued to make a harder turn to the left (west) and made landfall in Atlantic County as a post tropical storm in Brigantine City just north of Atlantic City at 730 p.m. EDT on the 29th. The estimated minimum central pressure was 945 millibars. The lowest recorded central pressure was 945.6 millibars at the Atlantic City Marina at 734 p.m. EDT. From there, Sandy continued to weaken or fill as it moved west. At 9 p.m. EDT, the low-pressure system was in western Atlantic County and continued to move west-northwest. At 11 p.m. EDT, the post tropical storm (about 954 millibars) was located in southern Chester County. Post tropical storm Sandy continued to move west-northwest and weaken. At 2 a.m. EDT on the 30th, the 962 millibar low was located near Harrisburg, Pennsylvania and at 8 a.m. EDT the 979 millibar low was near Altoona, Pennsylvania. From there, the rapidly weakening low pressure system moved northwest and reached Lake Erie (993 millibars) at 8 p.m. EDT that evening and from there drifted north into Canada. Prior to Sandy's arrival, Governor Martin O'Malley declared a State of Emergency for Maryland. No mandatory evacuations were ordered prior to or during the storm on the Eastern Shore. The Chesapeake Bay Bridge was closed due to high winds just before 3 p.m. on the 29th and remained closed through about 9 a.m. on the 30th. The state also closed the Millard E. Tydings Memorial Bridge, where Interstate 95 crosses the Susquehanna River. A swift water rescue team from South Carolina were on standby throughout the storm and thankfully were not utilized. In addition, several shelters were opened across the state, including three in Cecil County and two each in Kent, Queen Anne's, and Caroline Counties. In Chesapeake Bay, moderate tidal flooding occurred during the afternoon high tide cycle on the 29th at Cambridge and during the early morning high tide on the 30th at Tolchester Beach. The storm surge was 3 to 3.5 feet. The region was spared higher surges as Sandy made landfall in New Jersey and the winds prior to landfall pushed water down the Chesapeake Bay. Minor tidal flooding also occurred at Tolchester Beach during the subsequent afternoon high tide cycle on the 30th. Heavy rains fell across the area as Sandy approached and then moved through the region. This made it easier for shallow rooted and leafed trees to be uprooted, it also complicated the tidal flooding. Event rainfall totals ranged from just under 6 inches across the northern areas to nearly 13 inches across the southern areas of the Eastern Shore. The steady rain associated with Sandy spread into the Eastern Shore during the day on the 28th and slowly edged north. The heaviest rain fell overnight on the 28th into the early evening of the 29th. The rain ended during the middle of the day on the 30th. Peak wind gusts included 60 mph in Tolchester Beach (Kent County), 59 mph in Bay City (Queen Anne's County), 55 mph in Royal Oak (Talbot County), 53 mph at the Stevensville Airport (Queen Anne's County), 48 mph at the Easton Airport (Talbot County), 47 mph in Colora (Cecil County) and 41 mph near Jumptown (Caroline County). Strong winds spread northward along the Western Shore on the morning of the 29th with the highest winds (from the west) occurring during the evening of the 29th. Winds decreased rapidly during the early morning (shortly after Midnight) on the 30th.

Storm Event	Date	Event Narrative
Coastal Flood	12/21/2012	A deep low-pressure system tracked across the Lower Great Lakes northeastward into the St. Lawrence Valley from the evening of the 20th into the daytime of the 21st. Its associated strong cold front swept eastward through the Mid-Atlantic region and across Maryland during the early morning of the 21st. In addition, a secondary area of low pressure formed along the frontal boundary, west of Delaware Bay, and deepened rapidly. The approaching cold front and the deepening secondary low pressure produced a strong southeasterly flow during the early morning on the 21st that resulted in peak wind gusts of around 45 mph across the Eastern Shore and knocked over weak tree limbs and wires. In Grasonville (Queen Anne's County), the strong winds not only snapped a tree, but also damaged a greenhouse. Peak wind gusts included 49 mph in Salisbury (Wicomico County) and 43 mph at the Baltimore-Washington International Airport. In addition, the significant southeast flow allowed water to pile up into Chesapeake Bay. Once the winds shifted to the west, the higher tidal departures shifted to the Eastern Shore and producing moderate tidal flooding in Queen Anne's, Talbot and Caroline Counties and minor tidal flooding in Kent and Cecil Counties at the time of high tide during the daytime of the 21st. Moderate to heavy rain also fell across the Eastern Shore, with storm totals ranging between 1 to 2 inches. In Queen Anne's County, Maryland State Route 18 was covered with water from exit 42 at Kent Narrows to exit 43A in Grasonville. Tidal flooding along Maryland State Route 18 also occurred in Queenstown adjacent to Little Queenstown Creek. Flood waters nearly reached one home. In the Kent Narrows area, tidal flooding also occurred in and around Mears Point Marina north of U.S. Route 50. People were wading through the flood waters with boots. Minor to moderate tidal flooding occurred in the Chesapeake Bay during the morning and afternoon high tide cycle on the 21st. High tide in Cambridge (Dorchester County) reached 4.70 feet above mean lower low water. Moderate tidal flooding starts at 4.5 feet above mean lower low water. High tide at Tolchester Beach reached 4.17 feet above mean lower low water. Minor tidal flooding starts at 3.5 feet above mean lower low water.
2023 HMP Update		
Coastal Flood	10/29/2021	Strong high pressure located in eastern Canada and slow-moving low pressure approaching from the southeastern states resulted in a prolonged onshore flow along the Middle Atlantic coast. Moderate tidal flooding occurred along the upper eastern shore of Chesapeake Bay on the night of October 29. Widespread moderate flooding occurred in the tidal areas of Caroline County. There were several road closures with the flood waters approaching some homes and businesses. The tide gauge at Claiborne reached a level of 5.11 feet MLLW.

Source: National Center for Environmental Information (NCEI), 2023.

Note: No property damage was reported in the National Environmental for Center Information.

Winter Weather

Table 3-21: Cold/Wind Chill Event Composite

Cold/Wind Chill events Caroline County from January 1996 – June 2023		
24 Cold/Wind Chill events – Frequency 0.89		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	24	**Cold/ Wind Chill**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Cold/Wind Chill (Z). Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -18° F or colder) conditions. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data .		

Table 3-22: Extreme Cold/Wind Chill Event Composite

Extreme Cold/Wind Chill events Caroline County from January 1996 – June 2023		
1 Extreme Cold/Wind Chill events – Frequency 0.04		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	1	**Extreme Cold/ Wind Chill**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Extreme Cold (Z). A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35° F or colder). If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data .		

Table 3-23: Extreme & Cold/Wind Chill Event Narrative

Date	Type of Event	Event Narrative
February 4, 1996 to February 6, 1996	Cold/Wind Chill	Some schools along the Eastern Shore were closed on Monday the 5th, the result of both the dangerously cold wind chill and the ongoing snow removal. Low temperatures on both the 5th and 6th hovered around zero degrees.
January 17, 1997 to January 20, 1997	Cold/Wind Chill	The coldest air mass of the winter season moved into the Maryland Eastern Shore on Friday the 17th. Strong gusty northwest winds brought wind chill factors well below zero on the 17th and 18th. The coldest morning was the 19th. For most places this was the coldest day of the winter season.
April 9, 1997 to April 11, 1997	Cold/Wind Chill	An unseasonably cold air mass from Canada moved across the Maryland Eastern Shore from April 9th through the 11th. Low temperatures those three mornings were below the freezing mark in most areas.
May 31, 1997	Cold/Wind Chill	May 1997 was an unseasonably cool month. For most locations, it was the coolest May since 1967. Monthly departures averaged 3 to 4 degrees below normal.
July 31, 2000	Cold/Wind Chill	July 2000 was one of the coolest and wettest Julys on record for the Maryland Eastern Shore.
July 31, 2001	Cold/Wind Chill	July 2001 was an unseasonably cool month for the state of Maryland. The preliminary monthly state mean temperature was 71.7 degrees, the 3rd coolest July on record since 1895.
January 14, 2003 to January 28, 2003	Cold/Wind Chill	A cold frontal passage on the 13th initiated about a two-week run of unseasonably cold weather, even by January standards across the Delmarva Peninsula. The coldest morning was the morning of the 18th where low temperatures dipped into the single numbers.
January 9, 2004 to January 11, 2004	Cold/Wind Chill	An arctic air mass brought some of the coldest weather in years to the Delmarva Peninsula from the evening of the 9th through the morning of the 11th.
January 15, 2004 to January 16, 2004	Cold/Wind Chill	Most low temperatures were in the teens and the lowest hourly wind chill factors averaged around five degrees below zero.
December 20, 2004	Cold/Wind Chill	A high-pressure system of arctic origin built into the Eastern Shore on the 20th. This was one of the coldest air masses of the entire winter season. The strong northwest winds produced wind chill factors as cold as 10 degrees below zero during the morning of the 20th.

Date	Type of Event	Event Narrative
January 18, 2005	Cold/Wind Chill	An unseasonably cold air mass that originated in Siberia poured across the Middle Atlantic States on the 18th. Actual low temperatures during the morning of the 18th were in the teens.
January 23, 2005 to January 24, 2005	Cold/Wind Chill	The combination of wind and unseasonably cold temperatures produced wind chill factors of around 5 degrees below zero across the Eastern Shore from the evening of the 23rd into the morning of the 24th. Actual low temperatures the morning of the 24th were in the single numbers (above zero).
January 28, 2005	Cold/Wind Chill	Low temperatures were around 10 degrees above zero. The unseasonably cold weather led to an increase in the number of calls for dead vehicle batteries.
February 5, 2007 to February 6, 2007	Cold/Wind Chill	The combination of the unseasonably cold air and gusty northwest winds produced wind chill factors as low as 0 to 10 degrees below 0 during the mornings of the 5th and 6th. The lowest temperatures occurred during the morning of the 6th and were around 10 degrees.
February 6, 2007	Cold/Wind Chill	An arctic air mass that originated near the North Pole invaded the Maryland Eastern Shore on the 5th and 6th. The combination of the unseasonably cold air and gusty northwest winds produced wind chill factors as low as zero to 10 degrees below zero during the mornings of the 5th and 6th. The lowest temperatures occurred during the morning of the 6th and were around 10 degrees. The unseasonably cold weather caused many pipes and water meters to freeze across the Eastern Shore.
March 6, 2007	Cold/Wind Chill	The combination of the strong northwest winds and unseasonably cold air mass-produced wind-chill factors in the single numbers across the Eastern Shore on the morning of the 6th. Actual low temperatures were close to 20 degrees.
January 16, 2009 to January 18, 2009	Cold/Wind Chill	A large arctic high-pressure system moved toward the area during the 16th and 17th. The extent of the arctic air mass kept maximum temperatures only in the teens and 20s, with minimum temperatures down into the single digits.
January 4, 2014	Extreme Cold/Wind Chill	A high-pressure system that moved over the Eastern Shore coupled with fresh snow cover from the winter storm on the 2nd and 3rd gave the area one of its coldest winter mornings in years. This was the first of three arctic blasts in the state during the month. While this was the coldest morning of the winter for more rural areas that are normally colder on calm windy nights, it was not the harshest. Because the high-pressure system was over the region, wind chill factors and actual air temperatures were nearly the same. This was not the case a few days later and again around the 22nd of January. Low temperatures included 3 degrees in Tuckahoe (Caroline County).
January 7, 2014	Cold/Wind Chill	One of the harshest arctic outbreaks in years occurred across the Eastern Shore on the 7th. Record breaking calendar day low temperatures occurred and combined with strong northwest winds produced wind chill factors as low as 10 to 20 degrees below zero in most areas that morning. High temperatures struggled to reach double digits. The excessive cold caused many schools to have delayed openings. AAA Mid-Atlantic reported an 81 percent increase in service calls, mainly for dead batteries. Amtrak reported extensive delays in its rail service. The cold weather also affected power supplies. PJM Interconnection, the agency that oversees the electric grid supplying the region, said electricity suppliers were struggling to keep up with surging demand as the cold forced some power plants to shut. An all-time winter record usage was recorded at 8 a.m. EST on the 7th, 138,600 megawatts surpassing the previous record from 2007. Utilities asked their customers where it is possible to switch to diesel or fuel oil. Actual low temperatures included 6 degrees in Tuckahoe (Caroline County).
January 22, 2014	Cold/Wind Chill	Strong northwest winds behind the departing strong low-pressure system coupled with another arctic air mass dropped low temperatures on the morning of the 22nd into the single numbers to around 10 degrees along the Eastern Shore and produced wind chill factors as low as around 10 degrees below zero. In some places, low temperatures were as cold as January 7th and wind chill factors came close to matching that morning. Actual low temperatures included 5 degrees above zero in Tuckahoe (Caroline County).
January 7 to January 8, 2015	Cold/Wind Chill	The arrival of an arctic air mass brought one of the coldest mornings of the month of January to the Eastern Shore. The morning's low temperatures were near 10 degrees above zero. In addition, gusty northwest winds continued into the morning and lowest hourly wind chill factors reached around 5 degrees below zero throughout the Eastern Shore. Actual low temperatures included 10 degrees in Preston (Caroline County).
February 15, 2015	Cold/Wind Chill	The combination of strong to high winds and an approaching arctic air mass-produced wind-chill factors as low as 10 to 15 degrees below zero during the first half of the day on the 15th on the Eastern Shore. Actual morning low temperatures were around 10 degrees above zero.
February 16, 2015	Cold/Wind Chill	The near arrival of the center of the arctic air mass brought some of the lowest wind chills and temperatures of the winter season to the Eastern Shore on the 16th. While winds by the morning of the 16th were not as strong as they were on the morning of the 15th, air temperatures were lower. This produced wind chill factors as cold as around 10 degrees below zero during the morning. Actual low temperatures were in the single numbers above zero. Lowest hourly wind chill factors included 6 degrees in Tuckahoe (Caroline County).
February 20, 2015	Cold/Wind Chill	The arrival of another arctic air mass brought the lowest wind chills as well as temperatures of the winter season to the Eastern Shore on the 20th and 21st. As far as wind chill factors went, the first half of the day on the 20th was colder with wind chill factors as low as around 15 degrees below zero during the morning. Actual low temperatures were in the single numbers above zero. On the morning of the 21st, little, if any, wind was present as the arctic high-pressure system was nearby. Low temperatures in some more rural inland areas were lower, some were below zero. But, because of the lack of wind, wind chill factors nearly matched the air temperatures. Lowest temperatures on either the 20th or 21st included 3 degrees below zero in Tuckahoe (Caroline County).

Date	Type of Event	Event Narrative
February 24, 2015	Cold/Wind Chill	The high-pressure system responsible for third and last arctic blast of the month of February arrived in the Eastern Shore on the morning of the 24th. Unlike the two previous arctic outbreaks earlier this month, this one was not accompanied by strong winds during the first half of the day. Consequently, air and wind chill temperatures were nearly the same. Nevertheless, many low temperatures away from Chesapeake Bay were in the single numbers (a couple even below zero) and generally in the lower teens along Chesapeake Bay. These were approximately 20 degrees colder than normal. Lowest temperatures included 8 degrees above zero in Tuckahoe (Caroline County). Since 1895, this February ranked as the 6th coldest February on record for Maryland with an average statewide temperature of 25.4 degrees (10.3 degrees below average).
2023 HMP Update: No Events Reported Since 2015		

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-24: Blizzard Event Composite

Blizzard events Caroline County from January 2010 – June 2023		
1 Blizzard events – Frequency 0.08		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	1	**Blizzard**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Blizzard (Z). A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.		

Table 3-25: Frost/Freeze Event Composite

Frost/Freeze events Caroline County from January 2007 – June 2023		
1 Frost/Freeze events – Frequency 0.06		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	1	**Frost/Freeze**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Frost/Freeze (Z). A surface air temperature of 32 degrees Fahrenheit (°F) or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.		

Table 3-26: Heavy Snow Event Composite

Heavy Snow events Caroline County from January 1996 – June 2023		
24 Heavy Snow events Frequency – 0.89		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	24	**Heavy Snow**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Heavy Snow (Z). Snow accumulation meeting or exceeding locally/regionally defined 12 and/or 24 hour warning criteria. This could mean values such as 4, 6, or 8 inches or more in 12 hours or less; or 6, 8, or 10 inches in 24 hours or less. If the event that occurred is considered significant, even if it affected a small area, it should be entered into Storm Data.		

Table 3-27: Sleet Event Composite

Sleet events Caroline County from January 1997 – June 2023		
4 Sleet events – Frequency 0.15		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	4	**Sleet**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Sleet (Z). Sleet accumulations meeting or exceeding locally/regionally defined warning criteria (typical value is 1/2 inch or more).		

Table 3-28: Winter Storm Event Composite

Winter Storm events Caroline County from January 1996 – June 2023		
26 Winter Storm events – Frequency 0.96		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	1	$200,000
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	26	**Winter Storm**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Winter Storm (Z) - A winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Normally, a Winter Storm would pose a threat to life or property. In cases of winter storms, the preparer should be careful to classify the event properly in Storm Data. In general, the event should be classified as a Winter Storm event (rather than an Ice Storm event or a Heavy Snow event) only if more than one winter precipitation type presented a significant hazard. Some Winter Storm and Blizzard events may have had sustained or maximum wind gusts that met or exceeded High Wind criteria.		

Table 3-29: Winter Weather Event Composite

Winter Weather events Caroline County from January 1996 – June 2023		
77 Winter Weather events – Frequency 2.85		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	77	**Winter Weather**

Source: National Center for Environmental Information (NCEI), 2023.
Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone.
Based on NCEI definitions/criteria: Winter Weather (Z) - A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle). The Winter Weather event can also be used to document out-of-season and other unusual or rare occurrences of snow, or blowing/drifting snow, or freezing rain/drizzle. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Note that, in Storm Data, Blizzard events should cover a time period of 3 hours or more. Therefore, if blizzard-like conditions occur for less than 3 hours, the event should be entered as a Winter Storm, Heavy Snow, or Winter Weather, noting in the event narrative that near-blizzard or blizzard-like conditions were observed at the height of the event.

Table 3-30: Winter Weather Event Narrative

Date	Type of Event	Event Narrative
February 16, 1996	Heavy Snow	Accumulations averaged 7 inches in Talbot County, 8 inches in Caroline County, 9 inches in Cecil and Queen Anne's Counties and 12 inches in Kent County.
February 8, 1997	Heavy Snow	The snow ended during the evening hours. Accumulations were fairly uniform and averaged 4 to 6 inches across the Eastern Shore.
March 9, 1999	Heavy Snow	Caroline County accumulations ranged from around 3.5 inches in the northern part to around 5 inches in the southern part of the county.
January 20, 2000	Heavy Snow	Accumulations included 5.0 inches in Goldsboro (Caroline County).
January 25, 2000	Winter Storm	Total Accumulations included: Caroline County 10 inches in Denton and 8 inches in Federalsburg.
February 22, 2001	Heavy Snow	Specific accumulations included 7 inches in Preston (Caroline County) and 5.5 inches in Denton (Caroline County)
December 5, 2002	Winter Storm	In Caroline County alone, there were twenty-eight reported accidents. Accumulations included 7 inches Greensboro (Caroline County) and 4 inches in Denton (Caroline County).
January 16, 2003	Winter Storm	Schools were closed on the 17th in Caroline County. Specific accumulations included 3 inches in Federalsburg (Caroline County), and 1.0 inch in Denton (Caroline County).
February 6, 2003	Winter Storm	A winter storm that lasted about eighteen hours dropped about 5 to 8 inches of snow across most of the Eastern Shore. Specific accumulations included 8.5 inches in Greensboro (Caroline County) and 4.0 inches in Federalsburg (Caroline County).
February 16, 2003	Winter Storm	In Caroline County, problems with snow drifts kept many back roads blocked through the 18th. Government offices did not reopen until the 19th and schools were closed all week. 20.0 inches in Denton (Caroline County).
February 27, 2003	Heavy Snow	Schools were closed and after-school activities were cancelled. Specific accumulations included 5.5 inches in Denton (Caroline County),
January 25, 2004	Heavy Snow	Schools were closed on the 26th and the 27th in Caroline County. Untreated roads were slippery. Specific accumulations included 5.0 inches in Denton and Federalsburg (Caroline County).
January 22, 2005	Winter Storm	The snow mixed with sleet in Talbot and Caroline Counties and reduced accumulations. Specific snowfall accumulation, 6 inches in Denton (Caroline County)
February 25, 2005	Heavy Snow	Specific accumulations included 6.0 inches in Denton (Caroline County) and 5.0 inches in Greensboro (Caroline County)
February 12, 2006	Winter Storm	The Eastern Shore picked up a significant amount of snow, especially locations farther to the north. Some specific amounts include 8.0 inches in Ridgely (Caroline County), and 7.5 inches in Cordova (Talbot County).
February 25, 2007	Winter Storm	A winter storm that featured mixed precipitation affected the Maryland Eastern Shore on the 25th. Snowfall accumulations averaged 2 to 5 inches. Snowfall accumulations included 4.5 inches in Henderson (Caroline County).
March 1, 2009	Winter Storm	In Caroline County, 28 accidents were reported. Snowfall totals included 8.8 inches in Ridgely (Caroline County), and 5.5 inches in Denton (Caroline County). For some places this was the heaviest single snow event since February of 2003.

Date	Type of Event	Event Narrative
December 19, 2009	Winter Storm	Many municipalities declared states of emergency. Many school districts either closed schools or had two-hour delayed openings on the 21st. Some churches cancelled services on the 20th. Trash pick-ups were delayed. Representative snowfall included 17.0 inches in Denton (Caroline County).
January 30 to January 31, 2010	Heavy Snow	Heavy snow fell across the Eastern Shore from the morning of the 30th into the early morning of the 31st. Snowfall averaged 4 to 10 inches with the highest amounts in the southern part of the Eastern Shore. Snow spread from south to north from 9 a.m. EST to Noon EST during the morning of the 30th. It fell at its heaviest during the afternoon and evening and ended from north to south between Midnight EST and 4 a.m. EST on the 31st. Representative snowfall included 7.5 inches in Greensboro (Caroline County).
February 5 to February 6, 2010	Winter Storm	A major winter storm dropped 20 to 30 inches of snow across the Maryland Eastern Shore from the afternoon of the 5th into the afternoon of the 6th. The snow fell at its heaviest during the first half of the day on the 6th. Many businesses and stores were closed on the 6th. Many states of emergencies were declared on both the township and county level. There were fender bender accidents on the 5th, but because this event ended on a Saturday (the 6th), the total number of accidents was relatively lower. Representative snowfall included 23.0 inches in Denton (Caroline County).
February 9 to February 10, 2010	Winter Storm	For the second time within a week a major winter storm, this one with blizzard conditions at times, affected the Maryland Eastern Shore. Many city, federal, social and county offices as well as courthouses were closed on the 10th. Schools were closed on the 10th and 11th, some even on the 12th. Representative snowfall included 16.3 inches in Greensboro (Caroline County), and 7.0 inches at Denton (Caroline County).
February 10, 2010	Blizzard	For the second time within a week a major winter storm, this one with blizzard conditions at times, affected the Maryland Eastern Shore. Blizzard conditions occurred at times during the late morning and the first half of the afternoon on the 10th. Representative snowfall included 16.3 inches in Greensboro (Caroline County) and 7.0 inches at Denton (Caroline County).
January 2 to January 3, 2014	Heavy Snow	A winter storm dropped 4 to 7 inches of snow across the Maryland Eastern Shore from the late afternoon of the 2nd into the early morning of the 3rd. Representative snowfall totals included 7.0 inches in Greensboro (Caroline County)
January 21 to January 22, 2014	Heavy Snow	A winter storm dropped heavy snow across the Maryland Eastern Shore from the morning of the 21st into the morning of the 22nd. Representative snowfall totals included Henderson (Caroline County) and also in Denton (Caroline County) 4.0 and in Greensboro (Caroline County)
February 12 to February 14, 2014	Winter Storm	A winter storm dropped heavy snow and sleet across most of the Eastern Shore. Snowfall and sleet averaged 3 to 8 inches, except 8 to 15 inches in Cecil County which was most affected by heavy snow bands during the morning of the 13th. Representative snowfall included 6.0 inches in Greensboro (Caroline County), 5.7 inches in Henderson (Caroline County), 4.2 inches in Denton (Caroline County).
March 3, 2014	Winter Storm	A low-pressure system exiting the South Carolina coast brought a winter storm of freezing rain, sleet as well as heavy snow to the Eastern Shore on the 3rd. Representative snowfall included 5.1 inches in Denton (Caroline County).
March 16 to March 17, 2014	Heavy Snow	A low-pressure system that traversed across the southern United States brought heavy snow to the Maryland Eastern Shore on the 16th and 17th. Snowfall averaged 4 to 7 inches. Representative snowfall included 6.8 inches in Greensboro and Denton (Caroline County).
February 16 to February 17, 2015	Heavy Snow	A low-pressure system emerged east off the North Carolina coast and brought snow to Cecil and Kent Counties and heavy snow to Queen Anne's, Talbot, and Caroline Counties from the evening of the 16th into the morning of the 17th. Snowfall totals ranged mainly between 3 to 7 inches, with the highest totals being recorded in Queen Anne's, Talbot, and Caroline Counties. Representative snowfall totals included 6.0 inches in Greensboro (Caroline County) and 4.7 inches in Henderson (Caroline County).
March 5, 2015	Winter Storm	Waves of low pressure that formed along a sinking cold front brought the Eastern Shore its heaviest snow of the season on the 5th. Snowfall averaged 4.5 to 8.5 inches with the highest amounts in Cecil County. Representative snowfall included 7.2 inches in Greensboro (Caroline County).
January 22 to January 24, 2016	Winter Storm	An impulse from the west coast traversed the midsection of the country, then developed into a low-pressure system as it tracked across the Gulf states before intensifying along the Carolina coast into a major nor'easter, producing record snowfall in parts of Maryland on January 23rd. It then moved out to sea after passing by the mid-Atlantic coast early on January 24th. Some representative snowfall totals include: 16.0 inches in Newton, and 15.7 inches in Denton (both in Caroline County). Maryland Governor Larry Hogan declared a State of Emergency on Friday, January 22nd for the duration of the event. The Governor also requested a presidential disaster declaration. On March 4, 2016, President Obama declared the following counties federal disaster areas: Caroline, Cecil, Kent, and Queen Anne's. This declaration makes federal funding available on a cost-sharing basis for emergency work and the repair or replacement of facilities damaged by the severe winter storm. Federal funding is also available on a cost-sharing basis for hazard mitigation measures statewide.
January 7, 2017	Winter Storm	Snow began during the early morning hours on the 7th, then continued, heavy at times through the late afternoon hours, ending by sunset. Generally, 5 to 9 inches of snow fell in Caroline County during the storm, with the highest totals in the south. Some representative snowfall reports include 8.5 inches in Ridgely, 7.5 inches in Marydel, 7.0 inches in Federalsburg, 6.5 inches in Denton, and 5.2 inches in Greensboro.
March 21 to March 22, 2018	Winter Storm	Precipitation began as rain during the morning hours of Tuesday, March 20th. After a lull during the overnight hours, snow began falling by late morning on the 21st following some early sleet and freezing rain. Snow became heavy at times during the afternoon and evening hours. Some snowfall reports include: 7.5 inches in Griffin, and 6.8 inches in Greensboro.

Date	Type of Event	Event Narrative
2023 HMP Update		
January 4, 2018	Winter Storm	An area of low pressure tracked up the east coast interacting with a cold front which lead to rapid development of a winter storm across the state. This storm quickly moved out by the 5th. However, snowfall accumulations and gusty winds occurred with the storm. Snowfall ranged from 4 to 6 inches.
March 21, 2018	Winter Storm	A complex area of low pressure over the middle Atlantic, which involved several individual centers, slowly consolidated off the Virginia Capes Tuesday morning, March 20th into Wednesday March 21st along a frontal boundary. This primary low, the fourth nor'easter this month, gradually moved northeast Wednesday night, to a position southeast of the 40 North/70 West coordinates on Thursday morning. Rain developed across the eastern shore of Maryland on Tuesday morning, March 20th. As this precipitation moved northward into a colder air mass, snow and sleet developed across the northern portion of the eastern shore of Maryland during the Tuesday afternoon hours. During Tuesday evening, a mixed bag of precipitation developed, with freezing rain, sleet, and snow, expect rain closer to the coast. Freezing rain lead to ice accretion up to 0.20 across the northern portion of the eastern shore of Maryland, causing downed trees and limbs, which impacted power lines, and lead to power outages. The change over to snow progressed southeast across eastern shore of Maryland by late morning on Wednesday March 21st. Moderate to heavy snowfall developed, and gradually overspread eastern shore of Maryland from Wednesday morning into the evening. Snowfall rates, particularly outside of the southern portion of the eastern shore of Maryland, were around one inch per hour at times. The snow gradually ended from west to east around midnight. Snowfall amounts over the eastern shore of Maryland generally ranged from 8 to 12 inches over Cecil County, 6 to 9 inches over the remainder of the area, with the exception of Queen Anne's and Talbot Counties, where amounts tapered southward down into the 2-to-4-inch range. The weight of the heavy, wet snow brought down trees, limbs, and power lines across the northern portion of the eastern shore of Maryland, which led to power outages. Precipitation began as rain during the morning hours of Tuesday, March 20th. After a lull during the overnight hours, snow began falling by late morning on the 21st following some early sleet and freezing rain. Snow became heavy at times during the afternoon and evening hours. Some snowfall reports include: 7.5 inches in Griffin, and 6.8 inches in Greensboro.
January 3, 2022	Winter Storm	A winter storm impacted most of Delmarva and southern New Jersey on January 3, 2022. A strengthening area of low pressure developed over the Southeast US late on January 2 and move northeast, tracking offshore of the mid-Atlantic in a typical Nor'easter-type setup. A widespread 6 to 12 inches of snow with locally higher amounts fell across the Eastern Shore of Maryland, most of Delaware, and several counties of southern New Jersey. The storm was notable for having a very sharp cutoff in the northern extent of accumulating snow. Also, an unseasonably warm air mass had been in place prior to this storm's arrival, with areas that saw the most snowfall having been in the 50s and 60s less than 12 hours before snow began! The passage of a strong cold front brought rapid cooling in the hours leading up to the storm, and very heavy snowfall rates, at times well in excess of 1 inch per hour, overwhelmed the lingering warm ground and caused accumulation to occur. The storm was fairly quick moving and had departed by the late afternoon and early evening of the 3rd. A widespread 6 or more inches of snow fell. A maximum amount of 11.0 inches was reported by a trained spotter in Henderson.
January 28, 2022	Winter Storm	A strong coastal storm affected the eastern mid-Atlantic and Northeast US on January 28-29, 2022. As a deep trough moved into the Southeast US, low pressure began to develop off the coast of the Carolinas during the afternoon of January 28. A high amplitude upper-level steering pattern caused the developing low to begin moving north-northeastward, paralleling the US East Coast. In a classic Nor easter evolution, the developing low phased with a frontal system over the mid-Atlantic as it moved north. This frontal system had brought light snow to portions of the mid-Atlantic during the day on the 28th, and it also brought a fresh influx of cold air to the region. As it phased with the developing coastal storm, the coastal storm began to explosively intensify as it passed offshore of Delmarva. The strengthening storm spread precipitation back into the region, which fell as all snow thanks to the fresh injection of Arctic air. With the center of the low passing a few hundred miles offshore, the heaviest snow fell near the coast, from the night of the 28th through the morning of the 29th. In eastern New Jersey and coastal Delaware, several hours of heavy snow resulted in a widespread swath of 12 to 18 inches of snow. Amounts steadily tapered off heading further inland, though some snow fell in all of the local area. In addition, with the rapid strengthening of the low, strong winds also occurred, especially near the coast. Gusts of 40 to 50 mph with a few over 60 mph were observed. The combination of strong winds and heavy snow led to whiteout conditions along the coast and was sufficient for blizzard criteria to be met along both the New Jersey coast and the Delaware Beaches, making this the first blizzard to affect any portion of the region since 2018. Snow gradually lost intensity and came to an end during the afternoon of the 29th, as the still strengthening low continued moving northward, bringing blizzard conditions and even heavier snow to southeast New England. Heavy snow fell. A CoCoRaHS observer near Greensboro reported 7.2 inches of snow, and a trained spotter in Henderson reported 6.0 inches of snow.
January 12, 2019	Winter Weather	Weekend winter Storm. Totals likely met advisory criteria based on surrounding observations.
February 1, 2019	Winter Weather	Light snow fell across Delmarva and southern NJ during an arctic airmass outbreak. Totals likely met criteria based on surrounding reports and observations.

Date	Type of Event	Event Narrative
January 21, 2021	Winter Weather	Low pressure tracking out of the Ohio Valley weakened as it moved slowly eastward on January 31st. Meanwhile, as that low weakened, secondary low pressure began to develop off the coast of the Carolinas and tracked northward, just off the mid-Atlantic coast. The low steadily intensified as it moved up the coast in a classic Miller B storm evolution. Overrunning precipitation associated with the initial low over the Ohio Valley impacted the region on the 31st. A cold antecedent air mass allowed most of this precipitation to fall as snow over the Delmarva peninsula. This produced widespread snow accumulation, though the overrunning precipitation was mostly of the light to moderate variety. The Delmarva experienced a lull in precipitation overnight of the 31st as the secondary low began to develop and a dry slot overspread a large area. In addition, a surge of warmer air both at the surface and aloft caused precipitation to change to sleet or rain. As the secondary low strengthened, precipitation eventually turned back to snow as colder air was drawn in from the north. The secondary low pressure came to a near stall off the mid-Atlantic coast, causing snow to continue into February 2. However, snowfall rates by then were much lighter, and marginal surface temperatures prevented much if any accumulation following the initial batch of snow on January 31. A trained spotter near Henderson reported 5.7 inches of snow, most of which occurred on January 31. This was the only report from the county; observations from surrounding areas suggest a general 3 to 5 inches of snow fell on January 31, with little to no additional accumulation during mixed precipitation on February 1 and 2.
February 7, 2021	Winter Weather	A fast-moving wave of low pressure brought a period of snow to the Delmarva region on February 7. Snow began in the morning hours and came to an end by mid to late afternoon as the low tracked northeastward, off the Atlantic coast. Precipitation amounts were not especially heavy on Delmarva due to the structure of the precipitation shield, with a better organized shield of banded snow not developing until the system was a little ways past Delmarva. Marginal low-level temperatures also slowed rates of snow accumulation. However, a few inches of wet snow still accumulated over the region. Light snow fell in the county. A trained spotter in Henderson reported 4.0 inches of snow.
February 10, 2021	Winter Weather	A mid-level disturbance accompanied by a weak wave of surface low pressure passed south of the Delmarva peninsula in the early hours of February 11. Precipitation blossomed ahead of and north of this disturbance. Over the mid-Atlantic, temperatures were cold enough for this to fall as a fluffy light snow in most areas. The relatively weak nature of the system combined with considerable dry air in place limited the amount of precipitation that fell. However, good snow to liquid ratios and the predawn timing of most of the snow allowed for efficient accumulation, with a widespread area of 3 to 5 inches of snow over the mid-Atlantic and some amounts locally a little higher. Light snow fell across the county. The only report received, which is thought to be a good representation of the entire county, was a report of 4.5 inches of snow from a trained spotter in Henderson.
February 13, 2021	Winter Weather	Weak low pressure tracked offshore of the mid-Atlantic on February 13, spreading some light precipitation into the region. A surge of warm air aloft prevented the light precipitation from falling as snow. However, strong high pressure to the north promoted a cold air damming environment with sub-freezing air trapped at the surface. This led to most of the precipitation falling as freezing rain, with some generally light ice accretion across the area. Light freezing rain fell. A report of 0.19 inches of ice accretion was received from Denton. A trained spotter near Templeville reported 0.13 inches of accretion.
February 18, 2021	Winter Weather	Weak low pressure passed offshore of the mid-Atlantic on February 18. Another weak, secondary wave of low pressure tracked along a similar path along a frontal zone trailing behind the primary low on the 19th. Strong high pressure over New England provided a cold air mass over the mid-Atlantic, leading to wintry precipitation as these areas of low pressure tracked offshore. The heaviest precipitation occurred with the primary wave on the 18th, with many areas seeing snow, some locally heavy, with a change to sleet and rain towards coastal areas. By the overnight of the 18th and into the 19th, precipitation became lighter, with a mix of light snow and light freezing rain or drizzle providing some additional accumulations and impacts. The system finally pulled away entirely by the late afternoon and evening of the 19th. Light wintry mixed precipitation fell. A trained spotter near Ingleside reported 2.0 inches of snow. Some light freezing rain or drizzle may have also occurred.
January 5, 2022	Winter Weather	A developing wave of low pressure brought light precipitation to the mid-Atlantic on the morning of January 5, 2022. Warm air advection caused rising temperatures aloft over the region. However, surface temperatures were initially sub-freezing, and in some cases took several hours after precipitation began to move above freezing. This caused freezing rain to fall. A widespread light icing event transpired across the eastern mid-Atlantic as a result of this. While ice accumulations were no more than several hundredths of an inch, this event caused significant travel impacts during the busy morning commute hours of January 5. Trace amounts of freezing rain were reported near Greensboro.

Date	Type of Event	Event Narrative
January 6, 2022	Winter Weather	A developing wave of low pressure brought a period of snow to the eastern mid-Atlantic during the overnight of January 6 into the morning of January 7. The developing low was fast-moving, with steady precipitation lasting only 6 to 8 hours in many areas. However, the storm brought a widespread swath of 3 to 6 inches of snow to most of the eastern mid-Atlantic. Some portions of eastern New Jersey saw slightly higher amounts of 6 to 7 inches, but in general it was a fairly uniform snowfall for most areas. With most of the accumulation occurring near or before dawn, roadway conditions were rendered poor for the Friday morning commute on the 7th, causing many businesses and schools to close or shift to virtual operations for the day. One notable aspect of this event was its higher than usual snow to liquid ratios for the mid-Atlantic. Temperatures were cold enough for precipitation to fall as all snow. With plenty of cold air at the surface and aloft, snow tended to be light and fluffy, causing it to pile up quickly despite liquid equivalents being a rather paltry 0.20 to 0.50 inches in most of the region. The snowfall ratio, which often averages close to 10:1 or lower (i.e., 1 inch of liquid would equate to 10 inches of snow) was closer to 15:1 or even 20:1 in most reports containing both a snowfall and liquid equivalent measurement. A widespread 2 to 4 inches of snow fell. A CoCoRaHS observer near Greensboro reported 3.2 inches of snow.
January 16, 2022	Winter Weather	A strong storm affected the mid-Atlantic and much of the Eastern Seaboard from January 16-17, 2022. A strong negative tilt trough over the Southeast US spurred strong cyclogenesis near the Carolina coast late on January 16. This low would proceed to quickly deepen as it moved northward that evening and night. Upper-level steering patterns caused the low to take an inside runner track which kept the low center inland of the coast. A very strong easterly low-level jet developed in between the strengthening low and a departing high-pressure center to the north. With the center of the low tracking west of the region and an influx of marine air courtesy of the low-level jet, various precipitation types occurred during this event. An Arctic air mass had been in place in advance of this system, but due to the aforementioned factors, that air mass rapidly modified on the 16th. As precipitation arrived, temperatures remained cold enough for it to begin as snow in most areas away from the coast. However, a rapid transition from snow to mixed precipitation to rain occurred in most areas within hours. Frozen precipitation held on for longer across the interior, where some higher snowfall amounts occurred. The storm departed the region early on January 17. Light snow fell. A report of 2.2 inches of snow was received from Galena. Some freezing rain may have also briefly fallen before precipitation changed to rain.
December 23, 2022	Winter Weather	An Arctic cold front swept through the region with light precipitation lingering for a brief period in its wake. Temperatures plummeted below freezing before paved surfaces dried out. This resulted in icy areas on untreated surfaces. Lingering light precipitation in the wake of a strong Arctic cold front resulted in a flash freeze of untreated surfaces and icy roads as temperatures plummeted well below freezing.

Source: National Center for Environmental Information (NCEI), 2023.

Drought

Table 3-31: Drought Event Composite

Drought events Caroline County from January 1996 – June 2023		
60 Drought events – Frequency 2.22		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	60	**Drought**

Source: National Center for Environmental Information (NCEI), 2023.
Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone.
Based on NCEI definitions/criteria: Drought (Z). Drought is a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area. Conceptually, drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. There are different kinds of drought: meteorological, agricultural, hydrological, and social-economic. Each kind of drought starts and ends at different times.

Table 3-32: Drought Event Narrative

Date	Event Narrative
June 30, 1997 to October 31, 1997	June 1997 was drier than normal throughout the Maryland Eastern shore. On a county weighted average, deficits averaged between 1 and 2 inches. Only Talbot County was within an inch of normal. Coupled with the hot weather from June 21st onward, the lack of rain started to stress growing areas. The unseasonably hot and dry summer of 1997 caused the United States Secretary of Agriculture, Dan Glickman, to declare the state of Maryland a primary disaster area. Along the Maryland Eastern Shore, the corn crop was expected to be about 60 percent below normal and the soybean crop about 40 percent below normal. Yearly precipitation totals through October 31st on a county weighted average were below normal in all the Maryland Eastern Shore Counties
December 3, 1998 to December 31, 1998	The run of unseasonably dry weather that began in July started to take its toll on water supplies throughout the Middle Atlantic States. The commission urged the public and water suppliers to voluntarily conserve water, particularly indoor uses. December brought another month of below normal precipitation, especially in the northern part of the Maryland Eastern Shore.
January 1, 1999 to September 21, 1999	Monthly precipitation totals were 6.8 inches in Caroline County, about 3 inches above normal. Despite this, a drought warning was still in effect for the state as of January 31st. On a county weighted average February 1999 precipitation totals along the Eastern Shore ranged between 2.2 and 2.8 inches. However, additional precipitation was still needed to overcome longer-term water shortages as ground water levels were still below normal in most parts of the state. A drought warning remained in effect for the state of Maryland. March continued the trend of above normal precipitation during 1999 across the Maryland Eastern Shore. However, more precipitation was needed to overcome the long-term water shortages. The drought warning for the state of Maryland remained in effect through March. On a county weighted average April monthly precipitation across the Eastern Shore was close to normal as 3.1 to 3.5 inches of precipitation fell. While ground-water levels improved across the Eastern Shore, they were still below normal for April. On a county weighted average, monthly rainfall totals ranged from 0.6 inches in Talbot County (only .7 of an inch in Caroline County) to 2.7 inches in Cecil County. This was only around 15 percent of normal for Talbot and Caroline Counties. The drought intensified during the month of June across the Maryland Eastern Shore. The drought warning for the state of Maryland remained in effect. Several municipalities started implementing water restrictions including Centreville, Saint Michaels, and Preston. On June 8th, the Maryland Department of Natural Resources (DNR) issued a warning of high fire danger across the Eastern Shore. About 35 acres burned in the first week of June. The April 1st through July 31st four-month period was the driest on record over the past 105 years in the state of Maryland. Farmers in Maryland were feeling a double pinch. Irrigation, if possible, was driving up the costs of farming. Meanwhile, ideal growing conditions elsewhere in the country kept crop prices low. July 1999 continued the trend of extremely warm and dry weather across the Maryland Eastern Shore and for the state of Maryland as a whole. The July 1999 statewide average temperature of 78.0 degrees was the 6th warmest July on record dating back to 1895. The statewide average rainfall total of 2.51 inches was only 64 percent of normal and was the 15th driest July on record. The first half of August continued the dire drought conditions across the Eastern Shore. A statewide drought emergency was already in effect. On September 1st Governor Parris N. Glendening lifted the mandatory watering and open burning restrictions across the Eastern Shore. The drought for all intents and purposes ended with the arrival of rain associated with Hurricane Floyd on the 16th. As much as 14 inches of rain (or about 4 months' worth of normal rainfall) fell from Floyd across the Eastern Shore.

Date	Event Narrative
October 31, 2000	October 2000 was one of the driest Octobers and month on record for the Maryland Eastern Shore. On a county weighted average monthly precipitation total ranged from 0 (zero) in Caroline County to 0.4 inches in Cecil County. Normal monthly precipitation is around 3.1 inches. While the dry weather did minimal agricultural damage, it left the region susceptible to brush and forest fires because of the newly fallen leaves.
April 30, 2001	April 2001 was an unseasonably dry month for the Maryland Eastern Shore, especially during the second half of the month when very little rain fell. On a county weighted average, April monthly rainfall totals ranged from 1.5 inches in Queen Anne's County to 2.0 inches in Cecil County. This was about 50 percent of normal and most of the precipitation fell prior to April 14th. In addition to raising the fire danger, the unseasonably dry weather, if it persists, will threaten the growing season.
May 1 to May 19, 2001	Unseasonably dry weather continued across the Maryland Eastern Shore through May 18th. Little, if any, precipitation fell during the first 18 days of the month. It continued a trend that had prevailed since the second half of April. The lack of precipitation forced farmers to delay planting soybeans. May crops (grains/grasses) were either stunted or grew at a slow pace. Rain associated with a warm front brought the heaviest rain since early April to the Eastern Shore on the 19th and ushered in a change in the weather pattern. For the rest of the month, precipitation totals were wetter than normal.
October 1, 2001 to December 31, 2001	October 2001 was an unseasonably dry month across the Maryland Eastern Shore. On a county weighted average, monthly precipitation totals ranged between 0.8 and 1.0 inches, about 33 percent of normal. Normal monthly precipitation is around 3.1 inches. December 2001 continued the dry pattern that established itself during the latter half of the year in Maryland. On a county weighted average, monthly precipitation totals ranged from 1.7 inches in Kent County to 2.1 inches in Caroline County. Normal is around 3.6 inches.
January 1, 2002 to November 25, 2002	The Eastern Shore has received only 41 percent of normal precipitation since September 1st. For many locations, February 2002 was the driest February on record. On a county weighted average, monthly precipitation totals ranged from 0.5 inches in Cecil and Kent Counties to 0.8 inches in Caroline County. Normal is around 2.9 inches. The Maryland Department of the Environment continued its drought warning for all of the Maryland Eastern Shore. The rest of the Eastern Shore remained under a drought warning. Precipitation during May of 2002 was drier than normal in Talbot and Caroline Counties. The rest of the Eastern Shore remained under a drought warning. Precipitation during June of 2002 once again was drier than normal throughout the Maryland Eastern Shore. The combination of unseasonably warm weather and below normal precipitation intensified the drought across the Maryland Eastern Shore in July. The combination of unseasonably warm weather and below normal precipitation continued to intensify the drought across the Maryland Eastern Shore in August. The continued lack of precipitation prompted Governor Glendening to declare a drought emergency across the entire Eastern Shore and implemented level two water restrictions on August 27th. There was an increase in brush fires. Other than late planted soybeans, it was too late to help most crops. In early September stream flow and groundwater levels set many daily, monthly, and even some record low levels. On the 18th United States Department of Agriculture Secretary Ann Veneman declared a drought disaster in several states including Maryland, Delaware, and New Jersey. An unseasonably wet November ended the meteorological drought across the Maryland Eastern Shore.
September 1 to September 30, 2005	Dating back to 1895, it was the eight warmest and the driest September on record for the state of Maryland. Across the Eastern Shore, monthly county precipitation averages ranged from 0.4 inches in Caroline County to 0.7 inches in Kent County. Normal is about 3.6 inches.
July 24, 2007 to December 31, 2007	An unseasonably dry July was taking its toll on non-irrigated crops across the Maryland Eastern Shore from Kent County southward. Farmers were estimating their losses at 30 to 60 percent. Unseasonably dry weather into August took its toll on non-irrigated crops across the Maryland Eastern Shore. While the drought for the most part has been an agricultural concern, Preston (Caroline County) imposed odd/even watering restrictions. Unseasonably dry weather in September continued to take its toll on non-irrigated crops across the Maryland Eastern Shore. For the state of Maryland, it was the 3rd driest September on record dating back to 1895. The summer of 2007 was the second driest summer on record for the state since 1895. The entire Christmas tree planting was lost in Caroline County. Established trees survived, but the new plantings did not. November 2007 brought the return of below normal precipitation to the Maryland Eastern Shore. On a county weighted average, November rainfall ranged from 0.7 inches in Caroline County to 2.2 inches in Cecil County. Normal is around 3.4 inches. The unseasonably dry November led to the drought watch being upgraded to a drought warning for Caroline, Kent, Queen Anne's, and Talbot Counties.
January 1, 2008 to June 11, 2008	January 2008 was unseasonably dry across the Eastern Shore as the drought watch remained in effect. January precipitation ranged from 1.6 inches in Cecil County to 1.9 inches in Caroline County. Normal is around 3.3 inches. February 2008 was slightly wetter than normal across the Eastern Shore, but the drought watch remained in effect. March 2008 was slightly drier than normal across the Eastern Shore. The drought watch remained in effect. April 2008 was slightly wetter than normal across most of the Eastern Shore. The drought watch remained in effect. A drought watch calls for a voluntary reduction in water consumption of five percent. On a county weighted average, April precipitation ranged from 3.3 inches in Kent County to 3.7 inches in Caroline County. Normal is around 3.3 inches. The drought watch remained in effect for most of the Eastern Shore. The above normal rainfall during the month of May and into the first part of June was sufficient to replenish groundwater and stream flow. The drought watch for Kent, Queen Anne's, Talbot, and Caroline Counties was discontinued.
August 1 to August 31, 2008	An unseasonably dry August occurred across the Eastern Shore and could cause problems for crops if it persists into September and October.

Date	Event Narrative
September 9, 2010 to November 1, 2010	The Maryland Department of the Environment issued a drought watch for the Maryland Eastern Shore except for Cecil County on September 9th. The Maryland Department of Natural Resources Forest Service strongly encouraged homeowners not to do any outdoor burning until the state received significant steady rainfall of one inch or more. The drought conditions were caused by the hottest summer on record in the state of Maryland as well as a drier than normal (about 80 percent of normal rainfall) summer. September 2010 was also warmer than normal (statewide average 1.9F higher than average) and until the last day of the month was also drier than normal. The heavy rain that fell on September 30th gave the state on average a wetter than normal September. The wet weather on September 30th and October 1st started to recharge water supplies in the state of Maryland. Even so, the Maryland Department of the Environment maintained a drought watch for all of the Eastern Shore except for Cecil County. The statewide October monthly precipitation average for Maryland was 4.48 inches, about one hundred thirty percent of normal and 1.10 inches wetter than average. Across the Eastern Shore, on a county weighted average, October monthly precipitation ranged from 4.5 inches in Cecil County to 5.9 inches in Caroline County. Normal is about 3.2 inches. The continuation of near normal precipitation and the drop-in water demand with the end of the growing season permitted the Maryland Department of the Environment to cancel all drought watches for the Maryland Eastern Shore. The drought and summer heat took its toll on Eastern Shore farmers and the United States Secretary of Agriculture Thomas Vilsack declared all counties in the Eastern Shore natural disaster areas. The declaration permitted affected farmers, ranchers and other agricultural producers eligible to apply for low interest emergency loans from the Farm Service Agency.
April 10, 2012 to October 31, 2012	The unseasonably dry weather in 2012, was even drier in March and continued during the first three weeks of April. The Drought Monitor was raised to D2 (severe drought) from Kent County southward along the Eastern Shore on April 10th. The Maryland Department of the Environment issued a drought watch for the Eastern Shore from Kent County southward on April 13th. Groundwater and streamflow levels were below normal. The Department of the Environment recommended that homeowners, farmers and businesses conserve water and reduce water usage where possible for irrigation. In addition, it was recommended that leaks be actively pursued and fixed. While around two inches of rain fell on the 22nd, it did improve conditions slightly. The drought status was lowered to D1 (Moderate Drought) on April 24th. The Drought Watch remained in effect. The rain on the 22nd and 23rd helped April return to near normal precipitation amounts across the Eastern Shore. On May 8th, the Maryland Department of the Environment extended the drought watch into Cecil County while maintaining the drought watch for the rest of the Eastern Shore. Through the end of April, yearly to date average precipitation across Maryland was about 64.5 percent of normal, the driest start to a year on record for the state dating back through 1895. Stream flow and groundwater levels were below normal throughout much of the state. During a drought watch, there is an increase in oversight of water supply conditions and the Maryland Department of the Environment encourages citizens to become more aware of their water use and to conserve it. The hope is that voluntary conservation will cut water usage by 5 to 10 percent in drought watch areas. Homeowners, government facilities, businesses and industry were asked to reduce water use for irrigation. The drought was already having an impact on farming as some farmers have waited to plant crops due to low soil moisture levels while others have had to start irrigating, a practice not typically needed during spring. The United States Drought Monitor depicted all the Eastern Shore in moderate drought (D1 status) as May began. Cecil County's drought level improved to D0 (abnormally dry) with the May 22nd monitor release. The drought watch for the county remained in effect through May. During the month of May, the state of Maryland averaged 82 percent of its normal rainfall. Across the Eastern Shore, county monthly weighted precipitation averages for May ranged from 2.4 inches in Caroline County to 2.7 inches in Cecil County. This averaged around 1.3 inches less than normal. The drought watch remained in effect for Eastern Maryland through June. Conditions improved somewhat during the month, especially in the northern part of the Eastern Shore. During the drought watch phase, there is an increase in oversight of water supply conditions and the Maryland Department of the Environment encourages citizens to become more aware of their water use and to conserve it. The hope is that voluntary conservation will cut water usage by 5 to 10 percent in drought watch areas. Homeowners, government facilities, businesses and industry were asked to reduce water use for irrigation. Stream flow and groundwater levels were below normal through much of the state at the start of the month, but stream flow levels recovered somewhat as the month progressed. As June started, the United States Drought Monitor depicted Cecil County as unusually dry and moderate drought (D1 status) for the rest of the Eastern Shore. During the month, showers and thunderstorms were more widespread in the northern part of the Eastern Shore than southern. On a county weighted average, June monthly precipitation ranged from 1.9 inches in Caroline County, to 2.5 inches in Talbot and Queen Anne's County, to 3.4 inches in Kent County and 5.1 inches in Cecil County. Normal is around 3.6 inches. By the end of the month, most of Cecil County returned to normal status, with Kent County was a mixture of abnormally dry and moderate drought (D1) status and the rest of the Eastern Shore remained in severe drought (D2) status. The drought watch remained in effect for Eastern Maryland through July. During the drought watch phase, there is an increase in oversight of water supply conditions and the Maryland Department of the Environment encourages citizens to become more aware of their water use and to conserve it. The hope is that voluntary conservation will cut water usage by 5 to 10 percent in drought watch areas. Homeowners, government facilities, businesses and industry were asked to reduce water use for irrigation. July began with moderate drought conditions (level D1 on the Drought Monitor) across all of the Eastern Shore except Cecil County. As the unseasonably hot and dry weather continued during the month, Talbot and Caroline were upgraded to severe drought status (level D2 on the Drought Monitor) on July 24th and continued at that level for the rest of the month. Fields that did not have the capability of being irrigated were suffering. On a county weighted basis, all of the Eastern Shore counties were drier than average during July with Caroline County the driest. County averaged precipitation amounts ranged from 2.3 inches in Caroline County to 3.1 inches in Talbot County. Normal is around 4.1 inches. It was also the third hottest July on record for the state of Maryland dating back to 1895. Drought conditions persisted over most of the Maryland Eastern Shore during most of August.

Date	Event Narrative
April 10, 2012 to October 31, 2012 continued	The Maryland Department of the Environment issued a drought warning for Kent, Queen Anne's, Talbot and Caroline Counties on August 6th. The warning set a goal of reducing water usage by ten to fifteen percent. Drought relief arrived late in the month, but not in time to help the crops, especially corn. Crop losses in Caroline County reached 75 percent. On August 29th, the United States Department of Agriculture Secretary Tom Vilsack issued a Disaster Designation for Maryland. Farmers are now able to get some financial relief from the drought. The declaration covered all of the Eastern Shore counties. Because of the last week of the month, the state averaged above normal precipitation for the month of August. Improving drought conditions that started in late August continued throughout the month of September as the state of Maryland received (on a statewide average) near normal precipitation. According to the Drought Monitor, except for extreme eastern Caroline County (severe drought, level D2), drought conditions on the Eastern Shore improved to abnormally dry (level D0) in Kent County with moderate drought conditions (level D1) reported for Talbot and Queen Anne's Counties and most of Caroline County. Because of the improving conditions, the Maryland Department of the Environment upgraded the drought warning to a drought watch for Kent, Queen Anne's, Talbot and Caroline Counties on September 12th. The drought watch was continued because rainfall and ground water levels were still below normal for the year. The goal is for voluntary conservation to cut water usage by 5 to 10 percent in drought watch areas. Homeowners, government facilities, businesses and industry were asked to reduce water use for irrigation. Drought relief did not arrive in time to help the crops, especially corn. Crop losses in Caroline County reached 75 percent. On August 29th, the United States Department of Agriculture Secretary Tom Vilsack issued a Disaster Designation for Maryland. Farmers are now able to get some financial relief from the drought. The declaration covered all the Eastern Shore counties. The flooding rains associated with Sandy ended drought conditions along the Maryland Eastern Shore. The Maryland Department of the Environment lifted the drought watch for the area.
2023 HMP Update: No New Events Reported Since 2012	

Source: National Center for Environmental Information (NCEI), 2023.

Heat/Excessive Heat

Table 3-33: Heat Event Composite

Heat events Caroline County from January 1996 – June 2023		
59 Heat events – Frequency 2.19		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	9	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	59	**Heat**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Heat (Z). A period of heat resulting from the combination of high temperatures (above normal) and relative humidity. A Heat event occurs and is reported in Storm Data whenever heat index values meet or exceed locally/regionally established advisory thresholds. Fatalities or major impacts on human health occurring when ambient weather conditions meet heat advisory criteria are reported using the Heat event. If the ambient weather conditions are below heat advisory criteria, a Heat event entry is permissible only if a directly related fatality occurred due to unseasonably warm weather, and not man-made environments.		

Table 3-34: Excessive Heat Event Composite

Excessive Heat events Caroline County from January 2000 – June 2023		
16 Excessive Heat events – Frequency 0.70		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	16	**Excessive Heat**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Excessive Heat (Z). Excessive Heat results from a combination of high temperatures (well above normal) and high humidity. An Excessive Heat event occurs and is reported in Storm Data whenever heat index values meet or exceed locally/regionally established excessive heat warning thresholds. Fatalities (directly related) or major impacts to human health that occur during excessive heat warning conditions are reported using this event category. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.		

Table 3-35: Excessive Heat Event Narrative

Date	Type of Event	Event Narrative
March 31, 2000	Excessive Heat	March 2000 was an unseasonably warm and wet month across the Maryland Eastern Shore. The statewide monthly average temperature of 47.6 degrees was the 7th warmest March on record since 1895.
May 2 to May 4, 2001	Excessive Heat	High temperatures reached around 90 degrees on both the 3rd and the 4th.
June 26 to June 28, 2007	Excessive Heat	The first heat wave of the season (loosely defined as three consecutive days with high temperatures of 90 degrees or higher) occurred across most of the Maryland Eastern Shore from the 26th through the 28th.
July 8 to July 10, 2007	Excessive Heat	A heat wave brought unseasonably hot weather to the Eastern Shore on July 8th through the 10th. The combination of the heat and humidity produced afternoon heat indices of around 100F both afternoons.
August 7 to August 8, 2007	Excessive Heat	Highest temperatures were close to 100 degrees in most areas.
August 25, 2007	Excessive Heat	Heat indices of 105F to 110F which were similar only to August 8th as the highest of the summer.
June 7 to June 10, 2008	Excessive Heat	The combination of high temperatures well into the 90s and dew point temperatures in the 70s produced apparent temperatures or heat indices values as high as 105 to 110.
July 16 to July 23, 2008	Excessive Heat	The longest heat wave of the summer affected the Maryland Eastern Shore from July 16th through the 23rd. The combination of the temperatures and dew points produced apparent temperatures or heat indices of around 100F.
August 10, 2009	Excessive Heat	The heat index at Easton peaked at 105 degrees as the dew point was at 77 degrees. High temperatures were mainly in the mid-90s.
June 23 to June 24, 2010	Excessive Heat	Unseasonably hot and humid weather enveloped the Maryland Eastern Shore on the 23rd and 24th. It culminated on the 24th with maximum temperatures of 95 to 100 degrees and afternoon heat indices of around 105F.
June 27 to June 28, 2010	Excessive Heat	Two more days of unseasonably hot and humid weather affected Eastern Maryland on the 27th and 28th. High temperatures reached 95 to 100 again and combined with the humid air mass to produce afternoon heat indices of around 105F on the 28th.
July 5 to July 7, 2010	Excessive Heat	The hottest weather of the summer season occurred on July 5th through the 7th throughout the state of Maryland. Some high temperatures on the 6th and 7th exceeded 100 degrees. For those places that reached 100 degrees, this was the first time since August of 2001 than high temperatures exceeded 100 degrees. Humidity levels were relatively low and in many places the afternoon heat index was only slightly higher than the actual temperature.
July 23 to July 25, 2010	Excessive Heat	The last heat wave in July culminated with some of the highest heat indices of the summer on the 24th and numerous high temperatures around 100 degrees. The combination of the heat and humidity produced heat index values of 105 to 110 degrees on the 24th. The heat wave ended with the passage of severe thunderstorms and a strong cold front during the afternoon of the 25th.
July 21 to July 24, 2011	Excessive Heat	One of the most oppressive heat waves since mid-July 1995 enveloped the Eastern Shore from July 21st through the 24th. Many locations had high temperatures that reached the 100s. The most oppressive day was July 22nd when the combination of temperature and dew points pushed afternoon heat index values to between 110F and 125F.
June 29, 2012	Excessive Heat	An unseasonably hot and humid day produced high temperatures of around 100 degrees along the Eastern Shore on the 29th. Combined with the humidity levels, maximum hourly heat indices reached around 110F (for example 111 degrees at the Baltimore-Washington International Airport and 109 degrees in Salisbury). The heat and humidity then set the stage for the powerful derecho that moved through the Eastern Shore later that evening.
July 18 to July 19, 2013	Excessive Heat	The most oppressive hot spell of the summer season affected the Eastern Shore from July 15th through the 20th. Widespread high temperatures reached into the mid-90s, and the most oppressive days (combination of heat and humidity) occurred on the 18th and 19th. Afternoon heat indices reached nearly 110 degrees.
2023 HMP Update: No New Events Reported Since 2013		

Source: National Center for Environmental Information (NCEI), 2023.

Thunderstorms

Table 3-36: Thunderstorm Wind Event Composite

Thunderstorm Wind events Caroline County from January 1956 – June 2023		
138 Thunderstorm Wind events – Frequency 2.06		
Number of Days with Event and Death:	1	
Number of Days with Event and Injury:	1	
Number of Days with Event and Property Damage:	6	$405,000
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	138	**Thunderstorm Wind**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Thunderstorm Wind (C). Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if the result in fatalities, injuries, or serious property damage. Storm Data software permits only one event name for encoding severe and non-severe thunderstorm winds. The Storm Data software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.		

Table 3-37: Thunderstorm Wind Event Narrative

Location	Date	Event Narrative	Property Damage
Preston	June 4, 2008	A squall line of severe thunderstorms plus an EF0 tornado caused wind damage across southwestern Caroline County. The combination of the squall line and the tornado caused about $500,000 in damage to about 30 homes and businesses in and around Preston.	$200,000
Denton	July 25, 2010	A severe thunderstorm caused wind damage across several municipalities in Caroline County. Numerous trees and wires were knocked down, some were greater than 100 years old. Choptank Electric and Delmarva Power and Light reported about 3,000 homes and businesses lost power in the county. Power was not fully restored until 5 a.m. EDT on the 26th. In Denton, the porch railings were ripped away from one home and porch furniture was tossed two hundred feet. Numerous trees were knocked down from Asbury off of Maryland State Route 328 southeast through the Caroline Country Club. In Federalsburg, the damaging winds caused roof damage to one home and Henry's Furniture Store. Dover Doppler Radar was measuring winds of around 85 mph at 1,300 feet above Denton.	$100,000
Harmony	June 29, 2012	A gust front outrunning a cluster of severe thunderstorms entered near Harmony in western Caroline County at approximately 11:40 pm EDT on the 29th. This gust front produced damaging wind gusts estimated at 65 mph as it traversed eastward across the county. Within approximately 20 minutes of the gust front passage, a potent line of severe thunderstorms tracked eastward through Caroline County, producing another round of destructive wind gust, estimated at 65 mph. Trees and electric wires were reported down across the county. Severe thunderstorms exited eastern Caroline County, including the town of Henderson, at approximately 12:49 am EDT on the 30th.	$50,000
Preston	September 8, 2012	A severe thunderstorm caused roof damage to a home on Payne Road in Preston.	$5,000
Preston	February 21, 2014	A severe thunderstorm badly damaged a home in Preston. The winds lifted the house's front porch over the back of it. A window air-conditioning unit was blown into the house. Two sliding glass doors were torn away, and the effects of the wind badly damaged the home's kitchen and living room. The American Red Cross provided a hotel room for the homeowner. No injuries occurred.	$25,000
Preston	October 7, 2014	A severe thunderstorm caused tree and home wind damage in Preston. Multiple residents suffered minor damage to their homes, yards and outdoor items. In the Hughlett Road and Tidewater Circle area, several trees were knocked down. Several fences were damaged. Multiple trampolines and yard ornaments were blown into other yards. Several homes suffered damage to soffits and one heat pump was knocked over. A resident in the area had a measured wind gust of 77 mph. Street signs were also blown down. In the Williamson Street area, multiple residents also had whole trees knocked down.	$25,000

Location	Date	Event Narrative	Property Damage
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Greensboro	May 29, 2019	The second day of a three-day outbreak of severe weather, numerous severe thunderstorms developed over the mid-Atlantic as a wave of low pressure tracked along a stalled frontal boundary. Widespread wind damage occurred along with areas of severe hail and a weak tornado in Lehigh County, PA. Multiple trees and power lines were reported down. Time estimated from radar.	Not Available
Ridgeley Pelican Arp	May 30, 2019	Severe thunderstorms impacted the aera. Trees and wires down in Ridgeley. Time estimated from radar.	Not Available
Oakland	May 30, 2019	Severe thunderstorms impacted the region. Straight-line winds estimated between 60 and 70 mph. Uprooted or snapped and large limbs down from 15 trees.	Not Available
Greensboro	May 30, 2019	Severe thunderstorms impacted the region. Trees and wires down in Greensboro. Time estimated from radar.	Not Available
Goldsboro	May 30, 2019	Severe thunderstorms impacted the region. Trees and wires down in Goldsboro. Time estimated from radar.	Not Available
Preston	May 30, 2019	Severe thunderstorms impacted the region. Wires down in Preston. Time estimated from radar.	Not Available
Preston	June 18, 2019	For a third consecutive day, a nearly stationary frontal boundary triggered convection late in the day on June 18. Similar to the prior day, an overall marginal environment limited the threat for widespread severe weather. However, a few of the storms did become strong to severe. A report was received of wires down near the intersection of Sunset Blvd and Main St. Time estimated from radar.	Not Available
Concord	June 18, 2019	For a third consecutive day, a nearly stationary frontal boundary triggered convection late in the day on June 18. Similar to the prior day, an overall marginal environment limited the threat for widespread severe weather. However, a few of the storms did become strong to severe. Power lines were downed in the Concord area. Time estimated from radar.	Not Available
Preston	July 6, 2019	A cold front and a weak upper-level disturbance approached the mid-Atlantic on July 6. A hot and humid air mass was in place, with high temperatures well into the 90s. This led to significant instability and combined with adequate shear and the forcing from the approaching disturbances, scattered strong to severe thunderstorms developed in the area. A tree and other windblown debris were reported in the roadway due to thunderstorm winds. Time estimated from radar.	Not Available
Newton	August 7, 2019	A cold front along with a robust shortwave trough gradually approached the eastern mid-Atlantic on August 7. A pre-frontal surface trough was also in place. Ahead of the front, a warm and moist air mass built through the day. Strong instability developed, along with moderate wind shear. Convection initially developed along the pre-frontal trough. Later, a squall line associated with the front and trough combination moved through the region. Given the strong instability and adequate shear, numerous storms became severe, primarily producing damaging winds. In addition, low level shear was sufficient to help spawn a couple of brief tornadoes in New Jersey. Large tree limbs were downed on Preston Bridge Rd. Time estimated from radar.	Not Available
Greensboro	October 31, 2019	A severe weather outbreak impacted the mid-Atlantic from the evening of October 31 through the pre-dawn hours of November 1. A strong area of low pressure moved through the eastern Great Lakes on the 31st. Ahead of it, strong southerly flow advected an unseasonably warm and moist air mass into the mid-Atlantic. This generated enough instability, combined with extremely strong wind fields, to produce a low topped line of severe convection which tracked across the entire region. Widespread damaging wind occurred as the squall line moved through, along with a couple of short-lived embedded tornadoes. Downed power lines were reported near the intersection of Spring Branch Rd and Greensboro Rd. Time estimated from radar.	Not Available
Denton	February 7, 2020	An area of low pressure moving out of the Southeast began to explosively intensify as it moved over the mid-Atlantic. On the morning of February 7, the eastern mid-Atlantic was briefly within the warm sector of the deepening low. An environment of extreme wind fields was present, and temperatures and dew points rose enough for sufficient instability to develop to sustain convection. A line of low topped but intense convection developed, and despite producing little thunder and lightning it produced a long swath of wind damage over the mid-Atlantic, along with a few tornadoes between Virginia and Maryland. Significant structural damage occurred to a barn. Photos confirm this and radar data suggests straight line winds likely became enhanced in this location. Time estimated from radar.	Not Available
Ridgely	February 7, 2020	An area of low pressure moving out of the Southeast began to explosively intensify as it moved over the mid-Atlantic. On the morning of February 7, the eastern mid-Atlantic was briefly within the warm sector of the deepening low. An environment of extreme wind fields was present, and temperatures and dew points rose enough for sufficient instability to develop to sustain convection. A line of low topped but intense convection developed, and despite producing little thunder and lightning it produced a long swath of wind damage over the mid-Atlantic, along with a few tornadoes between Virginia and Maryland. A utility was downed on State Highway 480 at Sunset Blvd. Time estimated from radar.	Not Available

Location	Date	Event Narrative	Property Damage
American Corners	February 7, 2020	An area of low pressure moving out of the Southeast began to explosively intensify as it moved over the mid-Atlantic. On the morning of February 7, the eastern mid-Atlantic was briefly within the warm sector of the deepening low. An environment of extreme wind fields was present, and temperatures and dew points rose enough for sufficient instability to develop to sustain convection. A line of low topped but intense convection developed, and despite producing little thunder and lightning it produced a long swath of wind damage over the mid-Atlantic, along with a few tornadoes between Virginia and Maryland. Straight line winds collapsed a block barn on Howard Rd north of Federalsburg. A swath of damage also occurred to multiple other nearby structures, with damage consistent with straight line winds of 70 to 80 mph. Time estimated from radar.	Not Available
Newton	April 9, 2020	A warm front moved through the mid-Atlantic on the morning of April 9. During the late morning and early afternoon, the mid-Atlantic was in a narrow warm sector with a cold front quickly approaching from the west as low pressure tracked through the Great Lakes and then began to redevelop over southern New England. Ahead of the front, a strongly forced and highly sheared environment existed. Heating and moisture were limited in the small warm sector region, but sufficient instability developed to support convective development, and a broken line of showers and thunderstorms moved across the region, causing a considerable amount of wind damage. That evening, additional severe weather occurred as several post-frontal squalls developed. One of these squalls developed into a low-topped thunderstorm. Steep lapse rates and strong wind profiles allowed this storm to also produce wind damage over southeastern Pennsylvania, northeast Maryland, northern Delaware, and southern New Jersey. Trees and wires were downed in the area. Time estimated from radar.	Not Available
Baltimore Corner	April 13, 2020	A highly anomalous weather system affected much of the eastern United States on April 13. From the night of April 12 through the day on April 13, strengthening low pressure tracked in an almost due northerly direction from the Ohio Valley, through the Great Lakes, and into Canada. A record strong low-level jet developed ahead of it along the East Coast. In the mid-Atlantic, a warm front moved through the region during the morning of the 13th, bringing showery weather. During and after the warm frontal passage, mixing with the low-level jet brought destructive wind gusts to the surface, especially near the coast where gusts were enhanced by a well-defined gravity wave. During the afternoon hours, a strong cold front approached, providing strong forcing to an environment of strong to extreme wind shear. Instability was limited due to a lack of clearing following the morning warm frontal passage. However, enough heating occurred by mid-afternoon that a line of strong to severe thunderstorms did manage to develop, producing a number of damaging wind reports as it moved towards the coast. A metal shed was blown apart from the gusts.	Not Available
Greensboro	June 4, 2020	Several weak disturbances and their associated boundaries, in combination with an unstable airmass, produced strong to severe thunderstorms across northeastern Maryland during the late afternoon and evening hours. Localized heavy downpours were also reported. MD-313 northbound north of MD-314 was closed due to storm debris. Time estimated from radar.	Not Available
Baltimore Corner	July 6, 2020	A slow moving backdoor cold front drifted southwest through the mid-Atlantic region on July 6. Meanwhile, a shortwave vorticity impulse, one of several in a series, moved across the region during the day. A very hot and humid air mass was present ahead of the backdoor cold front, leading to the development of strong to extreme instability over the region. The approaching upper-level disturbance allowed for the development of moderate wind shear over the region. Combined with the front, it also acted as a trigger mechanism for convection. Severe thunderstorms developed by early afternoon over eastern PA and southern and central New Jersey. These storms produced strong outflow boundaries which served to initiate additional severe convection. The result was a ring of fire in which outflow steadily propagated outward in all directions. This caused severe weather to spread radially outward from its origin near Philadelphia to much of New Jersey, other portions of eastern Pennsylvania, and Delmarva. MD-313 was closed in both directions from Hollingsworth Circle to Jones Rd due to storm debris. Time estimated from radar.	Not Available
Goldsboro	July 6, 2020	A slow moving backdoor cold front drifted southwest through the mid-Atlantic region on July 6. Meanwhile, a shortwave vorticity impulse, one of several in a series, moved across the region during the day. A very hot and humid air mass was present ahead of the backdoor cold front, leading to the development of strong to extreme instability over the region. The approaching upper-level disturbance allowed for the development of moderate wind shear over the region. Combined with the front, it also acted as a trigger mechanism for convection. Severe thunderstorms developed by early afternoon over eastern PA and southern and central New Jersey. These storms produced strong outflow boundaries which served to initiate additional severe convection. The result was a ring of fire in which outflow steadily propagated outward in all directions. This caused severe weather to spread radially outward from its origin near Philadelphia to much of New Jersey, other portions of eastern Pennsylvania, and Delmarva. Video received via social media from this location of winds which appeared to be at least 60 mph. Time estimated from radar.	Not Available
Choptank	July 21, 2020	Two large and robust thunderstorms produced microburst-like damage in eastern Maryland. Winds of 60-70 mph or higher likely occurred based on the damage reports. Downed trees and power lines near Blades Road in Choptank. Time estimated from radar.	Not Available

Location	Date	Event Narrative	Property Damage
Preston	July 21, 2020	Two large and robust thunderstorms produced microburst-like damage in eastern Maryland. Winds of 60-70 mph or higher likely occurred based on the damage reports. Dispatch reports numerous trees down around the town of Preston. Time estimated from radar.	Not Available
Bethlehem	July 21, 2020	Two large and robust thunderstorms produced microburst-like damage in eastern Maryland. Winds of 60-70 mph or higher likely occurred based on the damage reports. Reports of trees and wires down near Bethlehem Road southeast of Tanyard. Time estimated from radar.	Not Available
Hillsboro	July 21, 2020	Two large and robust thunderstorms produced microburst-like damage in eastern Maryland. Winds of 60-70 mph or higher likely occurred based on the damage reports. Wind-blown debris closed Maryland Alternate Route 404 near and west of Cemetery Road. Time estimated from radar.	Not Available
Dressard	July 22, 2020	A slow-moving frontal boundary was draped across upstate New York and southern New England on July 22 with multiple waves of low pressure tracking along it. The mid-Atlantic was left in a warm sector air mass south of this front. This led to a very hot and humid day on July 22 with air temperatures rising into the 90s and dew point values near 70. This caused strong instability to develop. Shear values were not overly impressive, but an approaching shortwave disturbance from the Midwest did help to increase shear late in the day. This disturbance also served as forcing for convection to develop in the warm and unstable air mass. Widespread thunderstorm development occurred, with storms eventually developing into a mostly solid squall line. This line of storms produced numerous reports of wind damage across eastern Pennsylvania, New Jersey, and Delmarva. Downed trees and wires were reported near Reliance Rd southeast of Federalsburg. Time estimated from radar.	Not Available
Dressard	July 22, 2020	A slow moving frontal boundary was draped across upstate New York and southern New England on July 22 with multiple waves of low pressure tracking along it. The mid-Atlantic was left in a warm sector air mass south of this front. This led to a very hot and humid day on July 22 with air temperatures rising into the 90s and dew point values near 70. This caused strong instability to develop. Shear values were not overly impressive, but an approaching shortwave disturbance from the Midwest did help to increase shear late in the day. This disturbance also served as forcing for convection to develop in the warm and unstable air mass. Widespread thunderstorm development occurred, with storms eventually developing into a mostly solid squall line. This line of storms produced numerous reports of wind damage across eastern Pennsylvania, New Jersey, and Delmarva. Wires were downed near Bridgeville Rd east of Federalsburg. Time estimated from radar.	Not Available
Bethlehem	August 6, 2020	An impulse moving along a stalled boundary draped across the region, in combination with moisture left over from Hurricane Isaias, produced severe thunderstorms with damaging winds and flooding rains over the eastern shore of Maryland during the early morning hours of August 6th. Downed power lines near Tanyard. Time estimated from radar.	Not Available
Goldsboro	August 6, 2020	An impulse moving along a stalled boundary draped across the region, in combination with moisture left over from Hurricane Isaias, produced severe thunderstorms with damaging winds and flooding rains over the eastern shore of Maryland during the early morning hours of August 6th. Downed wires near the Goldsboro area. Time estimated from radar.	Not Available
Marydel	August 6, 2020	An impulse moving along a stalled boundary draped across the region, in combination with moisture left over from Hurricane Isaias, produced severe thunderstorms with damaging winds and flooding rains over the eastern shore of Maryland during the early morning hours of August 6th. Several reports of power lines down in the Marydel and Templeville areas. Time estimated from radar.	Not Available
Denton	August 25, 2020	A strong cold front along with a mid-level shortwave trough approached the mid-Atlantic on August 25. Ahead of the disturbances, wind shear increased significantly and surface temperatures warmed, increasing instability. While some ingredients were in place for a major severe weather event, an offset in timing between the shortwave and the front, combined with greater than expected mid-level dry air, caused storms to generally struggle to develop over the mid-Atlantic. Greater storm coverage was found in more favorable environments over both New England and the Ohio Valley. However, the environment over the mid-Atlantic was still highly favorable for damaging winds, so the few storms that did develop produced some instances of wind damage. A tree was reported blown down in Denton. Time estimated from radar.	Not Available
Federalsburg	September 3, 2020	A frontal boundary stalled over the mid-Atlantic on the overnight of September 2 and lifted northward slightly during the day on September 3. A robust shortwave trough was also approaching during the day. This combination caused a high shear environment to develop, with good moisture also present. However, instability was marginal due to considerable cloud cover over the area. In addition, multiple rounds of storms associated with different sources of lift tended to work against each other, as storms generally struggled to organize and become dominant. However, given the high shear some storms still became strong to severe and produced instances of damaging wind. County dispatch reported three calls for downed trees in Federalsburg. Time estimated from radar.	Not Available

Location	Date	Event Narrative	Property Damage
Smithville	September 3, 2020	A frontal boundary stalled over the mid-Atlantic on the overnight of September 2 and lifted northward slightly during the day on September 3. A robust shortwave trough was also approaching during the day. This combination caused a high shear environment to develop, with good moisture also present. However, instability was marginal due to considerable cloud cover over the area. In addition, multiple rounds of storms associated with different sources of lift tended to work against each other, as storms generally struggled to organize and become dominant. However, given the high shear some storms still became strong to severe and produced instances of damaging wind. Wires were downed on Smithville Rd. Time estimated from radar.	Not Available
Federalsburg	April 21, 2021	A strong cold front approached the mid-Atlantic coast on April 21. Ahead of the front, modest instability developed in a strongly sheared and strongly forced environment. This led to the development of convection along and ahead of the front as it moved through during the midafternoon hours. Mixed modes of linear and discrete storm cells were present, some of which became strong to severe. Scattered instances of hail and wind damage were reported across much of the eastern mid-Atlantic. A tree was downed onto an unoccupied vehicle.	Not Available
Marydel	July 1, 2021	After a significant heatwave, a cold front approached the mid-Atlantic on July 1, 2021. A potent mid-level trough was also digging southward through southern Ontario and into the Great Lakes region, and a strong upper level jet streak was present downstream the trough axis, over the interior mid-Atlantic and northern New England. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development on July 1. Storms occurred almost exclusively south of Interstate 78, in the environment of best instability. A number of storms became severe, taking the form of mainly linear and multi-cellular clusters but with some embedded super cellular characteristics. Straight line wind damage was the primary hazard, with a number of reports of downed trees and power outages due to winds. With the cold front remaining to the west, some storm activity continued into the overnight, but storm coverage and intensity gradually waned with the loss of daytime heating and the overturning of the atmosphere from earlier storms. Several reports of downed tree limbs and wires between Marydel and Hartly. Time estimated from radar.	Not Available
Federalsburg	July 1, 2021	After a significant heatwave, a cold front approached the mid-Atlantic on July 1, 2021. A potent mid-level trough was also digging southward through southern Ontario and into the Great Lakes region, and a strong upper level jet streak was present downstream the trough axis, over the interior mid-Atlantic and northern New England. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development on July 1. Storms occurred almost exclusively south of Interstate 78, in the environment of best instability. A number of storms became severe, taking the form of mainly linear and multi-cellular clusters but with some embedded supercellular characteristics. Straight line wind damage was the primary hazard, with a number of reports of downed trees and power outages due to winds. With the cold front remaining to the west, some storm activity continued into the overnight, but storm coverage and intensity gradually waned with the loss of daytime heating and the overturning of the atmosphere from earlier storms. Several reports of downed power lines and numerous power outages in the Federalsburg area. Time estimated from radar.	Not Available
Federalsburg	July 1, 2021	After a significant heatwave, a cold front approached the mid-Atlantic on July 1, 2021. A potent mid-level trough was also digging southward through southern Ontario and into the Great Lakes region, and a strong upper level jet streak was present downstream the trough axis, over the interior mid-Atlantic and northern New England. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development on July 1. Storms occurred almost exclusively south of Interstate 78, in the environment of best instability. A number of storms became severe, taking the form of mainly linear and multi-cellular clusters but with some embedded supercellular characteristics. Straight line wind damage was the primary hazard, with a number of reports of downed trees and power outages due to winds. With the cold front remaining to the west, some storm activity continued into the overnight, but storm coverage and intensity gradually waned with the loss of daytime heating and the overturning of the atmosphere from earlier storms. Trees and wires were down along MD-313 near Old Denton Rd. Time estimated from radar.	Not Available

Location	Date	Event Narrative	Property Damage
Hickman	July 1, 2021	After a significant heatwave, a cold front approached the mid-Atlantic on July 1, 2021. A potent mid-level trough was also digging southward through southern Ontario and into the Great Lakes region, and a strong upper level jet streak was present downstream the trough axis, over the interior mid-Atlantic and northern New England. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development on July 1. Storms occurred almost exclusively south of Interstate 78, in the environment of best instability. A number of storms became severe, taking the form of mainly linear and multi-cellular clusters but with some embedded supercellular characteristics. Straight line wind damage was the primary hazard, with a number of reports of downed trees and power outages due to winds. With the cold front remaining to the west, some storm activity continued into the overnight, but storm coverage and intensity gradually waned with the loss of daytime heating and the overturning of the atmosphere from earlier storms. Trees and wires were down along MD-404 and Breeding Rd. Time estimated from radar.	Not Available
Denton	July 1, 2021	After a significant heatwave, a cold front approached the mid-Atlantic on July 1, 2021. A potent mid-level trough was also digging southward through southern Ontario and into the Great Lakes region, and a strong upper level jet streak was present downstream the trough axis, over the interior mid-Atlantic and northern New England. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development on July 1. Storms occurred almost exclusively south of Interstate 78, in the environment of best instability. A number of storms became severe, taking the form of mainly linear and multi-cellular clusters but with some embedded supercellular characteristics. Straight line wind damage was the primary hazard, with a number of reports of downed trees and power outages due to winds. With the cold front remaining to the west, some storm activity continued into the overnight, but storm coverage and intensity gradually waned with the loss of daytime heating and the overturning of the atmosphere from earlier storms. Wires were downed in the Denton area. Time estimated from radar.	Not Available
Hillsboro	July 21, 2021	A strong cold front moved through the mid-Atlantic on July 21. Ahead of the front, an environment of moderate wind shear and seasonably warm and humid conditions promoted widespread thunderstorm development. Storms mainly took the form of multi-cell clusters and quasi-linear segments. A number of storms became severe, posing a threat for both damaging winds and, thanks to cold air aloft, large hail as they moved towards the coast. With the front moving through during the mid to late afternoon hours, most of the storm activity was offshore by early evening, with cooler and drier weather behind the front. A tree was downed across alternate Maryland Route 404.	Not Available
Newton	June 2, 2022	A cold front moved through the mid-Atlantic on June 2. A diffuse backdoor cold front that have moved into the area the prior day was also present near the Delmarva peninsula and southern New Jersey. A rather complex convective environment developed ahead of the approaching front, generally characterized by both moderate shear and instability. Widespread thunderstorm activity developed ahead of the front, with a mixed mode of multicells and a couple of supercells. Some of the storms became severe as they moved through the region, producing damaging winds and small hail. As the front moved offshore during the later evening hours, the severe weather threat diminished and a cooler, drier air mass settled in. MD-578 was closed in both directions at Newton Rd due to trees and/or wires down. Time estimated from radar.	Not Available
Fowling Creek	June 2, 2022	A cold front moved through the mid-Atlantic on June 2. A diffuse backdoor cold front that have moved into the area the prior day was also present near the Delmarva peninsula and southern New Jersey. A rather complex convective environment developed ahead of the approaching front, generally characterized by both moderate shear and instability. Widespread thunderstorm activity developed ahead of the front, with a mixed mode of multicells and a couple of supercells. Some of the storms became severe as they moved through the region, producing damaging winds and small hail. As the front moved offshore during the later evening hours, the severe weather threat diminished and a cooler, drier air mass settled in. Caroline County emergency managers relayed a report, with photos, of multiple large trees downed in a yard, including one down on a car. Radar data suggested a downburst or microburst occurred in the area at the time. Time estimated from radar.	Not Available
Williston	July 12, 2022	Isolated thunderstorms developed leading to some significant wind damage in Delmarva. Most notably was a macroburst which began near Denton, MD and continued for about 18 miles east into Delaware with estimated peak winds of 110 mph. Large trees down and a limb into a car windshield on Pealiquor Road. Pictures provided via social media. Time estimated via radar. This was near the beginning of a macroburst which continued for about 18 miles east into Delaware with estimated peak winds of 110 mph.	Not Available
Denton	July 12, 2022	Isolated thunderstorms developed leading to some significant wind damage in Delmarva. Most notably was a macroburst which began near Denton, MD and continued for about 18 miles east into Delaware with estimated peak winds of 110 mph. Photo of a camper significantly damaged by a fallen tree and the Martinak State Park Campground. This resulted in one injury to an occupant. Time estimated from radar. This was near the beginning of a macroburst which continued for about 18 miles east into Delaware with estimated peak winds of 110 mph.	Not Available

Location	Date	Event Narrative	Property Damage
Denton	July 12, 2022	Isolated thunderstorms developed leading to some significant wind damage in Delmarva. Most notably was a macroburst which began near Denton, MD and continued for about 18 miles east into Delaware with estimated peak winds of 110 mph. Underground gauge KMDDENTO27 measured wind gust. This was near the beginning of a macroburst which continued for about 18 miles east into Delaware with estimated peak winds of 110 mph.	Not Available
Greensboro	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. County 911 call center reported a tree down into a house. Time estimated from radar.	Not Available
Hillsboro	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. Numerous trees and wires down around Hillsboro, MD. Time estimated from radar.	Not Available
Greensboro	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. Tree down into a barn around Greensboro, MD. Time estimated from radar.	Not Available
Ridgely Pelican Arp	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. Numerous trees and wires down around Ridgely, MD. Time estimated from radar.	Not Available
Denton	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. Reports of numerous downed wires around Denton, MD. Time estimated from radar.	Not Available
Federalsburg	August 4, 2022	Clusters of thunderstorms moved into Delmarva from the west causing scattered wind damage across the eastern shore. Numerous trees and wires down in Federalsburg, MD. Time estimated from radar.	Not Available

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-38: Lightning Event Composite

Lightning events Caroline County from January 1996 – June 2023		
8 Lightning events – Frequency 0.30		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	1	
Number of Days with Event and Property Damage:	4	$59,000
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	8	**Lightning**

Source: National Center for Environmental Information (NCEI), 2023.
Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone.
Based on NCEI definitions/criteria: Lightning (C). A sudden electrical discharge from a thunderstorm, resulting in a fatality, injury, and/or damage.

Table 3-39: Lightning Event Narrative

Location	Date	Event Narrative	Property Damage
Denton	January 19, 1996	A person was struck and injured by lightning in Denton.	Not Available
Henderson	August 19, 1999	Thunderstorms with frequent lightning caused 10,000 homes and businesses to lose power on the Maryland Eastern Shore. Power outages also occurred in northern Caroline County.	Not Available
Denton	May 13, 2000	Lightning struck the ground near the Caroline County Courthouse and entered the building. The lightning damaged the County's and State's computer and phone systems.	$28,000
Federalsburg	June 30, 2001	Lightning struck and ignited a fire in a Federalsburg house. No serious injuries were reported.	Not Available
Baltimore Corner	April 6, 2009	A lightning strike and the ensuing fire destroyed an abandoned barn outside of Henderson along Bee Tree Road in Caroline County. A nearby tree was initially struck by lightning. The two-story barn was destroyed.	$25,000
Preston	April 21, 2009	A lightning strike caused 31 homes to lose power in Preston. Power was restored to all homes by 11 p.m. EDT that evening.	$1,000
Hillsboro	June 1, 2010	A house in Hillsboro was struck by lightning.	$5,000

Location	Date	Event Narrative	Property Damage
2023 HMP Update			
Preston	May 22, 2022	A cold front approached the eastern mid-Atlantic late on May 22. Ahead of the front, a warm and strongly unstable air mass was present. However, wind shear was fairly weak and frontal forcing was not overly strong. As the front moved east, a couple areas of thunderstorms developed with daytime heating, gradually progressing eastward from late afternoon through the evening. As supported by the environment, some storms became strong to marginally severe with a few instances of damaging wind. Storm activity gradually waned by the later evening hours with loss of heating, and the frontal passage brought quieter weather by the following day. A house fire due to a lightning strike was reported on Preston Rd. Time estimated from radar.	Not Available

Source: National Center for Environmental Information (NCEI), 2023

Table 3-40: High Wind Event Composite

High Wind events ***High Wind Events 50kts Or Stronger*** **Caroline County from January 1999 – June 2023**		
8 High Wind events – Frequency 0.33		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	4	$526,500
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	8	**High Wind**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: High Wind (Z). Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data.		

Table 3-41: High Wind Event Narrative

Date	Event Narrative	Property Damage
September 16, 1999	Hurricane Floyd battered the Maryland Eastern Shore on September 16th and brought with it torrential rains and damaging winds. President Clinton declared all of the Maryland Eastern Shore a disaster area. Wind gusts rarely exceeded 50 mph, but all the flooding rains made it easy for trees to be knocked over. Ten homes and several businesses along the Tuckahoe Creek were badly flooded. In Caroline County, towns near rivers (Denton, Federalsburg, Greensboro and Hillsboro) bore the brunt of the damage. Six roads and thirty bridges were in need of repairs. About 20 people were in shelters throughout the County. Other dam failures or spillovers occurred on Lake Bonnie near Goldsboro, Crouse Mill in Tuckahoe State Park and Chambers Lake near Federalsburg. Three schools suffered water damage. Large pieces of roadways collapsed on Maryland State Route 480 and Second Street in Denton. Infrastructure damage alone was estimated as high as 2.5 million. A truck driver was injured when his vehicle overturned on a flooded Maryland State Route 312. Storm totals included 11.20 inches in Federalsburg (Caroline County).	$500,000
November 2, 1999	An unseasonably humid air mass spread across the Middle Atlantic States on November 2nd. This produced wind damage across the Maryland Eastern Shore mainly in the form of downed trees, tree limbs and wires.	Not Available
December 12, 2000	Peak wind gusts ranged between 50 and 60 mph and knocked down trees, tree limbs and power lines. About 11,000 homes and businesses lost power. The worst reported wind damage occurred in Caroline County where seven municipalities reported wind damage. The worst damage within the county occurred in the northern part around Henderson where downed trees blocked several roads.	Not Available
December 31, 2008	High winds buffeted the Eastern Shore during the afternoon of the 31st. Numerous tree limbs, trees and power lines were knocked down. Delmarva Power and Light reported about 40,000 homes and businesses lost power in their service area including the Eastern Shore. A large garage fire in Denton (Caroline County) was tough to contain and battle because of the high winds. The fire spread to three other buildings and went to six alarms. All four structures were destroyed, and an old elementary school suffered heat damage.	$4,000

Date	Event Narrative	Property Damage
February 12, 2009	Peak wind gusts averaged around 50 mph and knocked down several tree limbs, weak trees and power lines. In Preston, the single support post of a roof covering at a Valero gas station snapped at 2 p.m. EST. Peak wind gusts included 47 mph in Ridgely (Caroline County).	$10,000
February 15, 2015	The increasing pressure difference (gradient) between a rapidly intensifying low-pressure system offshore and an arctic high-pressure system moving east from the Great Lakes caused strong to high damaging northwest winds to occur on the Eastern Shore from the evening of the 14th into the early afternoon on the 15th. Strong wind gusts started during the second half of the evening on the 14th, peaked overnight and continued into the early afternoon of the 15th. Peak wind gusts averaged around 55 mph and knocked down or snapped trees and tree limbs. This caused downed wires and widely scattered power outages. The strong to high winds also hampered road crews trying to keep roadways clear from the snow that fell on the 14th. It also ushered into the Eastern Shore one of the coldest air masses of the entire winter season.	$12,500
March 2, 2018	Downed trees were reported throughout the county. A wind gust of 48 mph was recorded by the AWOS unit at Easton Airport at 0750EST on March 2nd.	Not Available
2023 HMP Update		
February 25, 2019	A departing very deep cyclone combined with strong high pressure to the west yielded a strong pressure gradient from the Plains eastward to the northern Mid-Atlantic and New England regions. High winds gusting 50-60 mph resulted in scattered power outages and trees down across the region. Some minor structural damage also occurred. Based on surrounding reports and observations, winds likely gusted to 50 kts across the county.	$0

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-42: Funnel Cloud Event Composite

Funnel Cloud events Caroline County from January 2002 – June 2023		
1 Funnel Cloud events – Frequency 0.05		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	0	$0
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	1	**Funnel Clouds**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Funnel Cloud (C). A rotating, visible extension of a cloud pendant from a convective cloud with circulation not reaching the ground. The funnel cloud should be large, noteworthy, or create strong public or media interest to be entered.		

Table 3-43: Funnel Cloud Event Narrative

Location	Date	Event Narrative	Property Damage
Denton	June 13, 2009	A Skywarn spotter saw a funnel cloud northwest of Denton.	Not Available
2023 HMP Update: No New Events Reported Since 2009			

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-44: Tornado Event Composite

Tornado events Caroline County from January 1952 – June 2023		
7 Tornado events – Frequency 0.10		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	5	$375,250
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	7	**Tornado**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Tornado (C). A violently rotating column of air, extending to or from a cumuliform cloud or underneath a cumuliform cloud, to the ground, and often (but not always) visible as a condensation funnel. For a vortex to be classified as a tornado, it must be in contact with the ground and extend to/from the cloud base, and there should be some semblance of ground-based visual effects such as dust/dirt rotational markings/swirls, or structural or vegetative damage or disturbance.		

Table 3-45: Tornado Event Narrative

Location	Date	Event Narrative	Magnitude	Width	Property Damage
Caroline	April 5, 1952	No Report	F0	33 Yards	$250
Caroline	April 18, 1978	No Report	F1	10 Yards	$25,000
Caroline	July 14, 1990	No Report	F0	20 Yards	$25,000
Caroline	July 31, 1992	No Report	F1	183 Yards	$25,000
Bethlehem	June 4, 2008	An F0 tornado touched down west of Preston and moved through the city before lifting. The combination of the squall line and the tornado caused about $500,000 in damage to about 30 homes and businesses in and around Preston.	EF0	50 Yards	$500K
2023 HMP Update					
Baltimore Corner	April 13, 2020	An EF-0 tornado touched down just north of Baltimore Corner in Caroline County MD at approximately 327 PM on April 13, then moved in an east to northeast direction for about 4.9 miles before lifting just south of Henderson MD. No injuries were reported, but numerous trees along or near the path were either snapped or uprooted in a sporadic pattern. The maximum wind gusts were estimated to be 80 MPH at the tornado's peak intensity.	EF0	30 Yards	$0
Baltimore Corner	November 30, 2020	A tornado touched down along Maryland State Route 313 at 3:13 PM just south of the Caroline-Queen Annes County border. Damage was sparse in this area, but a velocity couplet developed over this location when viewed by the nearby NEXRAD KDOX in Dover Delaware. There was also a small area of low correlation coefficient values coinciding with this velocity couplet, suggestive of a tornado debris signature (TDS). This signature moved in a northeasterly direction roughly three to four miles northwest of the small town of Henderson, MD. Two areas of damage occurred along this linear path created by the TDS, the first being to a residence along Trunk Line Road just to the east of the intersection with Taylor Road. No damage was reported for roughly 1.4 miles as the tornado moved to the northeast, with the base perhaps lifting at times. A second area of damage occurred at a chicken farm on Shults Road between the intersections with Hecht and Zion Roads. From there, the TDS continued northeastward for another 1.4 miles before disappearing right before the Delaware Border just south of the small town of Templeville, MD in Caroline County. It is at this point that we estimate the tornado to have lifted based on trends in the corresponding velocity couplet and TDS from radar. The NWS survey team would like to thank the Marydel Volunteer Fire Company for their assistance in this survey, which was conducted remotely and is subject to change if additional information becomes available.	EF0	75 Yards	Not Available

Source: National Center for Environmental Information (NCEI), 2023.

Table 3-46: Hail Event Composite

Hail events Caroline County from January 1991 – June 2023		
15 Hail events – Frequency 0.47		
Number of Days with Event and Death:	0	
Number of Days with Event and Injury:	0	
Number of Days with Event and Property Damage:	1	$50,000
Number of Days with Event and Crop Damage:	0	$0
Number of Event Types reported:	15	**Hail**
Source: National Center for Environmental Information (NCEI), 2023. Legend: There are three designators: C - County/Parish; Z - Zone; and M – Marine Zone. Based on NCEI definitions/criteria: Hail (C). Frozen precipitation in the form of balls or irregular lumps of ice. Hail 3/4 of an inch or larger in diameter will be entered. Hail accumulations of smaller size, which cause property and/or crop damage or casualties, should be entered. Maximum hail size will be encoded for all hail reports entered.		

Table 3-47: Hail Event Narrative

Location	Date	Event Narrative	Magnitude	Property Damage
Caroline	2/24/1991	No Report	1.75 in.	$0
Caroline	4/01/1993	No Report	2.75 in.	$50,000
Greensboro	5/13/2000	A severe thunderstorm knocked over a couple of trees in Ridgely and produced quarter size hail in Greensboro. Lightning from the same storm struck the ground near the Caroline County Courthouse and entered the building. The lightning damaged the county's and state's computer and phone systems.	1.00 in.	$0
Greensboro	5/27/2001	Hail as large as hen eggs (about 2 inches in diameter) fell in Greensboro.	2.00 in.	$0
Goldsboro	6/19/2002	No Report	0.75 in.	$0
Henderson	4/24/2006	A severe thunderstorm produced nickel size hail in Templeville.	0.88 in.	$0
Denton	7/10/2007	A severe thunderstorm dropped penny size hail in central Caroline County in and around Denton.	0.75 in.	$0
Greensboro	7/10/2007	A severe thunderstorm dropped penny size hail in central Caroline County in and around Denton.	0.75 in.	$0
Denton	5/31/2008	Thunderstorms rolled across Eastern Maryland during the afternoon hours. The more intense storms produced hail to the size of pennies and nickels in Denton between about 2:25 PM and 2:30 PM EDT.	0.88 in.	$0
Denton	6/13/2009	Penny size hail fell from a severe thunderstorm near Denton.	0.75 in.	$0
Greensboro	May 23, 2011	A severe thunderstorm dropped golf ball size hail in Greensboro.	1.75 in.	$0
Preston	July 28, 2012	A thunderstorm dropped nickel size hail in Preston.	0.88 in.	$0
Federalsburg	July 28, 012	A thunderstorm also dropped nickel size hail in Federalsburg.	0.88 in.	$0
Denton	May 2, 2016	Hail reached the size of 1.25 inches with thunderstorms that moved through the area.	1.25 in.	$0
Hillsboro	May 23, 2016	Thunderstorms associated with an offshore low-pressure system moved through Caroline County during the late afternoon hours on the 23rd. While these storms had a history of producing pea-size hail earlier in their lifespan, one report from social media indicated nickel-size hail near Griffin.	0.88 in.	$0
2023 HMP Update: No New Events Reported Since 2016				

Source: National Center for Environmental Information (NCEI), 2023.

[i] National Risk Index

[ii] Fifth National Climate Assessment – Chapter 21. Northeast

[iii] Fifth National Climate Assessment – Chapter 21. Northeast

Chapter 4 Flooding

Hazard Ranking

- **Hazard Mitigation Planning Committee**
  Riverine Flooding – Concerned
  Coastal Flooding – Somewhat Concerned
- **Municipalities (R-Riverine, C-Coastal Levels of Concern)**
  - Denton – Somewhat Concerned (R, C)
  - Federalsburg – Very (R), Somewhat (C)
  - Goldsboro – Somewhat (R), Not (C)
  - Greensboro – Very (R), Concerned (C)
  - Henderson – Very (R), Not (C)
  - Hillsboro – Not (R), Somewhat (C)
  - Marydel – Somewhat (R), Not (C)
  - Preston – Somewhat Concerned (R, C)
  - Ridgely – Very (R), Not (C)
  - Templeville – Somewhat (R), Concerned (C)
- **State**
  Riverine Flooding - Medium High
  Coastal Flooding - Medium
- **National** – Relatively Low
- **Public** – Somewhat Concerned

Public Survey Responses

- 17% of residents have flood insurance. 80% state their mortgage does not require flood insurance.
- Only 6% of residents have experienced damage from flooding.
- 6% of residents have floodproofed their homes to reduce the flood risk.
- 30% of participants feel their community is at risk to riverine flooding, while 19% feel at risk to coastal flooding.
- 12% of participants indicated that the following mitigation measure should be taken: buyout flood prone properties and maintain as open space.

Chapter Updates

- This chapter now discusses nontidal and tidal flooding.
- Characteristic information was updated with current information.
- New images have been included.
- All maps have been updated.
- History event data has been updated with the most current available data.
- The 2019 Flood Risk Report was integrated into the chapter.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Risk assessment using the new critical facilities were conducted and incorporated in the vulnerability section of the chapter.
- New riverine and coastal loss estimates from the flood risk report were added.
- A risk assessment for historic structures is new element in the chapter.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.
- FEMA Reports and Statics was updated with current data.
- Repetitive Loss properties were updated to reflect the most up to date information.

Flood Hazard Characterization

The FEMA definition for flooding is “a general condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source.” Floods can be caused by the passage of thunderstorms, hurricanes, snow melt or some combination of the above events.

The State of Maryland is subject to three types of flooding:

- **Nontidal** – flooding from rivers and streams (riverine flooding).
- **Tidal** – flooding from tides and storm surges (coastal flooding).
- **Nuisance** – typically unrelated to particular storm events, though it may be exacerbated by long-duration wind events or passing storm systems and the astrological position of the sun and the moon (discussed in Chapter 6 Shoreline Erosion & Sea Level Rise).

There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Typically, the determining characteristics that can induce a flash flood include high rainfall intensity over a short time duration. Flash floods can be further influenced by local topography, the ground’s capacity to hold water and soil moisture content. The sudden release of water can also cause flash floods, such as the breakup of an ice jam or dam. One of the deadliest flash floods in Maryland killed 14 people.

The flood occurred in eastern Baltimore County when 11 inches of rain fell in a 10-hour time span on August 1-2, 1971.

Riverine flooding is caused by persistent moderate or heavy rain over one or more days. Remnants of hurricanes can also cause riverine flooding. Riverine flooding can be combined with snowmelt, causing a river to slowly rise and overflow its banks. This type of flooding can take several days or even weeks to rise out over its banks, which typically provides adequate warning for people to move to higher ground.

According to FEMA, coastal flooding is when water inundates or covers normally dry coastal land as a result of high or rising tides or storm surges.

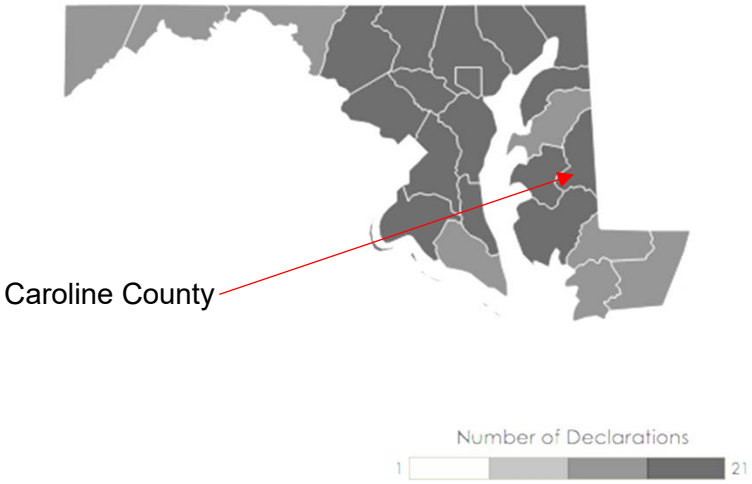
Coastal areas are also vulnerable to increases in the intensity of storm surge and heavy precipitation. Storm surges flood low- lying areas, damage property, disrupt transportation systems, destroy habitat, and threaten human health and safety. Coastal inundation is particularly likely when high tides, storm surge and/or large waves occur at the same time. At these times, areas where rivers or creeks meet the sea are more vulnerable because high tides can cause the rivers to back up inland.

Figure 4-1: The Choptank River Floods After Hurricane Sandy - October 30, 2012

Source: https://www.myeasternshoremd.com

Thirty-seven (37) disaster declarations have occurred in Maryland since 1950. The flood hazard accounts for more declarations in Maryland than any other hazard. As shown in Figure 4-2, Caroline County is shaded in the dark grey indicating that the county has a high number of declarations relative to other Maryland jurisdictions. In fact, the county has been included in twenty (20) of Maryland's Disaster Declarations, one of which was for flood.

Figure 4-2: Disaster Declaration for Maryland Jurisdictions



Source: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

Flooding is the most common type of natural disaster worldwide; about 40% of all-natural disasters involve flooding. According to the *2010 Caroline County Comprehensive Plan*, Caroline County is located within six State-designated 8-digit watersheds: Upper Choptank River, Tuckahoe Creek, Marshyhope Creek, Lower Choptank River, Nanticoke River, and Upper Chester River. Almost 96 percent of the County is located with the Upper Choptank River, Tuckahoe Creek and Marshyhope Creek watersheds. The Upper Choptank River, Tuckahoe Creek and Marshyhope Creek watersheds together occupy nearly the entire County. Only about 0.1 percent of Caroline County lies within the Upper Chester River and Nanticoke River watersheds and only four percent in the Lower Choptank River.

The County encompasses an area of 326 square miles, 4 square miles of which is water. The Choptank River flows through Caroline County and drains into Chesapeake Bay. Tuckahoe Creek and Hunting Creek, the main tributaries of the Choptank River, form part of the County's western and southern boundaries. A small area in the southeastern part of the county is drained by Marshy Hope Creek, one of the main tributaries of the Nanticoke River, depicted on Map 4.1.

Most of the county lies on a gently upward-sloping plain at an elevation of 40 to 60 feet. In the northern part of Caroline County, the elevation reaches 78 feet. However, the slope of the land seldom exceeds 5 percent and less than 2 percent of the total land area has slopes over 10 percent. The terrace plains on which Caroline County lies are dissected by numerous streams and rivers. In the headlands, the streams are generally straight. In the lower reaches, many streams exhibit meanders. The meanders are found in streams at or below an elevation of 20 feet. At tide level, these streams become meandering estuaries.

Agricultural drainage ditches are also an important part of the waterway system in Caroline County. These ditches are necessary in order to create useable farmland in the County due to the overall drainage in the County tending to be slow due to, depending on location, either generally level ground, poorly drained soils, numerous depressions, or proximity to tidal waterways.

According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides. The flat topography of the County, combined with its humid climate, high seasonal water tables, and generally poorly drained soils, produce natural flood problems, such as the control and disposal of surface water caused by abnormally high rainfall and conveyance issues.

Caroline County is largely rural but does contain some smaller urban centers such as Denton and Federalsburg. Much of the land in the County outside of these smaller urban centers is used for agriculture,

primarily in the form of poultry farming and corn and soybean production. Caroline County has a continental climate, temperatures are moderate due to its close proximity to Chesapeake Bay and Atlantic Ocean. The county annually averages 43.2 inches of rainfall and 18.5 inches of snowfall. The average temperature is 75°F in summer and 37°F in winter. In general, the county has flat terrain and poorly draining soils, leading to problems with flooding during larger storm events.

Flooding Facts

• 75% of all Presidential disaster declarations are associated with flooding.

• Homeowners Insurance typical does not include flood related damage. This means you need a separate flood insurance quote and policy in addition to your homeowner insurance policy.

• It may take up to 30 days for your flood insurance policy to take effect.

• In a 30-year mortgage, a home has a 26% chance of being damaged by a flood compared to a 9% chance of fire.

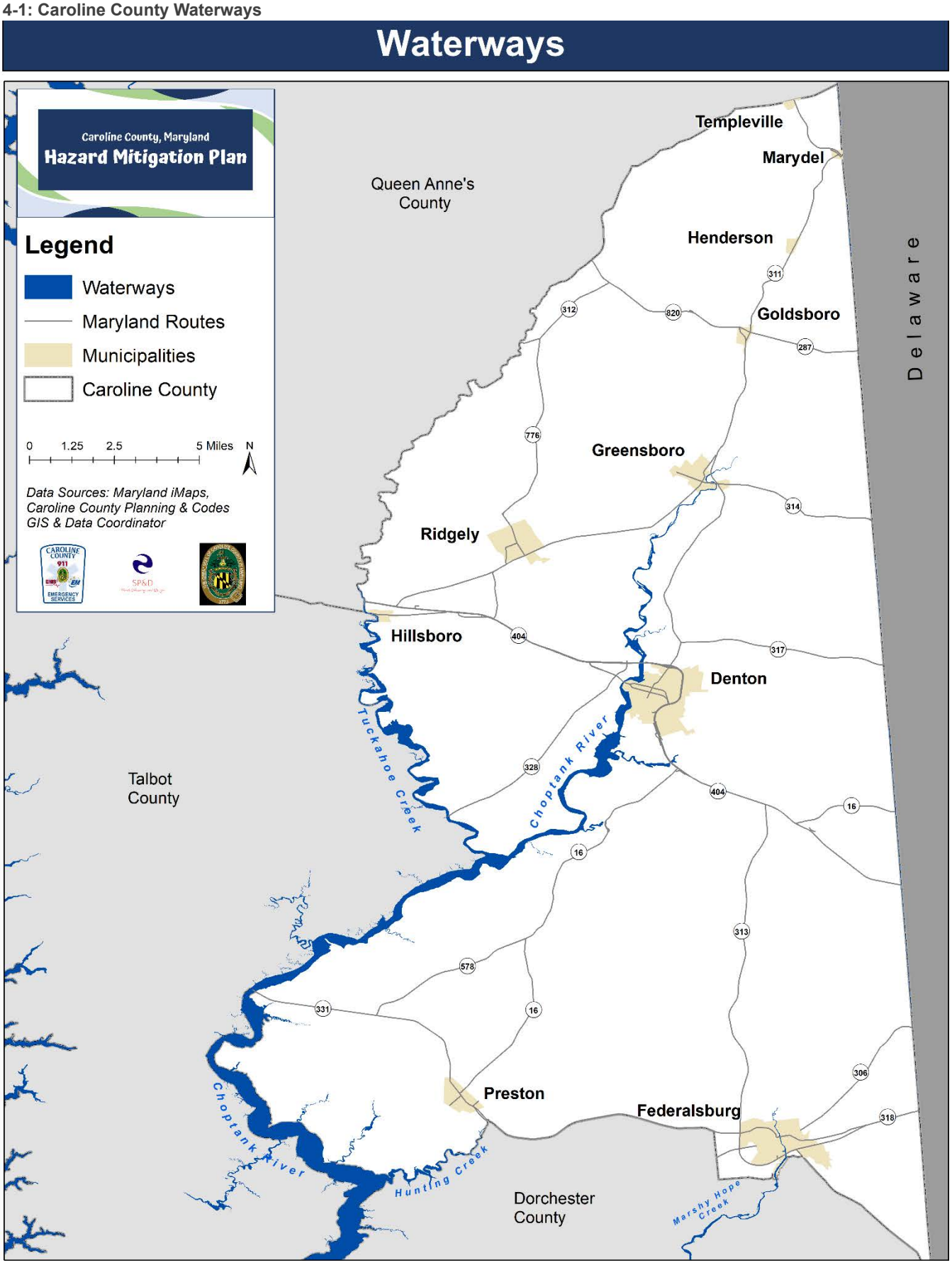
• Only 12% of U.S. homeowners have flood insurance, according to a 2016 poll conducted by the Insurance Information Institute.

Source: www.nationalfloodinsurance.org/flood-fact

Figure 4-3: Greensboro - Sunset Avenue & Bridge Flooding After Hurricane Irene, August 2011

Picture Source: Caroline County Department of Planning & Codes

Map 4-1: Caroline County Waterways



Flood Hazard Risk & History

The Hazard Mitigation Planning Committee (HMPC) ranked riverine flooding as "concerned" based on local experience. Local climatic conditions can produce large amounts of precipitation at any time of the year, creating no limit to the potential of flooding at any time of year. On June 26, 2006, the worst recorded flooding in the County occurred causing five million dollars in damage. In addition, on August 25, 2011, then Maryland Governor Martin O'Malley declared a state of emergency in preparation for Hurricane Irene. In Caroline County, sections of Maryland State Routes 287, 313, 31, and 311 were among twenty (20) roadways that were closed. Two dozen homes were damaged by the flooding and wind. About 5,500 homes and businesses lost power.

The towns of Denton and Greensboro are located along the floodplain of the Choptank River, while Hillsboro is located on Tuckahoe Creek and Federalsburg is located on Marshyhope Creek.

The following tables list flash flooding, heavy rain events, and flooding that has occurred in the County based on data from the National Centers for Environmental Information (NCEI). In terms of number of occurrences, the NCEI listed a total of 52 heavy rainfall events affecting Caroline County from 1996-2023. Therefore, Caroline County experiences 1.93 heavy rainfall events per year.

Table 4-1: Heavy Rain Events

Heavy Rain Events – 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
52	**0**	**0**	**0**	**1.93**

Source: National Centers for Environmental Information (NCEI), Events through June 2023

In terms of number of occurrences, the NCEI listed a total of 8 flood events affecting Caroline County from 2006-2023. Therefore, Caroline County experiences 0.47 flood events per year.

Table 4-2: Flood Events

Flood Events– 2006-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
8	**0**	**0**	**1.050M**	**0.47**

Source: National Centers for Environmental Information (NCEI), Events through June 2023

As reported in the Star Democrat Newspaper, the following are recent flooding events:

- June 2006 – *Flooding* – Residents who suffered flood damage are eligible for federal assistance.
- September 3, 2006 –*Remnants of Hurricane Ernesto* – Steady rain all day resulted in flooding that evening during high tide. A total of 3.5 inches of rain were measured at Denton.
- April 24, 2006 - *Heavy Rains* - Part of Caroline County, near Denton received more than a couple of inches of rain.
- November 16, 2006 - *Heavy Rains* – Afterschool activities were canceled.
- December 8, 2009 – *Flooding* - 2.95 inches of rain were recorded at American Corner. All four lanes in both directions on Route 619 at Shore Highway closed. Corkell Road in Denton and Crouse Mill Road in Ridgely were closed. Three school buses in the county were forced to take detours around 3 closed roads.
- August 30, 2011 – *Flooding* – Greensboro fairgrounds flood and part of Route 313 were shut down.
- June 4, 2013 – *Flooding* - Sandy takes toll on Caroline County.
- July 12, 2017 – *Street Flooding* – In Ridgely, parts of Central Avenue blocked to traffic and road blocked between Third and Fourth Streets due to flooding and overhead power wire being knocked loose.

In terms of number of occurrences, the *NCEI* listed a total of 19 flash flood events affecting Caroline County from 1999-2023. Therefore, Caroline County experiences an average of 0.70 flash flood events per year.

Table 4-3: Flash Flood Events

Flash Flood Events– 1999-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
19	**1**	**0**	**8.370M**	**0.70**

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Coastal flooding in Caroline County primarily occurs in areas along the Choptank River, Marshyhope Creek, Tuckahoe Creek and their tributaries. Caroline County includes the following towns within the coastal region.

Table 4-4: Overview of Floodplain Management Program Information

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Denton	240104	4,793	5.35	Y	10	Y
Town of Federalsburg	240013	2,842	1.99	Y	10	Y
Town of Greensboro	240014	1,929	1.07	Y	10	Y
Caroline County	240130	33,433	326	Y	7	Y

Source: U.S. Census Bureau, 2020; FEMA CRS, 2023; FRR 2019

In terms of coastal storms, a total of five (5) events have been recorded for the county between 1996 and 2023. Therefore, Caroline County experiences an average of 0.17 coastal flooding events per year.

Table 4-5: Coastal Flood Events

Coastal Flood Events– 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
5	**0**	**0**	**0**	**0.17**

Source: National Centers for Environmental Information (NCEI), Events through June 2023

As shown on the storm event Tables 4-1 through 4-3, the annual frequency of occurrences is 0.47 for flood events and 1.93 heavy rain. Therefore, the likelihood of future events is high. In addition, projections for increased rainfall in the Northeast Region of the United States may affect the current frequency statistics resulting in an even higher likelihood of occurrences. Mitigating current conditions based on hazard risk is important, however, understanding of future conditions is essential.

Flood Vulnerability

Drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides. The flat topography of the County, combined with its humid climate, high seasonal water tables, and generally poorly drained soils, produce natural flood problems, such as the conveyance, control and disposal of surface water caused by abnormally high rainfall.

The FEMA Flood Insurance Study (FIS) and associated Digital Flood Insurance Rate Maps (DFIRM's) became effective on January 16, 2015. The FIS includes:

- Caroline County (Unincorporated Areas)
- Town of Denton
- Town of Federalsburg- *Please note that the Town of Federalsburg is geographically located in Caroline and Dorchester Counties*

- Town of Goldsboro
- Town of Greensboro
- Town of Henderson
- Town of Hillsboro
- Town of Marydel
- Town of Preston
- Town of Ridgely
- Town of Templeville- *Please note that the Town of Templeville is geographically located in Queen Anne's and Caroline Counties*

Please note that on the effective date of this study, the Towns of Henderson, Marydel, Preston, Ridgely, and Templeville have no mapped Special Flood Hazard Areas (SFHA). This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e., annexation of new lands) or the availability of new scientific or technical data about flood hazards.

Flooding sources studied within the FIS included:

- Broadway Branch
- Marshy Hope Creek
- Chapel Branch
- Miles Branch
- Choptank River
- Smithville Ditch
- Henderson Creek
- Tanyard Branch
- Herring Run
- Tidy Island Creek
- Hunting Creek
- Watts Creek

Special Flood Hazard Areas (SFHA) are the geographic areas that FEMA has defined according to their varying levels of flood risk. The SFHA for Caroline County are described in Table 4-6 and depicted on Map 4-2: Special Flood Hazard Areas (SFHA).

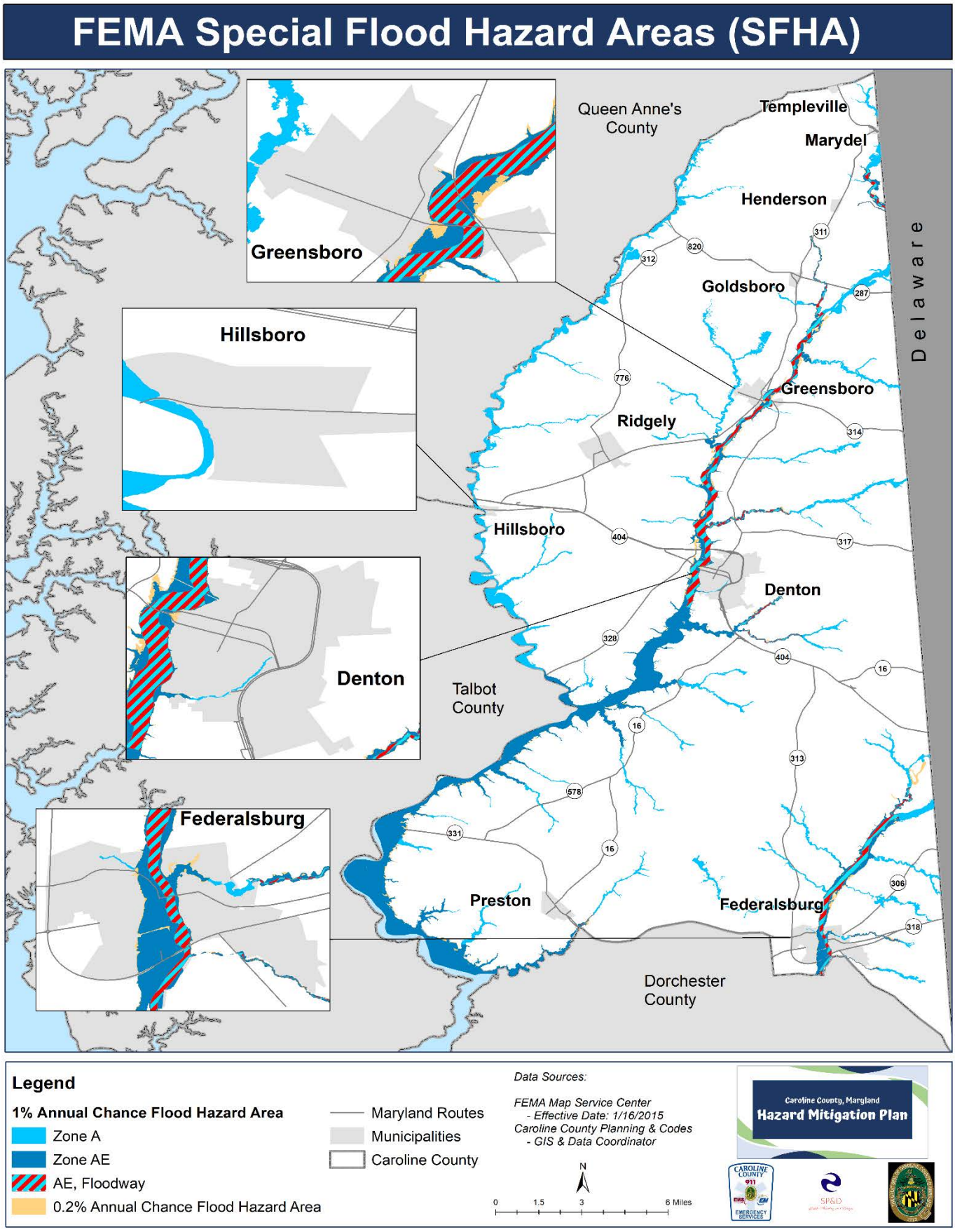
Table 4-6: FEMA Flood Zone Descriptions

FEMA Flood Zone Descriptions		
Flood Zone		**Description**
High Risk Areas		
1% Annual Chance Flood Hazard	**A**	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
	AE	The base floodplain where base flood elevations are provided for a 100-year flood event. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
Moderate Risk Areas		
0.2% Annual Chance Flood Hazard	**Zone X Shaded**	Areas outside the 1% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones.

Source: FEMA

Flood maps show the Special Flood Hazard Area (SFHA), the area that would be affected by a 1% annual chance flood (or base flood). Properties within the SFHA are at a high risk of flooding, with at least a 26% chance of flooding over the course of a 30-year mortgage. A Flood Insurance Rate Map (FIRM, or flood map) is an official map on which FEMA has delineated Special Flood Hazard Areas (SFHAs), or areas at a high risk of flooding. Along the coast, the flood map has delineated coastal SFHAs where the source of flooding is from coastal hazards, such as storm surge and waves. The SFHA for coastal flooding affects Caroline County, primarily in the areas along the Choptank River and to some extent its tributaries.

Map 4-2: FEMA Special Flood Hazard Areas (SFHA)



According to the 2015 FEMA Flood Insurance Study (FIS), The Choptank River floodplain located in the city limits of Denton and Greensboro is too swampy for most types of development. Although there is some residential development in the flood plain, the majority has generally been above the higher flood levels. Anticipated development is expected to continue at a slow rate. It will probably not occur in the floodplain areas since suitable land for development is available elsewhere.

The Town of Denton located on the Maryland eastern shore in Caroline County lies at the intersection of Maryland Route 404 and the Choptank River. The town is situated on the east bank of the Choptank River with the river forming a common boundary between the town and Caroline County. At Denton, the Choptank River drains an area of approximately 200 square miles, most of which lies within Caroline County. The Choptank River is also influenced by tides from Chesapeake Bay as far upstream as Greensboro, Maryland. At Denton, the tidal range for the Choptank River is approximately 2.2 feet for the mean tide and 2.5 feet for the spring tide.

The principal source of flooding in the Town of Denton is the Choptank River. The flood elevations of the river are influenced by the magnitude of flood flows from the drainage basins in Caroline County, upstream from Denton and the tide levels in the Chesapeake Bay. High intensity rainfall over prolonged periods and storm tides on the Chesapeake both singly and in combination have led to flood elevations on the Choptank River which have inundated the low-lying riverbanks in the Denton vicinity. In areas of flat topography and poorly drained soils, high intensity rainfall has led to local flooding problems.

The Town of Federalsburg, Maryland, is in the eastern part of the county, near the Delaware border and adjacent to the border between Caroline and Dorchester Counties. Marshy Hope Creek flows through Federalsburg, with approximately 148 square miles of its 218 square mile watershed contributing at that point. The principal flooding source in the Town of Federalsburg is Marshy Hope Creek. The drainage area characteristics of Marshy Hope Creek are such that flood conditions are produced by high intensity rainfall.

Floodwater damage and problems related to agricultural water management occur in the same areas due to the flatness of the watershed and the extent of poorly drained soils. Floodwater problems include the conveyance, control, and disposal of surface water caused by abnormally high direct precipitation. Drainage problems occur where, under natural conditions, excess water keeps the soil too wet for sustained agricultural use. Landowners in the watershed have experienced complete crop losses in large areas during seasons with heavy rains, occurring approximately once every five years. Flooding occurs most often in the late summer and early autumn. Large portions of the business district of Federalsburg lie on the west bank of the floodplain subject to storm overflow.

The Town of Greensboro lies in the Atlantic Coastal Plain Province. Most of the town lies above an elevation of 20 feet on a flat terrace plain. Two small areas of the town lie above the 40-foot elevation. Low elevations of two to three feet can be found in the swampy region in the southern sectors of the town near Sunset Avenue, the overbank elevations are generally higher with a minimum elevation of six to seven feet. Near Park and Riverview Lane which separate the areas of higher 20 feet elevations in the west from the lower areas near the Choptank River the land slopes toward the Choptank River with gradients in the order of 5 to 10 percent. The Choptank River is influenced by tides from Chesapeake Bay. The principal source of flooding around the Town of Greensboro is the Choptank River. The flood elevations on the river are influenced by the magnitude of flood flows from the drainage areas in Caroline County upstream from Greensboro and the tide levels in the Chesapeake Bay. High intensity rainfall over prolonged periods and storm tides on the Chesapeake both singly or in combination have led to flood elevations on the Choptank River which have inundated the low-lying riverbank areas in the Greensboro vicinity. The low-lying areas bordering Forge Branch may also experience flooding during high intensity rainstorms, especially during higher-than-normal flows on the Choptank River.

Vulnerability and Impacts to People, Systems, and Resources from Flood

To describe the impacts of flood within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 4-7.

Table 4-7: Riverine Flooding Vulnerability and Impacts to People, Systems, and Resources

People	• Populations aged 65 and older and children aged 5 and younger are most at-risk for flooding. The highest socially vulnerable populations are located in the northeast and southeast portions of Caroline County. • Other at-risk populations are those with health problems. Power outages caused by flooding affect people's ability to access health related products. • Property damage caused by destruction of property and/or long-term mold/rot issues. • Floodwater brought in from coastal flooding is very dangerous due to its potential to contain disease causing bacteria. In addition, floodwaters may contain parasites, viruses, agricultural waste, chemicals, and raw sewage.
Systems (including networks and capabilities)	• Coastal flooding has been known to create problems with utility services, such as power outages due to stress on power systems. • Flooding has been known to create problems with utility services, such as power outages due to stress on power systems. • Outages impact the availability of emergency and government services. • There are approximately 11,000 system/drain fields located on properties throughout Caroline County. A total of 1,500 of these lies within critical areas. Heavy rainfall and tidal inundation can overload a system's ability to function properly which leads to overflow and potential septic failures which presents a public health threat. • Communication systems break down due to loss of power. • Transportation systems may be disrupted entirely due to flooding. • Impacts to municipal sewer pump stations located adjacent to rivers (Federalsburg & Greensboro).
Natural, Historic, and Cultural Resources	• Coastal flooding can cause the destruction of coastal habitats such as wetlands and estuaries displacing wildlife and affecting local ecosystems. • Flooding can cause stress to local wildlife in the form of displacement and/or destruction of habitats. • Disruption of soil structure. • Failure of roof drainage systems or other building services such as water mains may cause moisture accumulation in porous materials such as timber, lime mortars, platers, soft brick, masonry, pugging, or other insulation. This can lead to long-term damp and decay on historical properties.

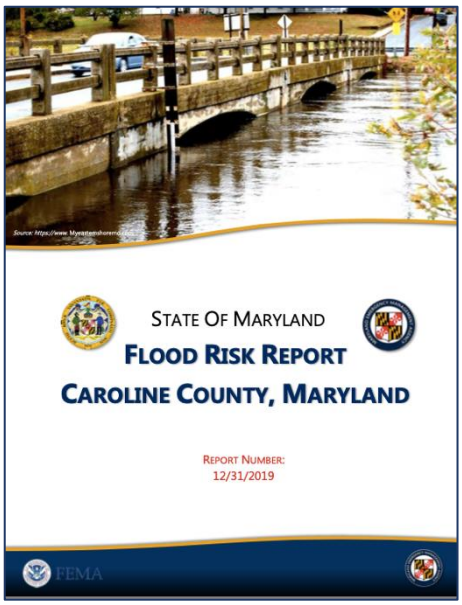
In May 2015, the State of Maryland published the *Local Hazard Mitigation Plan Guidance* to ensure continuity between local and State Hazard Mitigation Plan documents. As part of the local guidance, the State determined at a minimum the following essential facilities must be included in both the State and local plan update process:

- Fire Stations
- Hospital and Medical Clinics
- Police Stations
- Emergency Operations Centers
- Schools (K-12 & Colleges)

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have

little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death. Therefore, these facilities are vital to the health and safety of the county and must continue to operate before, during, and after a hazard event.

In addition to the FEMA FIRM maps that depict flood areas, other flood risk resources are available. In December 2019, the Flood Risk Report (FRR) for Caroline County was published and has been included as part of the update as intended by FEMA. The FRR is a non-regulatory product providing information for a better understanding of the flood risk in Caroline County. The FRR provides flood risk data for the entire county as well as for each individual community. The 2019 FRR differs from the 2015 Flood Risk Report in that refined loss data results for both coastal and riverine areas of the County are included, as only coastal areas were analyzed in the previous 2015 version. The 2019 FFR was also expanded to include refined losses for both essential facilities and state assets. Loss estimations for residential and commercial structures are included in this report for coastal and riverine areas. The Flood Risk Report is available to review in Appendix E. This Appendix provides mapping for high-risk areas.



According to the FFR, to fully assess flood risk, the following sources of information were leveraged:

- New/revised engineering analyses (i.e., hydrologic, and hydraulic modeling), floodplain boundaries, and flood depths based on regulatory FIRM updates and published in the FEMA National Flood Hazard Layer.
- Maryland PropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of February 2015), acquired through the Maryland Department of Planning.
- Building footprints, representing real-world locations for addressable structures, provided by Caroline County Planning and Codes - GIS Office.
- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized software suite that contains models for estimating potential losses from floods and other natural disasters.

Flood depth grids were created for all mapped 1% annual chance floodplains in the County, whereby flood depth is a function of the difference between the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground. It was noted that separate flood depth grids were created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1% annual chance flood elevation. The 1% annual chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1% annual chance floodplain. Nevertheless, the regulatory 1% annual chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report.

FEMA understands that flood risk is dynamic—that flooding does not stop at a line on a map—and as such, provides the following flood risk products:

- Flood Risk Report (FRR)
- Flood Risk Map (FRM)
- Flood Risk Database (FRD)

The risk products may be used to:

- Update local hazard mitigation plans.
- Update community comprehensive plans.
- Update emergency operations and response plans.
- Develop hazard mitigation projects.
- Communicate flood risk.
- Inform them about the modification of development standards.

The goal of this report is to help inform and enable communities to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Others with special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Information from the Flood Risk Report (FRR) has informed the mitigation strategies within the plan and will continue to be of use throughout the plan implementation process. Flood loss estimates provided in the FRR were developed using a FEMA flood loss estimation tool, Hazus (FEMA version 3.1 & 2.2). Caroline County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1% annual chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data.

FRR reported there are 37 essential facilities within Caroline County and had a total estimated building value of $95,711,000.00. Table 4-8 details each facility type, number of facilities and estimated building value.

Table 4-8: Essential Facilities

Facility Type	Number of Structure	Estimated Building Value
Emergency Operations Center (EOC) & 9-1-1	2	$3,548,900
Fire/Rescue Stations	12	$5,394,000
Hospital & Medical Clinics	5	$18,222,000
Police Stations	5	$2,193,100
Schools (K-12 & Colleges)	13	$66,357,000
Total	**37**	**$95,711,000**

Source: Caroline County 2019 Flood Risk Report

Results from the 1% annual chance flood event analysis indicate one (1) essential facility are at-risk, the Federalsburg Police Station. The flood depth for this facility is provided below.

- Federalsburg Police Station, Federalsburg – 2.0' Projected Flood Depth

The Federalsburg Police Station is located within the riverine 1% annual chance flood hazard area of Marsh Hope Creek, depicted on Figure 4-5. Table 4-9 depicts a loss estimation for the Federalsburg Police Station.

Table 4-9: Loss Estimations for Federalsburg Police Station

Facility Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
Police Station	$141,170	$52,010	37%	$89,160	63%

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.
[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Other critical facilities that warrant special attention in preparing for a disaster and are of vital importance in maintaining the function of the community were identified in Chapter 2 Critical Facilities. These facilities include government buildings, communication towers, power stations, water treatment plants, water towers, and wastewater treatment plants. Utilizing the FEMA DFIRM, effective January 2015, an updated analysis of facilities located within flood zones was completed. Facilities located within 1% annual chance flood hazard area are listed in Table 4-10. Facilities also within the 0.2% annual chance flood hazard area are included in the table and highlighted in green.

Table 4-10: Critical Facilities in 1% and 0.2% Annual Chance Flood Hazard Areas

Facility Type	Number of Facilities	Facility	Address of Facility
Government – Municipal Owned	2	Federalsburg Town Hall	118 N Main St, Federalsburg, MD 21632
		Mayor and Council of Federalsburg Facility	704 Morris Ave, Federalsburg, MD 21632
WWTP	1	Greensboro WWTP Pump Stations	13514 Greensboro Rd, Greensboro, MD 21639
Power Station	1	Delmarva Power & Light Company	Pennsylvania Ave, Federalsburg, MD 21632
Total Facilities			**4**

Source: 2023 Caroline County Facilities Database and FEMA DFIRM

Loss estimates for critical facilities located within flood zones were calculated during the Plan update. These calculations were derived from 2017 Maryland Tax Assessment values, which were last updated in December 2022.

Table 4-11: Loss Estimates for Critical Facilities

Facility Type	Facility Name	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Government – Municipal Owned	Federalsburg Town Hall	$ 671,800	$134,360.0	$335,900.0
	Mayor and Council of Federalsburg Facility	$ 899,700	$179,940.0	$449,850.0
WWTP	Greensboro WWTP Pump Stations	$277,400	$55,480.0	$138,700.0
Power Station	Delmarva Power & Light Company	$28,100	$5,620.0	$14,050.0

Source: Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County, Maryland Department of Assessments and Taxation-Real Property Data Search-Base Values

As shown in Table 4-11, critical facilities at-risk to the 1% and 0.2% annual chance flood hazard area includes the two (2) municipal facilities, one (1) wastewater treatment plant pump stations and one (1) power station. Figure 4-4 illustrates flooding that occurred at the Greensboro WWTP, which has since relocated, however pump stations for the WWTP are now at this location. Mitigation action items have been developed to address critical facilities located within the 1% annual chance flood hazard area. Note, analysis of critical facilities and their vulnerability to the coastal 1% annual chance flood hazard determined that no critical facilities are within the flood hazard area.

Figure 4-4: Greensboro Wastewater Treatment Plant 8/28/2011

Source: Department of Planning & Codes

During the 2018 planning process, the Caroline County Sheriff's Office was located on 101 Gay Street and within a moderate flood risk area, known as the 0.2% annual chance flood hazard area. The table below provided potential loss estimations calculated in 2018 for the Caroline County Sheriff's Office at the Gay Street.

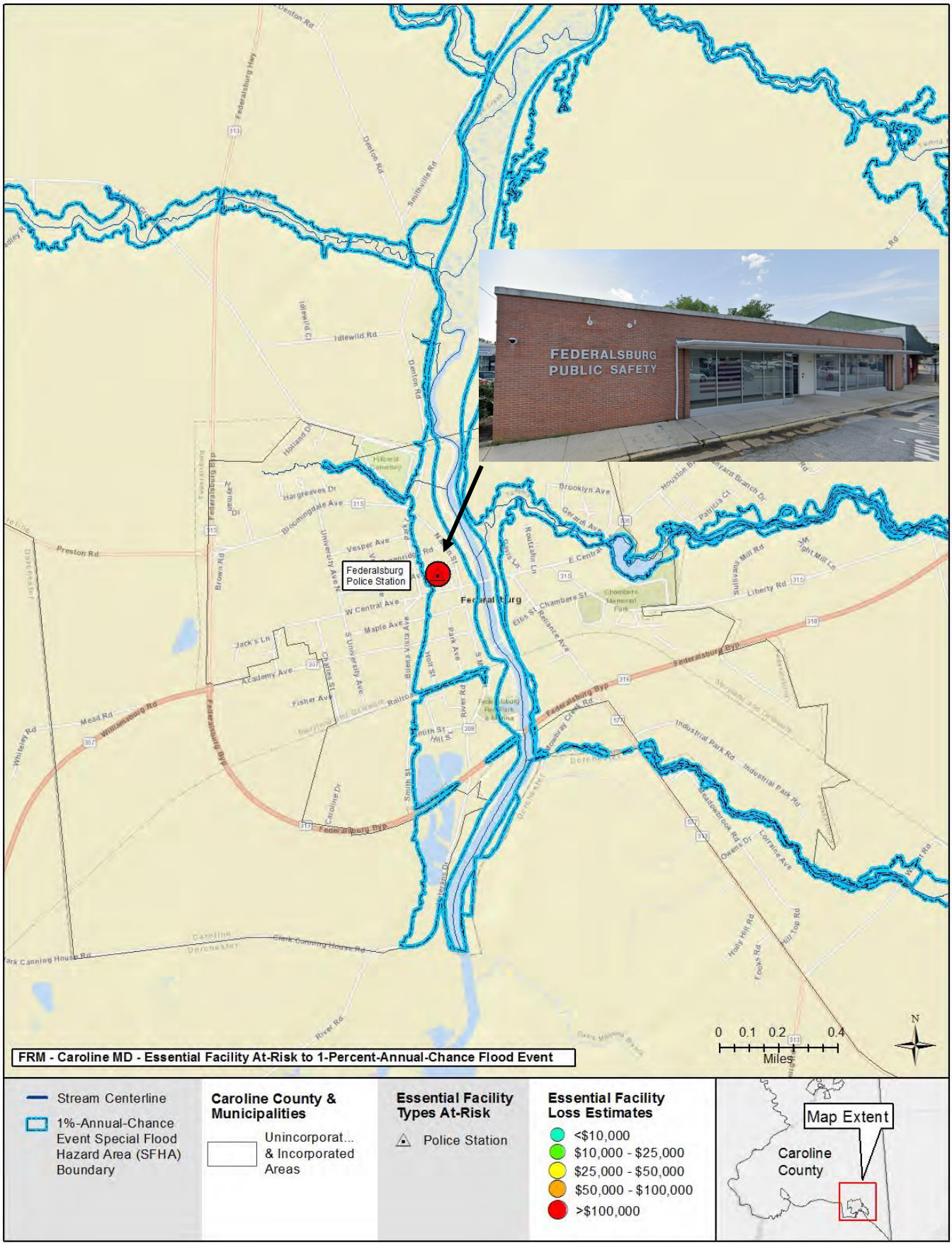
Table 4-12: Loss Estimations for Caroline County Sheriff's Office

Facility Type	Facility Name	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Police Station	Caroline County Sheriff's Office	$239,500	$47,900	$119,750

Source: Caroline County 2018 Hazard Mitigation Plan

However, since the 2018 planning process, the Sheriff's Office has relocated to 9305 Double Hills Road in Denton. At the current location, the facility is no longer within the moderate flood risk area and therefore not subject to potential flooding.

Figure 4-5: Essential Facility At-Risk to 1% Annual Chance Flood Event



Source: Caroline County 2019 Flood Risk Report

The 2019 Flood Risk Report (FRR) for Caroline County also analyzed residential, commercial, and other (industrial, agricultural, religious, government, and educational) structures at risk to the riverine and coastal 1% annual chance flood events. Overall loss estimates for the County as well as for each municipality was provided in the report. Several municipalities are impacted by the riverine 1% annual chance flood hazard, such as the Towns of Denton, Federalsburg, and Greensboro. Structures at risk to the riverine 1% annual chance flood hazard are provided in Chapter 4. The Towns of Henderson, Marydel, Preston, Ridgeley, and Templeville have no mapped Special Flood Hazard Areas (SFHA). The Towns of Goldsboro and Hillsboro do not have any buildings within the coastal 1% annual chance Special Flood Hazard Areas (SFHAs). The following provides a summary of each community's flood risk calculations.

The Caroline County (Unincorporated Areas) flood risk analysis incorporated modeled floodplain boundaries and flood depths for the 1% annual chance flood along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data.

Flood loss estimates for the **riverine** 1% annual chance flood event were calculated using Hazus-MH, and the results are presented in Table 4-13.

Table 4-13: Caroline County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses	1% (100-yr) Percent Loss
Residential Building & Contents	38	$5,700,000	55%	$600,000	11.0%
Commercial Building & Contents	7	$1,700,000	16%	$500,000	29.0%
Other Building & Contents	6	$3,000,000	29%	$300,000	10.0%
Total Building & Contents	51	$10,400,000	100%	$1,400,000	-
Business Disruption	N/A	N/A	N/A	$200,000	N/A
Total	**51**	**$10,400,000**	**100%**	**$1,600,000**	**-**

Source: Caroline County Flood Risk Report 2019

Flood loss estimates for the **coastal** 1% annual chance flood hazard were calculated using Hazus-MH. Only the unincorporated areas of the County are impacted, and results are presented in Table 4-14.

Table 4-14: Caroline County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses	1% (100-yr) Percent Loss
Residential Building & Contents	57	$9,900,000	88%	$800,000	8.0%
Commercial Building & Contents	3	$900,000	8%	$300,000	33.0%
Other Building & Contents	2	$400,000	4%	$200,000	50.0%
Total Building & Contents	62	$11,200,000	100%	$1,300,000	-
Business Disruption	N/A	N/A	N/A	$200,000	N/A
Total	**62**	**$11,200,000**	**100%**	**$1,500,000**	**-**

Source: Caroline County Flood Risk Report 2019

The primary flooding sources in the Town of Denton is the Choptank River, Watts Creek, Tributary No. 4 to the Choptank River, and Tributary No. 7 to the Choptank River. The Town of Denton flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1% annual chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Flood loss

estimates for the 1% annual chance flood event were calculated using Hazus-MH, and the results are presented in Table 4-15.

Table 4-15: Town of Denton Flood – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses	1% (100-yr) Percent Loss
Residential Building & Contents	1	$300,000	100%	$40,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$0	0%	$0	0.0%
Total Building & Contents	2	$300,000	100%	$40,000	13.0%
Business Disruption	N/A	N/A	N/A	$0	N/A
Total	**2**	**$300,000**	**100%**	**$40,000**	**13.0%**

Source: Caroline County Flood Risk Report 2019

The Town of Federalsburg is in southern Caroline County, with small portions of the town in Dorchester County. It consists of 1.99 square miles along State Highway 318. The primary flooding sources in the town are Marshy Hope Creek, Tanyard Branch, Tributary No. 1 to Marshy Hope Creek, and Miles Branch. The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Table 4-16: Town of Federalsburg Flood – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses	1% (100-yr) Percent Loss
Residential Building & Contents	161	$15,700,000	36%	$2,800,000	18.0%
Commercial Building & Contents	55	$14,600,000	34%	$4,600,000	32.0%
Other Building & Contents	19	$12,900,000	30%	$5,300,000	41.0%
Total Building & Contents	235	$43,200,000	100%	$12,700,000	29.0%
Business Disruption	N/A	N/A	N/A	$2,200,000	N/A
Total	**235**	**$43,200,000**	**100%**	**$14,900,000**	**34.0%**

Source: Caroline County Flood Risk Report 2019

The Town of Greensboro is in northern Caroline County. It consists of 1.07 square miles along State Highway 480. The primary flooding sources in the town are Choptank River and Forge Branch. The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Table 4-17: Town of Greensboro Flood – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses	1% (100-yr) Percent Loss
Residential Building & Contents	31	$3,800,000	84%	$500,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	5	$700,000	16%	$50,000	7.0%
Total Building & Contents	36	$4,500,000	100%	$550,000	12.0%
Business Disruption	N/A	N/A	N/A	$10,000	N/A
Total	**36**	**$4,500,000**	**100%**	**$14,900,000**	**12.0%**

Source: Caroline County Flood Risk Report 2019

Historic structures were analyzed in addition to critical facilities, residential, commercial, and structures to determine flood vulnerability. Chapter 2, Historic Properties, provides the full listing of Caroline County's National Register Properties. Of the twenty-three (23) properties, a total of nine (9) are within the 1% annual chance flood hazard area and are listed below. In addition, a portion of the Williston Mill Historic District is within the coastal 1% annual chance flood hazard area.

The five (5) National Register Properties highlighted in green also intersect with the 0.2% annual chance flood hazard area.

- Daffin House - Building
- Denton Historic District
- Federalsburg West Historic District
- Leonard House - Building
- Linchester Mill - Building
- Nanticoke Lodge No. 172 AF & AM - Building
- Potter Hall - Building
- West Denton Warehouse/Wharf - Building
- Williston Mill Historic District

Loss estimates were determined utilizing building footprints for National Register Properties that are categorized as buildings in Table 4-16.

Table 4-18: Loss Estimations for Caroline County National Register Properties

National Register Property	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Daffin House - Building	$1,042,800	$208,560	$521,400
Leonard House - Building	$108,200	$21,640	$54,100
Linchester Mill - Building	$257,400	$51,480	$128,700
Nanticoke Lodge No. 172 AF & AM- Building	$158,400	$31,680	$79,200
Potter Hall- Building	$339,400	$67,880	$169,700
West Denton Warehouse/Wharf - Building	$37,500	$7,500	$18,750

Source: Maryland's National Register Properties, Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County, Maryland Department of Assessments and Taxation-Real Property Data Search-Base Values

Social Vulnerability

Populations at risk are defined as at-risk individuals with access and functional needs (temporary or permanent) that may interfere with their ability to access or receive medical care before, during, or after a disaster or public health emergency. Examples of at-risk populations may include but are not limited to children, pregnant women, older adults, people with disabilities, people from diverse cultures, people with limited English proficiency, people with limited access to transportation, people with limited access to financial resources, people experiencing homelessness, people who have chronic health conditions, and people who have pharmacological dependency.

In Caroline County approximately 16.5% of the population is comprised of individuals 65 and older. An elderly individual's ability to mobilize during the event of a flooding emergency is a cause of concern when assessing at risk populations. Also, most elderly individuals rely on medical equipment attached to a power source within their homes to live and survive independently which becomes a source of risk during the event of a power outage caused by flooding. According to FEMA's depiction of 'special flood areas' within Caroline County shown in Map 4-2, Zone AE (the area's most at risk to detrimental flooding) correlates with areas within Caroline County with the highest density of socially vulnerable populations.

Figure 4-6 shows a map of overall social vulnerability within Caroline County and the SVI Theme maps. Areas in and around the Towns of Federalsburg, Denton, and Greensboro have not only have an overall high Social Vulnerability Index (SVI) score, but also overlap with the flood hazard areas. In reviewing the SVI theme maps, the Household Characteristics map, which is comprised of the following indicators, is also high for these areas.

- Aged 65 or Older
- Aged 17 or Younger
- Civilian with a Disability

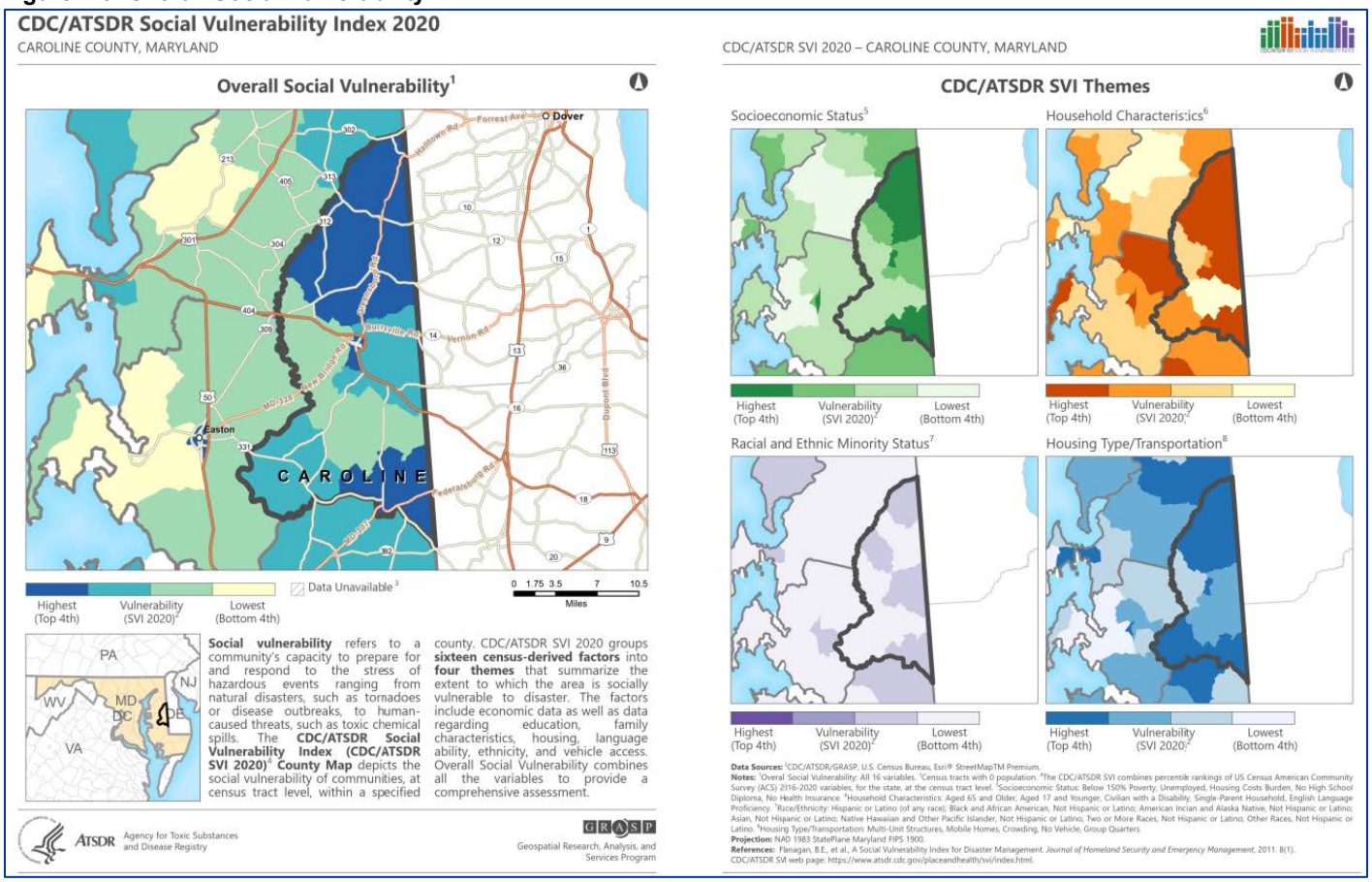
- Single-Parent Households

Targeted public information and messaging related to the flood hazards should occur in and around the areas the Towns of Federalsburg, Denton, and Greensboro as well as the unincorporated portions of the County have a highly vulnerable population and are at risk to flood.

In relation to coastal flooding, the area impacted by the coastal 1% annual chance flood hazard area is along the southwestern area of the County, Map 5-1. The social vulnerability index is moderate in this area. The Town of Preston is in the moderate SVI, however not impacted by the coastal 1% annual chance flood hazard area.

Other municipalities, such as Templeville, Marydel, Henderson, Goldsboro, and Ridgely, have high SVI scores, however, to do not overlap with flood hazard areas.

Figure 4-6: Overall Social Vulnerability



Source: CDC/ATSDR Social Vulnerability Index 2020 – Caroline County

Future Vulnerability

The frequency of flooding, flash flooding, and heavy rain events are likely to increase due to climate change. Areas that currently experience regular flooding due to proximity to rivers and/or steep slopes are likely to see conditions change or worsen, and some areas that historically flood very little or not at all are likely to start flooding with greater frequency due to the increased amount and intensity of storm events. According to a 2021 study published in Nature "when it comes to riverine flooding, climate change is likely exacerbating the frequency and intensity of extreme flood events but decreasing the number of moderate floods." Flash flooding will continue to increase as there are more extreme precipitation events. Warmer temperatures increase evaporation, putting more moisture into the atmosphere that then gets released as rain or snowfall.

The 3rd National Risk Assessment: Infrastructure on the Brink quantifies risk as "the unique level of flooding for each infrastructure type relative to operational thresholds, as established by the federal government and other authoritative bodies." Operational flood risk at the local level denotes when a facility is flooded to the point where it can no longer function as intended or becomes unsafe. At a high level, the assessment finds the following true today and likely in the coming decades:

- Risk to residential properties is expected to increase by 10% over the next 30 years, with 12.4 million properties at risk today (14%) and 13.6 million at risk of flooding in 2051 (16%).
- Additionally, 2.0 million miles of road (25%) are at risk today and that is expected to increase to 2.2 million miles of road (26%) over the next 30 years (a 3% increase over the next 30 years).
- Commercial properties are expected to see a 7% increase in risk of flooding from 2021 to 2051, with 918,540 at risk today (20%) and 984,591 at risk of flooding in 30 years (21%).
- Currently, 35,776 critical infrastructure facilities are at risk today (25%), increasing to 37,786 facilities by 2051 (26% and a 6% increase in risk).
- Compounding that risk, 71,717 pieces of social infrastructure facilities are at risk today (17%), increasing to 77,843 by 2051 (19% and an increase of 9% over that time).

In Maryland, there are 112,187 residential properties, 11,990 miles of roads, 8,445 commercial properties, 379 infrastructure facilities, and 826 social facilities with operational flood risk today. According to riskfactor.com, in Caroline County, there are 1,733 properties that have greater than a 26% chance of being severely affected by flooding over the next 30 years. This represents 18% of all properties in the County.

FEMA Reports & Statistics

Communities can voluntarily participate in the National Flood Insurance Program (NFIP) by adopting and enforcing floodplain management ordinances to reduce future flood damage. By doing this, the NFIP makes Federally backed flood insurance available to homeowners, renters, and business owners in these communities.

Table 4-19: NFIP Insurance Report

Location	2023 Number of Policies	Total Coverage	Total Claims Since 1978	Total Paid Since 1978
Town of Denton	20	$ 1,330,000	0	$0
Town of Federalsburg	42	$ 10,031,000	21	$176,904.18
Town of Greensboro	24	$ 4,252,200	24	$677,683.57
Town of Hillsboro	1	$ 350,000	1	$0
Town of Ridgley	4	$630,000	0	$0
Unincorporate Areas	105	$29,368,300	28	$422,549.01
County Total	**188**	**$45,961,500**	**73**	**$1,277,136.76**

Source: FEMA Policy & Claim Statistics for Flood Insurance, as of October 16, 2023

Note: Flood insurance is available to anyone in the County and even those structures outside of the 1% annual chance flood hazard area. Therefore, in some cases, the number of policies includes structures that are located outside of the 1% annual chance flood hazard area.

Considering the amount of flood insurance policies and the number of claims that have been reported, identifying areas of repetitive loss within a community is a good indicator to utilize in determining areas of high flood damage vulnerability. While flood damage is not necessarily limited to these areas, repetitive loss data provides location indicators for areas where structures are experiencing recurring and costly flooding damage.

FEMA defines a repetitive loss property as:

- A structure covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (44 CFR § 77.2(i))

FEMA defines a severe repetitive loss property as:

- A structure that is covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have been made, with cumulative amount of such claims exceeding the value of the insured structure. (44 CFR § 77.2(j))

As of December 2018, there is one residential repetitive loss property in Caroline County. This residential property is in Greensboro at Cedar Lane. There were no non-residential repetitive loss structures located in Caroline County. Furthermore, no new residential properties were identified during the 2019 Plan update.

As of November 2023, two (2) repetitive loss properties were in Caroline County. One of the residential properties is in Greensboro at Cedar Lane, while the other is located on Tammuxzena Drive in Preston. Both properties are single family homes that are not NFIP insured and have not been mitigated.

There are no severe repetitive loss properties located within Caroline County.

The Community Rating System (CRS) can be an important part of any town, city, or entire County with floodplains. According to FEMA, the CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum National Flood Insurance Program (NFIP) requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of five percent. For example, a Class 1 community would receive a forty-five percent premium discount; while a Class 9 would receive a five percent discount (a Class 10 is not participating in the CRS and does not receive discounts). The CRS classes for local communities are based on 18 creditable activities, organized under four categories:

- Public Information
- Mapping and Regulations
- Flood Damage Reduction
- Flood Preparedness

Currently, Caroline County has a CRS rating of a Class 7. Caroline County was recently reclassified on October 1, 2022. This gives residents of the County 15% off their flood insurance policies. Undertaking mitigation activities and projects, as specified in this planning document will give Caroline County the opportunity to lower their CRS rating by added credit points.

Nuisance Flooding

As sea levels rise due to changing climate conditions, the impacts on tidal levels can be noted. Nuisance flooding, sometimes known as high-tide flooding or sunny day flooding, is expected to increase through 2021, and more than triple by 2050 according to NOAA's State of High Tide Flooding and Annual Outlook. "Nuisance flooding is typically unrelated to particular storm events, though it may be exacerbated by long-duration wind events or passing storm systems and the astrological position of the sun and the moon. Over time, however, as a changing climate drives sea levels higher and precipitation events to greater severity, these repeated "nuisance" impacts will become significant stressors on infrastructure, emergency services, public health, and community fabric as they become more chronic in nature."

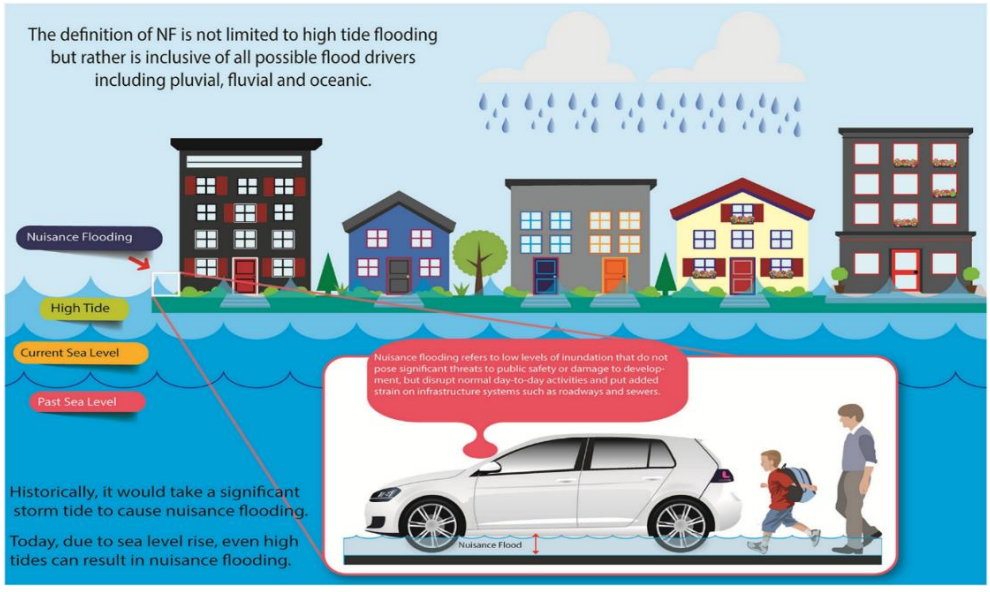
Nuisance flooding is defined in §3-1001 of the Natural Resource Article of the Maryland Annotated Code as "high-tide flooding that causes public inconvenience." This is similar to how the National Oceanic and Atmospheric Administration (NOAA) defines nuisance flooding or high tide flooding: "flooding that leads to public inconveniences such as road closures."

Source: Maryland Nuisance Flood Plan Development Guidance

According to the Nuisance Flood Plan Development Guidance, there is recognition by Maryland lawmakers, local and state governments, and citizens that tidally driven nuisance flood events are happening with more frequency. While nuisance flooding may not pose a serious threat or result in major damage, it interrupts and causes impacts to daily routines and can negatively impact commerce. Pursuant to Maryland House Bill 1427 (2019), §3-1018(b) and (c), on or before Oct. 1, 2020, a local jurisdiction that experiences nuisance flooding (NF) shall develop a plan to address nuisance flooding. In addition, a local jurisdiction shall update the plan every five years; publish the plan on the local jurisdiction's website; and shall submit a copy of the plan to the Maryland Department of Planning. This legislation is an update to Senate Bill 1006 and House Bill 1350 (2018).

Caroline County has a significant history of being impacted by coastal storms. The County has also experienced flooding outside mapped floodplains with increasing frequency, including both nuisance and urban flooding. The definition of nuisance flooding in accordance with §3-1001 of the Natural Resource Article of the Maryland Annotated Code is "high tide flooding that causes a public inconvenience." Urban flooding is associated with precipitation events and is due to a variety of issues related to development: increased impervious surface, disruption of natural watershed flows and functions, undersized and aged stormwater infrastructure, and changing weather patterns which exacerbate the inadequacies of older stormwater systems and the fragmented watersheds.

Figure 4-7: Nuisance Flooding



Source: Nuisance Flood Plan Development Guidance, October 2019

The National Oceanic and Atmospheric Administration (NOAA) defines nuisance flooding or high tide flooding: "flooding that leads to public inconveniences such as road closures." Nuisance flooding is frequently referred to as "sunny day" or high tide flooding. Utilizing the NOAA Coastal Flood Exposure Mapper areas likely to flood during extreme high tides can be identified. NOAA recognizes high tide flooding as sunny day, nuisance, and recurrent tidal flooding.

Figure 4-8 illustrates low-lying coastal areas prone to flooding during extreme high tides. According to NOAA, annual occurrences of high tide flooding, exceeding local thresholds for minor impacts to infrastructure, have increased 5- to 10-fold since the 1960s in several U.S. coastal cities. The flood thresholds for this map are based on national flood thresholds from NOAA Technical Report NOS CO-OPS 086: Patterns and Projections of High Tide Flooding along the U.S. Coastline Using a Common Impact Threshold.

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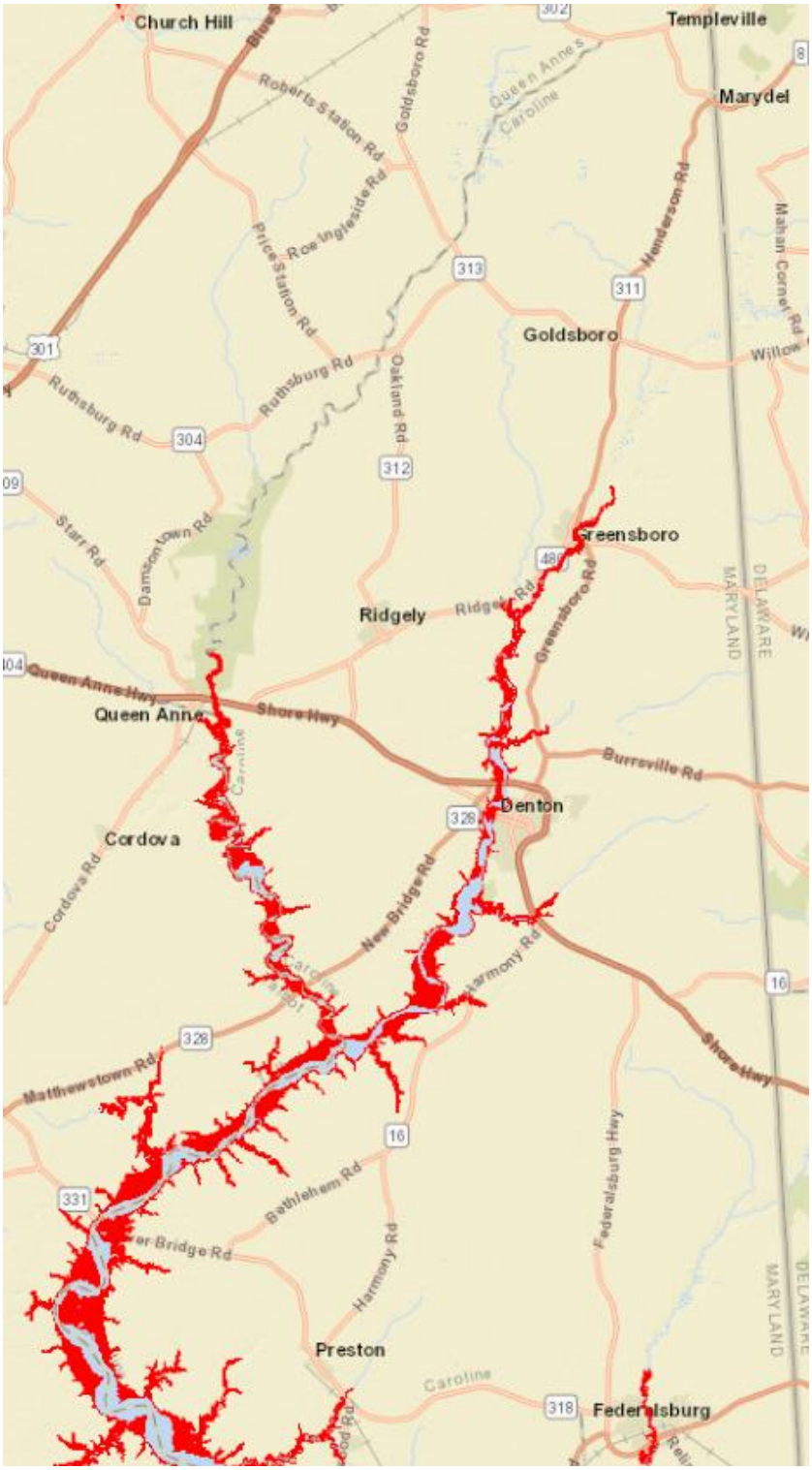


Figure 4-8: High Tide Flooding

Source: NOAA Coastal Flood Exposure Mapper

As shown on the map, areas near the Choptank River and Tuckahoe Creek are the most prone to flooding during high tides. According to the 2021 Caroline County Comprehensive Plan, flood origins include riverine flooding from rivers, creeks and streams and coastal flooding from the Choptank River and Tuckahoe Creek. Approximately 8% of the County lies within the 1%-annual-chance floodplain area. Residents are at risk from tidal flooding, strong winds, storm surge, heavy rains and sea level rise that can cause temporary and permanent destructive flooding in both waterfront and inland areas.

Roadways impacted by nuisance flooding can be significant stressors on the infrastructure, emergency response, and public health. Nuisance flooding can disrupt daily activities through a variety of ways, such as the closure of roads due to high water, the inundation of yards and parks, and the impairment of engineered and natural drainage systems. Currently, these disruptions typically occur for a period of several hours and then abate. In addition, roadways are also impacted by urban flooding, not tidally influenced flooding.

Vulnerability Analysis

Caroline County experiences flooding outside mapped floodplains with increasing frequency, including both **nuisance** and **urban flooding**.

Nuisance Flooding	Nuisance flooding is associated with high tides that flow back through the stormwater system, increasing/raising the level of groundwater, and overtopping the banks and edge of waterways. Nuisance flooding is an indicator of rising water levels in the Chesapeake Bay and its tributaries. Areas that were previously dry now flood during high tides because the water elevation is high enough to lap over the banks of waterways and to enter stormwater systems through outfalls that were previously high enough to prevent backflow, while allowing outflow.
Urban Flooding	Urban flooding is due to a variety of issues related to development: increased impervious surface, disruption of natural watershed flows and functions, undersized and aged stormwater infrastructure, and changing weather patterns which exacerbate the inadequacies of older stormwater systems and the fragmented watersheds. Urban flooding reflects decades of development that has outstripped the capacity of stormwater infrastructure and disrupted the natural flow and discharge of watersheds. Additionally, many stormwater systems are beyond their expected useful life and in need of repair and replacement.

Challenges from both nuisance and urban flooding are compounded by what is becoming the new normal: an increase in the frequency and intensity of storms caused by higher global temperatures that increase evaporation in the ocean and atmosphere, creating more favorable conditions for heavier and more frequent precipitation. Increased runoff can contribute more nutrients, contaminants (e.g., oil, gasoline, antifreeze, among others) and sedimentation into the waterways and ultimately the Bay.

As part of the Hazard Mitigation Plan update, flooded roadways were examined using information from the 2019 Plan. The 2019 repetitive roadway flooding table was reviewed by the Department of Emergency Services (DES) and the Department of Public Works (DPW). Modifications and updates were made to the table and all ten municipalities were provided with the listing for review and comment. Municipalities updated and modified those roadway issues that directly impacted their jurisdiction.

Bryan North, DPW, ranked the roads that fell under County maintenance and used a scale ranking as follows: 1-highest, 2-medium, and 3-little or no priority. There are thirteen (13) County roads that appear in highlighted in green that are of the highest importance for mitigation as determined by Public Works. Of the thirteen (13) high priority roads, five (5) road are impacted by nuisance flooding. The results are shown table below.

Table 4-20: Repetitive Flooded Roadways

Roadway ID #	Roadway	State, County, or Municipal	Flood Related Issue	Evacuation Issue (Y/N)	SWM or Elevation Problem	Nuisance /Urban	Priority for Mitigation
1	Town of Ridgely Liberty Street	Municipal	Rainfall	N	SWM	Urban	-
2	Town of Denton Second Street	Municipal	Rainfall	Y	SWM	Urban	2
5	Town of Denton Seventh at Sunnyside Ave	Municipal	Rainfall	Y	SWM	Urban	3
6	Town of Denton 5th & Legion	Municipal	Rainfall	Y	SWM	Urban	1
3	Town of Federalsburg Railroad Ave	Municipal	Rainfall	N/A	SWM	Urban	-
4	Town of Greensboro East Sunset Ave by the Bridge	Municipal	Tidal/Rainfall	N	Elevation	Nuisance	1
7	Town of Greensboro Smugglers Way	Municipal	Rainfall	Y	SWM	Urban	3
8	Town of Greensboro Mill Street	Municipal	Rainfall	Y	SWM	Urban	2
9	Town of Greensboro Riverview Lane	Municipal	Rainfall	Y	SWM	Urban	2
10	Town of Greensboro Bernard Avenue	Municipal	Rainfall	N	SWM	Urban	3
11	Corkell Rd	County	Rainfall	N	SWM	Urban	3
12	Long Swamp Rd	County	Rainfall	N	SWM	Urban	3
13	Crouse Mill Rd	County	Rainfall	N	SWM	Urban	2
14	Holly Rd	County	Rainfall	N	SWM	Urban	1
15	Peaviner Rd	County	Rainfall	N	SWM	Urban	3
16	Nagel Rd	County	Rainfall	N	SWM	Urban	3
17	Hog Lot Rd near Seward Rd	County	Rainfall	N	SWM	Urban	3
Flooded Areas with Posted Flood Signs							
18	River Rd by North Caroline High School	County	Rainfall	Yes	Undersized pipes & Elevation	Urban	1
19	Noble Rd	County	Rainfall	N	SWM/Elevation	Urban	2
20	Veteran's Drive	County	Rainfall	N	SWM/Elevation	Urban	2
21	River Landing Rd	County	Tidal	N	Tides/SWM	Nuisance	1
22	Main Street Choptank	County	Rainfall	N	Elevation	Urban	1
23	Poplar Neck Rd	County	Rainfall	N	SWM	Nuisance	2
24	Blades Rd	County	Tidal	N	Tides/Elevation	Nuisance	1
25	Maryland Ave	County	Tidal	N	Tides Elevation	Nuisance	1
26	Frazier Neck Road	County	Tidal	N	Tides/Elevation	Nuisance	1
27	Gilpin Point Rd	County	Tidal	N	Tides/Elevation	Nuisance	1
Other Roads with Isolated Flooding							
28	Sunset Ave	County	Rainfall	N	SWM	Urban	2
29	Harper Rd	County	Rainfall	N	SWM	Urban	3
30	Hickory Hill Rd	County	Rainfall	N	SWM	Urban	2
31	Central Ave	County	Rainfall	N	SWM	Urban	2

Roadway ID #	Roadway	State, County, or Municipal	Flood Related Issue	Evacuation Issue (Y/N)	SWM or Elevation Problem	Nuisance /Urban	Priority for Mitigation
32	Bradley Rd	County	Rainfall	N	SWM	Urban	3
33	Reed Road	County	Rainfall	N	SWM	Urban	2
34	Log Cabin Rd	County	Rainfall	N	SWM	Urban	2
35	Red Bridges Rd	County	Rainfall	N	SWM	Urban	3
36	Sawmill Rd	County	Rainfall	N	SWM	Urban	3
Roads that may need type II Barricades for washout (Road Closures)							
37	Poplar Neck Rd	County	Rainfall	N	SWM	Urban	3
38	Tanyard Rd	County	Rainfall	N	SWM	Urban	2
39	Gregg Rd	County	Rainfall	N	SWM	Urban	3
40	Knife Box Rd	County	Rainfall	N	SWM	Urban	1
41	Boyce Mill Rd	County	Rainfall	N	SWM	Urban	1
42	River Rd (Dirt Part)	County	Rainfall	N	SWM	Urban	3 (Bridge is Closed)
43	Tuckahoe Rd	County	Rainfall	N	SWM	Urban	1
44	Garland Rd	County	Rainfall	N	SWM	Urban	1
45	Cherry Lane	County	Rainfall	N	SWM	Urban	1

Source: Caroline County Department of Public Works

According to the Public Works Department-Roads Division, the most frequent causes of road closures in Caroline County are flooding and wash outs. The roads division will close roads for public safety as warranted. The following roads were considered as high importance for mitigation:

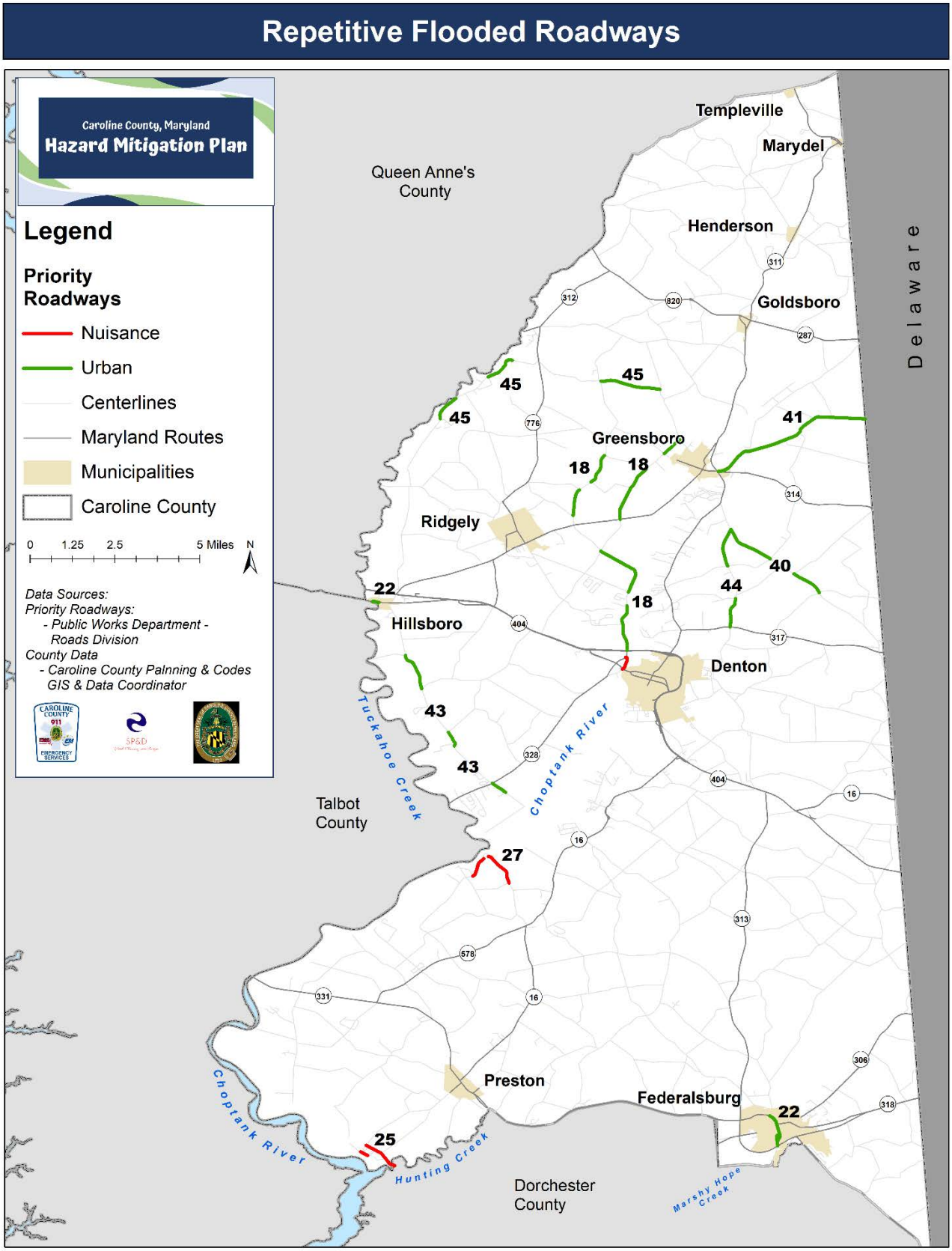
- #14 – Holly Road (Urban)
- #18 – River Road (Urban)
- #21 – River Landing Road (Nuisance)
- #22 – Main Street (Urban)
- #24 – Blades Road (Nuisance)
- #25 – Maryland Ave (Nuisance)
- #26 – Frazier Neck Road (Nuisance)
- #27 – Gilpin Point Road (Nuisance)
- #40 – Knife Box Road (Urban)
- #41 – Boyce Mill Road (Urban)
- #43 – Tuckahoe Road (Urban)
- #44 – Garland Road (Urban)
- #45 – Cherry Lane (Urban)

Figure 4-9: Road Closure Due to Flooding

Photo Source: Caroline County Website

The following map, Map 4-3, depicts the five (5) roadways affected by nuisance flooding and eight (8) roadways impacted by urban flooding can considered high priority. Note, the location numbers identified on the map are associated with Table 4-20. This map will continue to be used for further review, analysis, and implementation activities.

Map 4-3: Repetitive Flooded Roadways



In 2019, two tidal stations in Maryland monitored by NOAA broke the record for the number of nuisance flood days: Annapolis and Tolchester Beach. The average number of flood days in 2000 for each location was two, with the record being 18 and 17. By 2030, NOAA is projecting these numbers to increase to 15 to 25 days at each location and by 2050 to 55 to 170 days in Annapolis and 50 to 160 days in Tolchester Beach.[i]

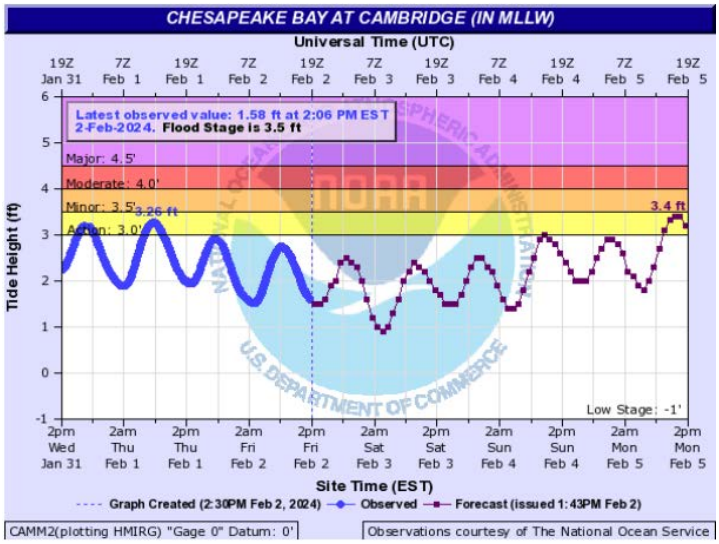
In order to prepare for a nuisance flood event, critical tide information should be monitored from the National Oceanic and Atmospheric Administration (NOAA) tide gauge stationed at Hillsboro, as well as additional gauges elsewhere throughout Chesapeake Bay. The Hillsboro Tide Gauge, Station ID 8572669, is located on the Hillsboro Boat Ramp; from the intersection of 404 and 303 proceed south on 303 to ALT 404, proceed east on ALT 404 approximately 2.4 km (1.5 mi) over the bridge and into Caroline County. The Hillsboro boat ramp is on the right, the gauge was located on the seawall. The gauges enable the County to be aware of and prepare for possible nuisance flooding impacts.

The Department of Emergency Services (DES) maintains a close relationship with the National Weather Service, who provides notifications of special hazards and watches or warnings of severe weather before the community is impacted. In addition, critical flood information from NOAA gauge at Cambridge is monitored. The gauge allows Caroline County to prepare for flood events and their impacts. The National Weather Service provide hydrographs for this gauge. A hydrograph shows how the river level changes over time at a specific location. The hydrograph for the Chesapeake Bay at Cambridge gauge is shown below along with flood categories.

Using the following thresholds, Caroline County will direct their actions based on flood inundation levels and/or frequency of flooding.

Figure 4-10: Tide Gauge at Cambridge

Chesapeake Bay at Cambridge



Flood Categories (in feet)

Major Flood Stage:	**4.5**
Moderate Flood Stage:	**4.0**
Flood Stage:	**3.5**
Action Stage:	**3.0**

Source: NWS: Advanced Hydrologic Prediction Service

Threshold	Response Level	Required Action
Forecast data from the National Weather Service or NOAA tide gauge indicates likely nuisance flooding impacts.	Level I – Public Warning	Make the public aware of nuisance flooding threat via mass notification emails, social media, etc.
Flood waters are present below nuisance levels and are rising.	Level II – Monitor Inundation	Deploy Department of Public Works and State Highway Administration personnel to monitor flood levels as needed and place high water signs at impacted locations.
Flood waters are high enough to warrant temporary road closures.	Level III – Flood Response	Place additional Department of Public Works and State Highway Administration personnel on standby; close roads and reroute traffic as flooding reaches hazardous levels.

DES disseminates public safety information via social media outlets and the Everbridge Notification System. When nuisance flooding is anticipated, it may be necessary for DES to initiate a message to flood hazard areas social media outlets with details about flood severity, duration, or impacts such as road closures.

In addition, Maryland deployed the MyCoast application to document nuisance and precipitated-induced flooding, storm damage, and more. Coastal decision makers, emergency managers, and others use your reports to make better decisions. Caroline County will continue to promote the use of this application, which is currently included on the County's website.

Once the application is downloaded onto a mobile device, users can take photographs of nuisance flooding and submit them. These submissions are called "reports." The MyCoast application captures the time and location of the photograph, in addition to the weather and tidal conditions. This data is recorded by the application and can be downloaded. Data obtained could assist decision makers on how to address nuisance flooding.

Data collected from the application is utilized to track the occurrence of nuisance flood events and support the development of mitigation actions for areas impacted by these events. The MyCoast report data can be used to:

- Confirm and identify new locations of nuisance flooding.
- Define the hazard (depth, duration, area covered by flooding).
- Further refine the thresholds for when nuisance flooding will occur (in conjunction with tide data).
- Develop mitigation strategies to reduce nuisance flooding.

To date, a total of 16 high tide reports have been submitted for Caroline County. These reports start in April 2021 and go on to January 2024. The following locations were identified:

- Denton
- Ridgely
- Greensboro
- Preston

These reports can be found on the MD MyCoast website under High Tide Flooding.

Figure 4-11: Denton – High Tide Flooding Report, MyCoast

Denton Crouse Park in Denton experienced nuisance flooding from high tides on April 15, 2021.

Source: MyCoast Reports

The Town of Denton provided additional information on the repetitive flooded roadways identified for the Town and included in Table 4-20. Additional details are provided below:

1. **Second Street**: There are 2 potential flooding areas, both are small bridges that are low lying. It would take a ton of rain, over 5" for these to flood. The first bridge is at 38° 52'44" N, 75°50'05" W, and the second bridge is 38°52'29.76" N, 75°50'04.92" W. I would add both as a moderate flooding area. Although it almost never floods, a 100-year storm would affect this area.

2. **Seventh and Sunnyside**: This area always has the potential to flood temporarily in the event of major rainfall. The water tends to go away shortly thereafter.

3. **5th and Legion**. This is a major drainage area for not only the Town, but State Highway ditches as well. Ordinarily the water flows with no issues, however a major rainfall accompanied by debris like trash and tree limbs will clog the pipe that goes underneath the road, causing major flooding. The Town is working with Shore Riverkeepers in an attempt to secure funding to rehab this area. SHA has offered no financial support.

Furthermore, the Town of Denton developed a Nuisance Flood Plan, which was adopted in August 2020. According to the plan, in the Town of Denton, nuisance flooding, meeting the definition of HB 1427, occurs at Crouse Park and boat ramp, along the Choptank River.

As part of the nuisance flood planning process for the Town of Denton, staff interviewed the Town's Public Works Department to create an inventory of known nuisance flood areas. There is only one area, within town, at Crouse Park where there are instances of nuisance flooding. There are two road segments, adjacent to Town but within unincorporated Caroline County, along River Landing Road also experiencing nuisance flooding.

Currently, Crouse Park and the boat ramp are experiencing the following types and frequency of nuisance flooding:

- During normal high tide, 3-4 inches of flooding occur in the boat ramp parking lot.
- During certain weather conditions of a south wind blowing from the north which holds the tide in the boat ramp area, 1 ft. – 1 ½ ft. of flooding occur in the boat ramp parking lot area and ends at the sidewalk at the Crouse Park Visitor and Heritage Center. On an average, Crouse Park Lane is closed six times per year for approximately 4-5 hours.
- The Water Quality Garden located at the Crouse Park Visitor and Heritage Center receives daily tidal influence from the Choptank River. With the changing tides, the Garden as designed has become a stormwater pond. The original planting design for the Water Quality Garden have been eliminated by the river water intrusion.

Nuisance flooding has increased dramatically over the past 50 years (2-4 feet). This is likely due to siltation of the Choptank River. The Choptank River has needed dredging for many years. The Town has tried unsuccessfully to obtain the necessary funds to dredge the river. The siltation also affects the ability of recreational boaters to utilize the river. The Town is hopeful that DNR will provide the necessary funding to dredge the river and reduce the nuisance flooding occurrence and increase the recreational opportunity for the public to enjoy the river. DNR is aware of the nuisance flooding but cannot close off the inlet or supply funds for the repairs resulting in the water intrusion.

Source: The Town of Denton Nuisance Flooding Plan

Figure 4-12: Town of Denton Nuisance Flood Plan Exhibits

Town of Denton: Crouse Park Boat Ramp and Visitor and Heritage Center.
Caroline County: River Landing Road.

Roadway Inundation

Flood Depth Grids

Source: The Town of Denton Nuisance Flooding Plan

The Town of Greensboro also provided additional information about the flooding issues on Sunset Avenue near the bridge. According to the Town, the flood risks at this location include drowning, flooded homes, and significant sewer contamination. Community parks are located along the Choptank on both sides of Sunset Avenue (at/by the bridge). In addition, one (1) of the Town's pump stations is in close proximity to the bridge and abuts one of the parks. The Town's previous WWTP is near this location. Heavy rains cause flooding, and it is worsened by high tides. Tropical Storm Irene devastated the area (pictures below).

Nuisance Flood Mitigation Action Items

Mitigation actions specific to nuisance and urban flooding were added during this Plan update and are include in Chapter 15, Table 15-5. These mitigation action items are for both the County and affected municipalities.

[i] State of Maryland Hazard Mitigation Plan 2021

Chapter 5 Hurricanes

Hazard Ranking

- **Hazard Mitigation Planning Committee** – Concerned
- **Municipalities**
  - Denton – Very Concerned
  - Federalsburg – Very Concerned
  - Goldsboro – Concerned
  - Greensboro – Concerned
  - Henderson – Concerned
  - Hillsboro – Very Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Concerned
  - Templeville – Concerned
- **State** – Medium
- **National** – Relatively Moderate
- **Public** – Somewhat Concerned

Public Survey Responses

- Only 11% of residents have experienced damage from hurricanes.
- Many participants indicated they experienced damage from wind.
- 6% of residents have installed high impact windows or doors to withstand high winds.
- 50% of participants have removed dead/drying trees and vegetation from around the home as a mitigation measure.
- 24% of participants feel their community is at risk to hurricanes.
- 12% of participants indicated that the following mitigation measure should be taken: buyout flood prone properties and maintain as open space.
- Participants indicated that stricter ordinances are needed for building close to tidal water.

Chapter Updates

- This chapter now discusses hurricanes only.
- Characteristic information was updated with current information.
- New images have been included.
- All maps have been updated.
- History event data has been updated with the most current available data.
- New historic track data was integrated.
- Vulnerability and impacts to people, systems, and resources is a new element.
- National Hurricane Center Storm Surge Risk Map mapping was included.
- Risk assessment using the new critical facilities were conducted and incorporated in the vulnerability section of the chapter.
- New hurricane loss estimates using current MD Property View Tax Assessment values.
- A risk assessment for historic structures is new element in the chapter.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.

Hurricane Hazard Characterization

As defined by the National Hurricane Center, a major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The categories and associated characteristics are as follows:

- **Major Hurricane:** A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.
- **Hurricane:** maximum sustained surface wind speed exceeds 74 mph.
- **Tropical Storm:** maximum sustained surface wind speed from 39-73 mph.
- **Tropical Depression:** maximum sustained wind speed is less than 38 mph.

Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics, referred to as "cyclones" due to their rotation. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. In terms of impact, high winds, heavy rain, lightning, tornados, hail, and storm surge are all associated with tropical cyclones. In addition, as tropical cyclones move inland, they can cause severe flooding, downed trees and power lines, and structural damage.

Hurricanes are rated for intensity by using the Saffir-Simpson Scale, which gives an estimate of the potential damage that a hurricane may cause. This scale is based upon both wind speed and surface pressure. Scale categories range from Category 1 to 5, with Category 1 having winds from 74-95 mph and pressure greater than 980 mb, while a Category 5 hurricane can have winds of more than 157 mph and pressure of less than 920 mb. Table 5-1 depicts the five categories of hurricane strength. Some notable hurricanes that have affected Maryland include Hazel in 1954; Donna in 1960; Camille in 1969; David in 1979; Fran in 1996; Floyd in 1999; Isabel in 2003; Ernesto in 2006; Irene in 2011; and Hurricane Sandy in 2012. Hurricane Sandy brought significant impacts to numerous mid-Atlantic coastlines, as well as the Delmarva Peninsula.

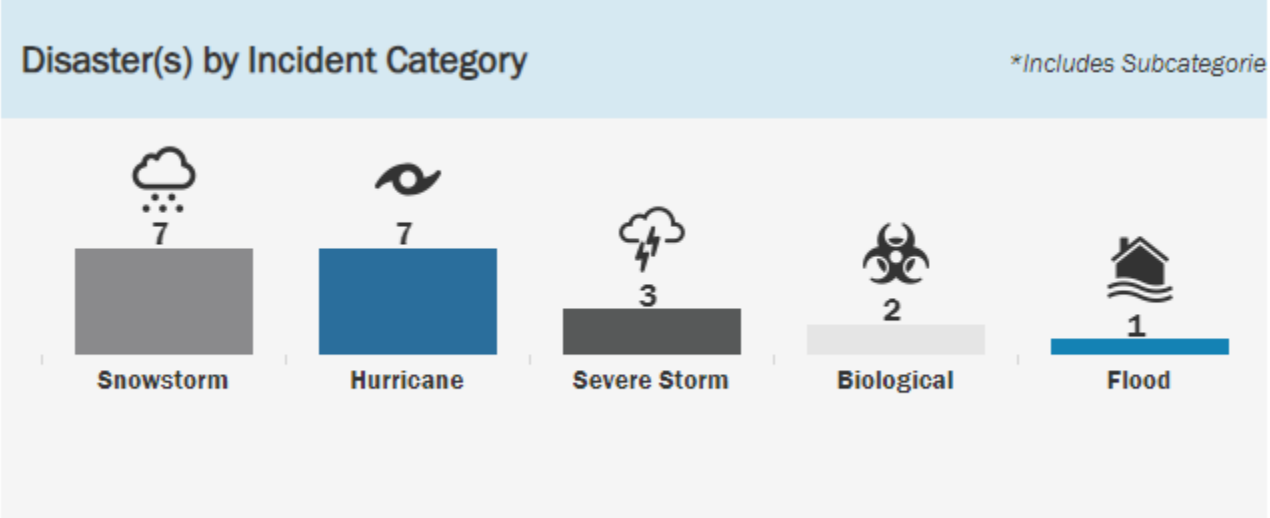
Table 5-1: Saffir-Simpson Hurricane Categories

Saffir-Simpson Hurricane Wind Scale	
Category Wind Speed Storm Surge	**Effects**
Category 1-Weak 74-95 mph	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, and 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.
Category 2-Moderate 96-110 mph	Extremely dangerous winds will cause extensive damage: 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.
Category 3-Major 111-129 mph	Devastating damage will occur: 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.
Category 4-Major 130-156 mph	Catastrophic damage will occur: 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 possible months. Most of the area will be uninhabitable for weeks or months.
Category 5-Major >157 mph	Catastrophic damage will occur: 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 Weather Service, 2023

The most common coastal storms that impact Caroline County are Tropical Storms or Tropical Depressions. While at sea, notable hurricanes have been classified as Category 4 or 5, but typically these storms tend to lose their intensity as they travel from their point of origin up the Atlantic coastline. Often these storm events are downgraded to a Tropical Storm or Depression by the time they reach Maryland, at most a Category 1 Hurricane. According to FEMA's Disaster Declarations for States and Counties, Caroline County has had seven (7) disaster declarations for hurricanes.

Figure 5-1: Disaster Declarations for Caroline County



Source: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

Heavy rain from Category 1 hurricanes and tropical storms have been known to cause 500-year floods (which have a 0.2% chance of occurring each year) and greater flooding in inland communities. In addition, coastal erosion can also be a major problem created by coastal storms. Coastal erosion may impact man-made structures and human activities such as shore protection structures and navigation channels that had previously been dredged.

Although high winds and excessive amounts of precipitation are common and may cause tremendous damage, the most serious effect of hurricanes is coastal destruction caused by storm waves or storm surge. In India more than 300,000 people died in 1737 as a result of a 40-foot storm surge accompanying a severe tropical cyclone in the Bay of Bengal. If a hurricane strikes at high tide, the storm surge can be devastating as was the case in Galveston, Texas in 1900 when more than 6,000 people drowned in a hurricane generated storm surge. Damage estimates for the 1900 Galveston hurricane topped $57,051,332.92 in 2024 dollars.

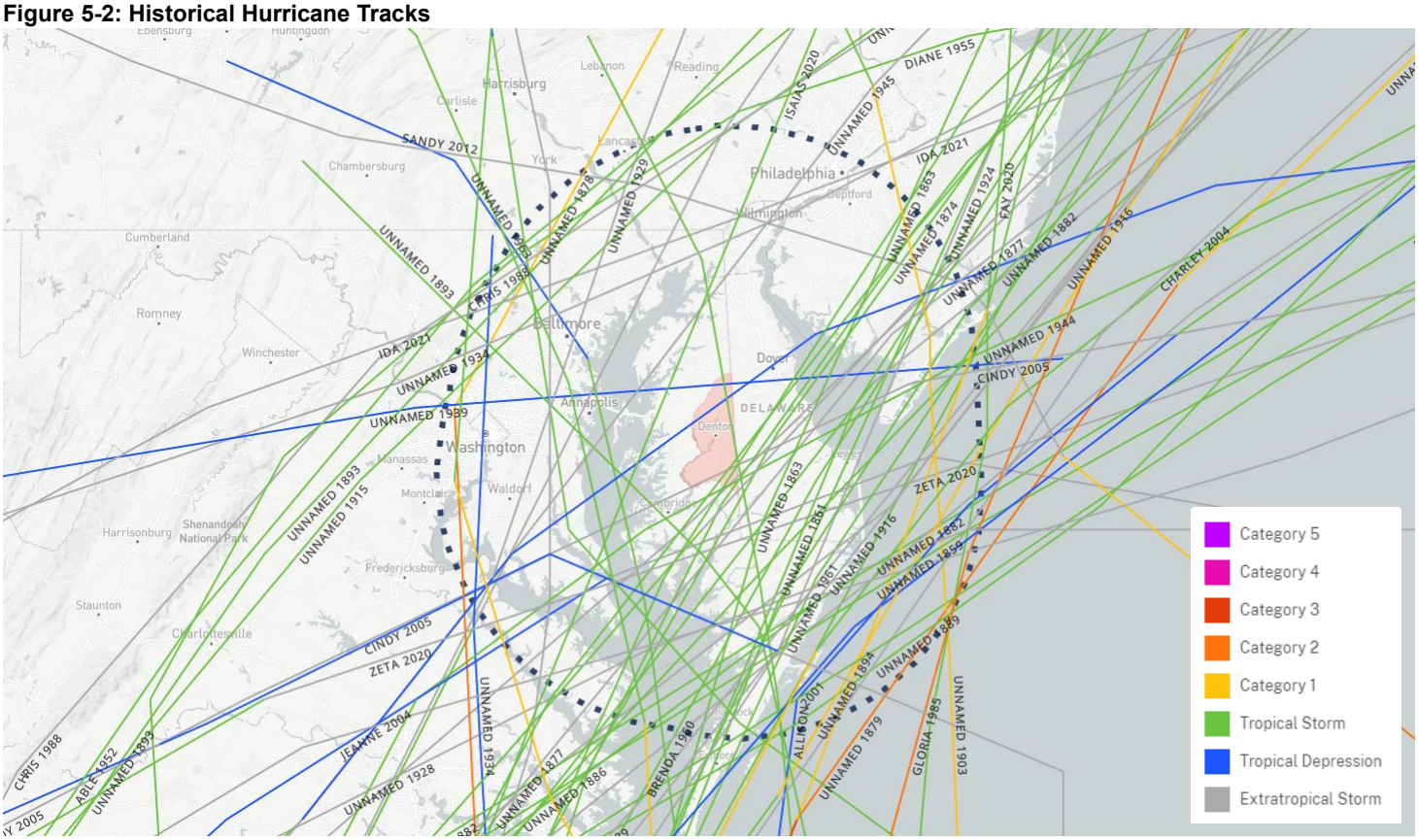
On Maryland's Eastern Shore, particularly along the bay, storm surge is also related to rising sea level and to shoreline subsidence. Counties fronting on the east side of the Bay are facing shoreline submergence that has been ongoing since the last glacial period when sea level was approximately 400 feet lower than today. While the process has been continuing for approximately 10,000 years, sea level is still rising at a rate of plus one foot or so every century. This rise in sea level will certainly affect the relative height of future storm surge events.

Several factors point to the potential for increased danger from severe tropical cyclones in Maryland. Population growth and continuing near-shore development increases the risk of human injury and property loss. Additionally, there is widespread agreement among climatologists that gradual global warming is occurring. Potential effects include the melting of polar ice, expansion of the oceans, and an overall rise in sea levels. The slow sinking of land in the Chesapeake region, due to the combined effects of ground water withdrawal and post-glacial rebound, effectively doubles the global rate of sea level rise in Maryland's coastal areas, which is further discussed in Chapter 6 Shoreline Erosion & Sea Level Rise. These factors increase the vulnerability of coastal areas to storm surge.

Hurricane Hazard Risk & History

Caroline County has been affected over the years by the passage of hurricanes, including an unnamed hurricane in 1929, Hurricane Hazel in 1954, Hurricane Connie in 1955, Hurricane Floyd in 1999, Hurricane Isabel in 2003, and others shown on Figure 5-2 below. Potential storm surge can occur on the Choptank River, Tuckahoe Creek, and Marshyhope Creek in the passage of a hurricane. Hurricanes can affect Caroline County from either the Gulf of Mexico or the Atlantic. Normally the greatest damage results from hurricanes that come ashore in the Tidewater area of Virginia or the Carolina Capes.

Figure 5-2: Historical Hurricane Tracks



Source: [NOAA Historical Hurricane Tracks]

According to the National Centers for Environmental Information (NCEI), there were no hurricane events for Caroline County during the update period. However, tropical storm events have been documented by NCEI. They are shown on Tables 5-2. In terms of number of occurrences, the NCEI listed a total of four (4) tropical storm events affecting Caroline County from 2003-2023. Based on this data, Caroline County experiences an average of 0.20 tropical storm events per year.

Table 5-2: Tropical Storm Events – 2003-2023

Tropical Storm Events – 2003-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
4	0	0	135.00K	0.20

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Hurricane Hazard Vulnerability

Vulnerability and Impacts to People, Systems, and Resources from Hurricanes

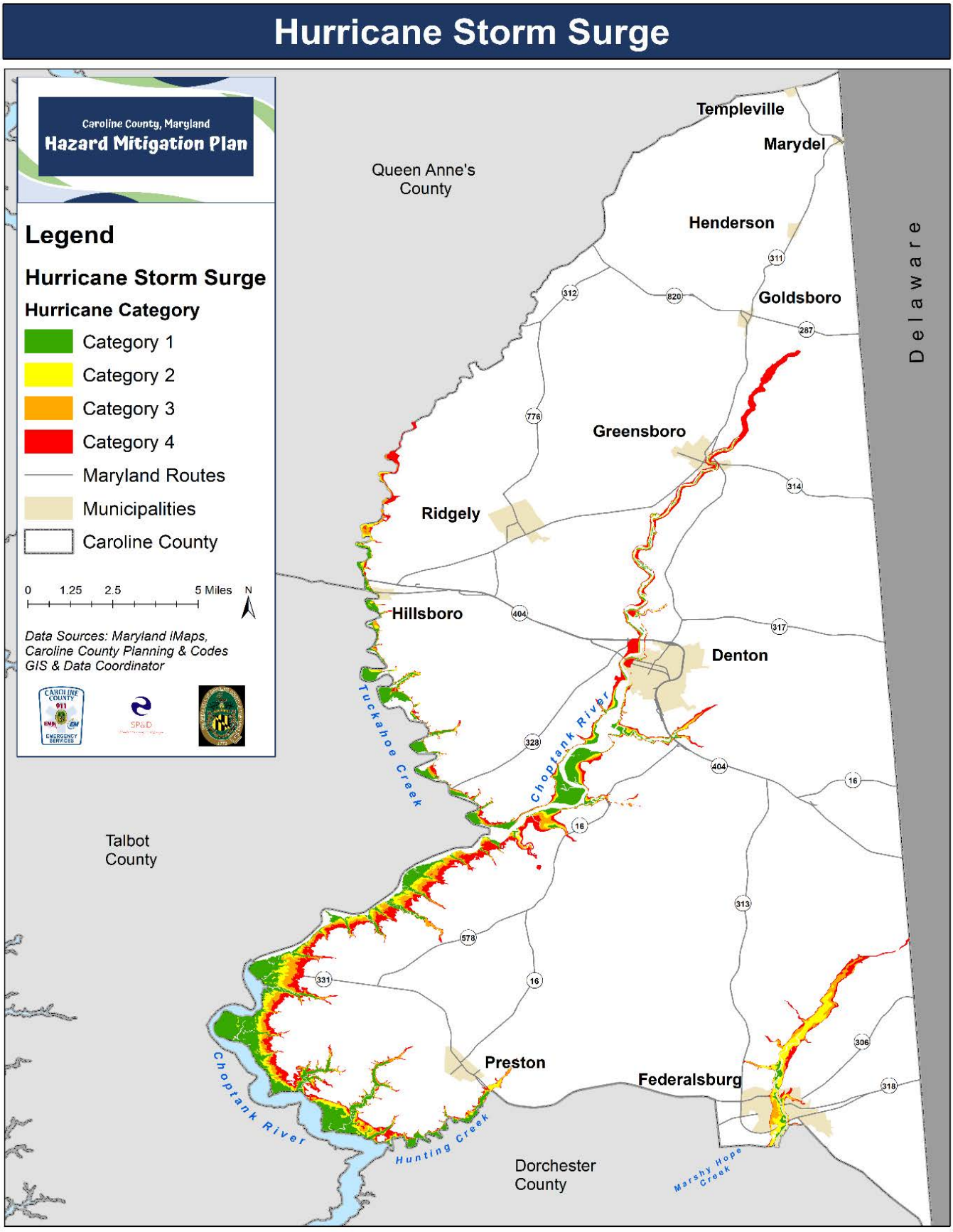
To describe the impacts of coastal flood and storms within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 5-3.

Table 5-3: Hurricane Vulnerability and Impacts to People, Systems, and Resources

People	• Climate change and its associated rising and warming sea levels and intensifying weather events disproportionately impact coastal communities, including populations who are already vulnerable due to social or economic factors. • Potential failure of drinking water and wastewater infrastructure puts people at risk of being exposed to pathogens and harmful chemicals. • Homes within vulnerable areas could become engulfed by storm surge. • Populations aged 65 and older and children aged 5 and younger are most at-risk for coastal flooding. The highest socially vulnerable populations are in the northeast and southeast portions of Caroline County. • Other at-risk populations are those with health problems. Power outages caused by coastal flooding affect people's ability to access health related products. • Property damage caused by immediate destruction of property and/or long-term mold/rot issues.
Systems (including networks and capabilities)	• Power outages impact the availability of emergency and government services. • There are approximately 11,000 system/drain fields located on properties throughout Caroline County. A total of 1,500 of these lies within critical areas. Heavy rainfall and tidal inundation can overload a system's ability to function properly which leads to overflow and potential septic failures which presents a public health threat. • Communication systems break down due to loss of power. • Transportation systems may be disrupted entirely due to coastal flooding.
Natural, Historic, and Cultural Resources	• Wildlife my become exposed to potential disease and/or chemical burns like dermatitis from toxic substances within floodwaters. • Soil and bank erosion may occur causing potential landslides. • Failure of roof drainage systems or other building services such as water mains may cause moisture accumulation in porous materials such as timber, lime mortars, platers, soft brick, masonry, pugging, or other insulation. This can lead to long-term damp and decay on historical properties.

The southwest portion of the County is most vulnerable to storm surge inundation. The Towns of Denton and Greensboro face more danger from flooding associated with the passage of a hurricane because of their location partially in the storm surge area of the Choptank River. The Town of Federalsburg is partially located in the storm surge area of Marshyhope Creek. A part of Hillsboro is in the storm surge area of Tuckahoe Creek. The Towns of Templeville, Marydel, Henderson, Goldsboro, and Ridgely are not subjected to impacts from storm surge due to location. Storm surge maximums for Caroline County range from 5 feet for Category 1 storms to 8 feet for Category 2 storms, and from 11 feet for Category 3 storms to 16 feet for Category 4 storms.

Map 5-1: Hurricane Storm Surge



The national depiction of storm surge flooding vulnerability helps people living in hurricane-prone coastal areas. These maps make it clear that storm surge is not just a beachfront problem, with the risk of storm surge extending many miles inland from the immediate coastline in some areas. As shown in Figure 5-3, a majority of potentially affected areas during a Category 1 hurricane within Caroline County have a storm surge potential of less than three (3) feet above ground. A few areas affected shown within Figure 5-4 lie within an area of a potential storm surge greater than three feet above ground.

Figure 5-3: National Hurricane Center Storm Surge Risk Map – Caroline County

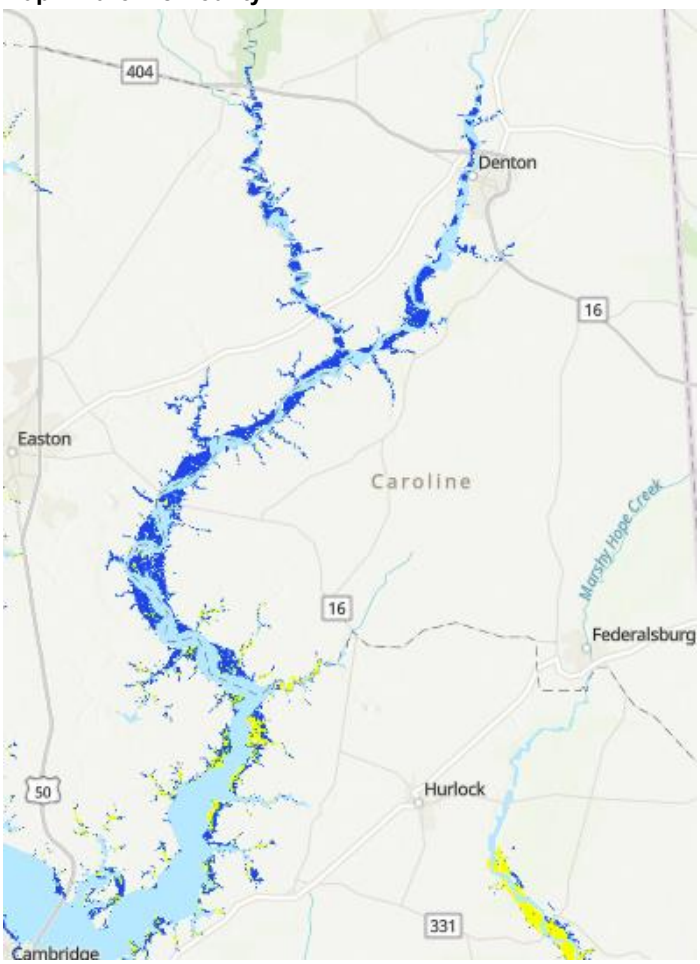
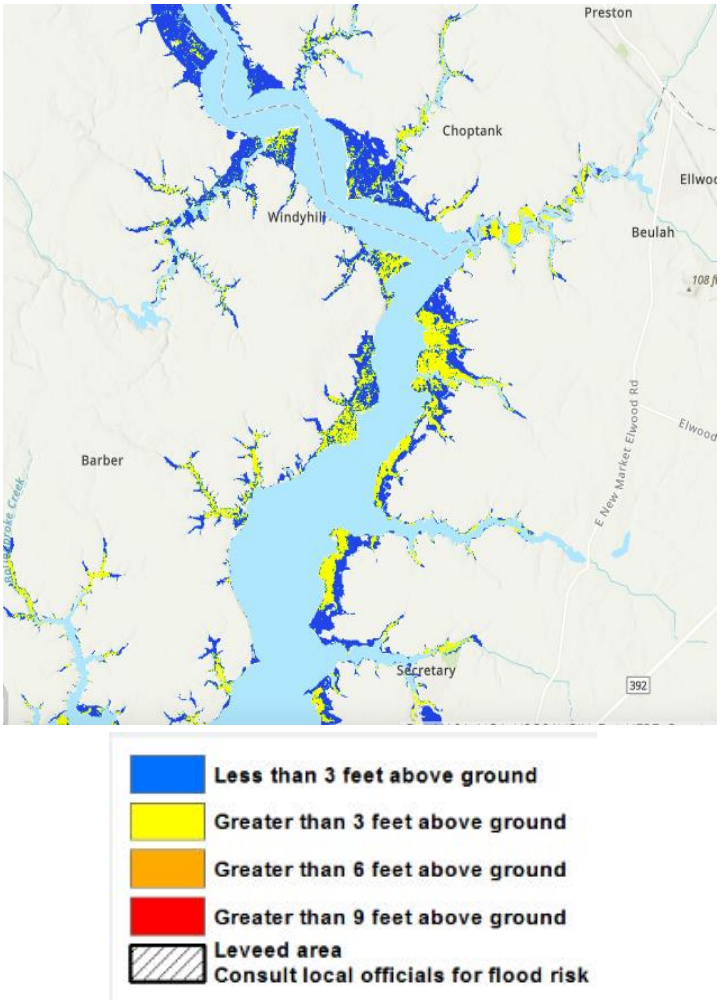


Figure 5-4: National Hurricane Center Storm Surge Risk Map – Caroline County Zoomed



Source: National Hurricane Center Storm Surge Risk Map

As discussed in Chapter 4 – Riverine Flooding, the Federalsburg Police Station is vulnerable to flood. It is not surprising that this facility is vulnerable to storm surge, as well. However, given that hurricane category 3 and 4 storm surge inundation areas would need to make landfall in Maryland, the likelihood of impacts to these facilities is low. Please note this does not consider sea-level rise.

Table 5-4: Essential Facilities At-Risk to Storm Surge

Facility Type	Facility Name	Estimated Building Value	Hurricane Storm Surge Category	Projected Flood Depth (feet)
Police Station	Federalsburg Police Station	$743,800	3 & 4	10.13’

Source: 2023 Essential Facilities Database

In the previous planning process, the Caroline County Sheriff’s Office was also located within the hurricane category storm surge inundation area, however this facility has relocated since 2019. The Sheriff’s Office’s new location is no longer within a hurricane storm surge inundation area.

Other critical facilities warrant special attention in preparing for a disaster and are important in ensuring the resiliency of the community. Category 1 storm surge inundation area has the most likelihood of occurrence based on historical data. Critical facilities located in all four storm surge inundation areas were analyzed during the Plan update utilizing the storm surge data prepared by the U.S. Army Corps of Engineers, Baltimore District, Planning Division in January 2016. Table 5-5 lists the critical facilities located within the storm surge areas, while Map 5-2 depicts all critical facilities and storm surge inundation areas.

Table 5-5: Critical Facilities in Storm Surge Inundation Areas

Facility Type	Number of Facilities	Facility	Address of Facility	Categories	
Government – County & Municipal Owned	4	Federalsburg Town Hall	118 N Main St, Federalsburg, MD 21632	3	4
		Mayor and Council of Federalsburg Facility	704 Morris Ave, Federalsburg, MD 21632	3	4
		Federalsburg Branch Library	123 Morris Ave, Federalsburg, MD 21632		4
		County Historical Society	3395 Linchester Rd, MD		4
Power Station	2	Delmarva Power & Light Company	Pennsylvania Ave, Federalsburg, MD 21632	3	4
		Choptank Electric	River Rd, Denton, MD		4
Total Facilities			**6**		

Source: 2023 Critical Facilities Database and 2016 Hurricane Storm Surge Category Database

Loss estimates for critical and public facilities located within storm surge inundation areas were calculated. These calculations were derived from 2017 Maryland Tax Assessment values, which were last updated in December 2022.

Table 5-6: Loss Estimates for Critical Facilities

Facility Type	Facility Name	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Government – County & Municipal Owned	Federalsburg Town Hall	$671,800	$134,360	$335,900
	Mayor and Council of Federalsburg Facility	$899,700	$179,940	$449,850
	Federalsburg Branch Library	$555,700	$111,140	$277,850
	County Historical Society	$257,400	$51,480	$128,700
Power Station	Delmarva Power & Light Company	$28,100	$5,620	$14,050
	Choptank Electric	$25,000	$5,000	$12,500

Source: Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County (Updated December 2022), Maryland Department of Assessments and Taxation-Real Property Data Search-Base Values

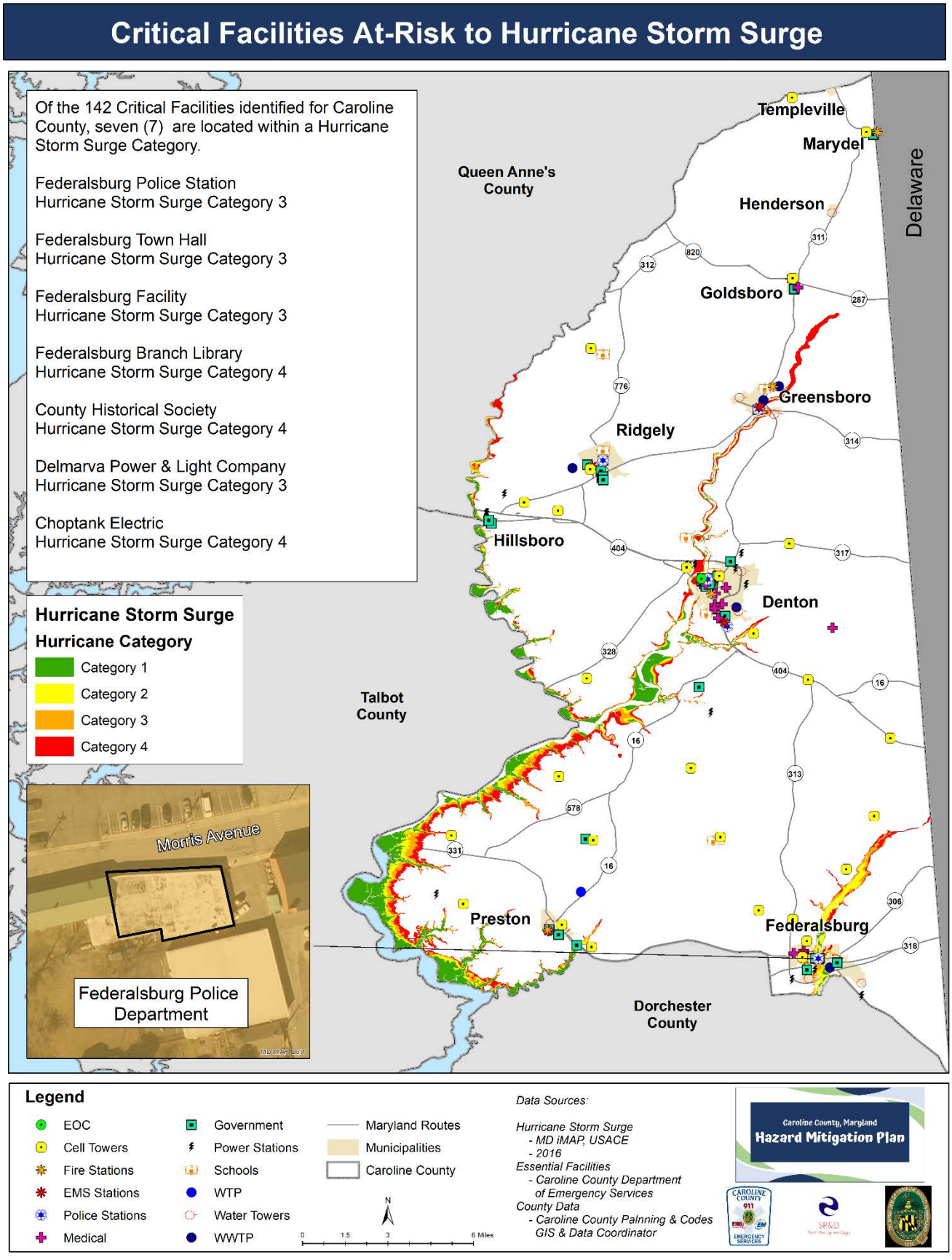
Loss estimates in dollars for all structures, including critical facilities by land use were also calculated from 2017 Maryland Property View Tax Assessment values. Land use category loss estimates were determined for hurricane category 1 storm surge considering a storm of this magnitude is more likely to impact the County.

Table 5-7: Loss Estimates for All Facilities by Land Use - Hurricane Category 1 Storm Surge Inundation Area

Land Use	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Agricultural	$13,998,210	$2,799,642	$6,999,105
Apartments	$430,400	$86,080	$215,200
Commercial	$1,163,190	$232,638	$581,595
Commercial Residential	$590,510	$118,102	$295,255
Exempt	$720,440	$144,088	$360,220
Exempt Commercial	$1,281,150	$256,230	$640,575
Industrial	$0	$0	$0
Marsh Land	$192,100	$38,420	$96,050
Residential	$41,129,580	$8,225,916	$20,564,790
Residential Commercial	$0	$0	$0
Total	$59,505,580	$11,901,116	$29,752,790

Source: Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County (Updated December 2022)

Map 5-2: Critical Facilities At-Risk to Hurricane Storm Surge



Analysis of historic structures listed in Chapter 2 resulted in a total of five (5) National Register Properties that intersect with the hurricane storm surge inundation area.

- Daffin House - Building
- Denton Historic District
- Federalsburg West Historic District
- Linchester Mill - Building
- Williston Mill Historic District

Loss estimates were determined utilizing building footprints for National Register Properties that are categorized as buildings in Table 5-8.

Table 5-8: Loss Estimations for Caroline County National Register Properties

National Register Property	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Daffin House - Building	$1,042,800	$208,560	$521,400
Linchester Mill - Building	$257,400	$51,480	$128,700

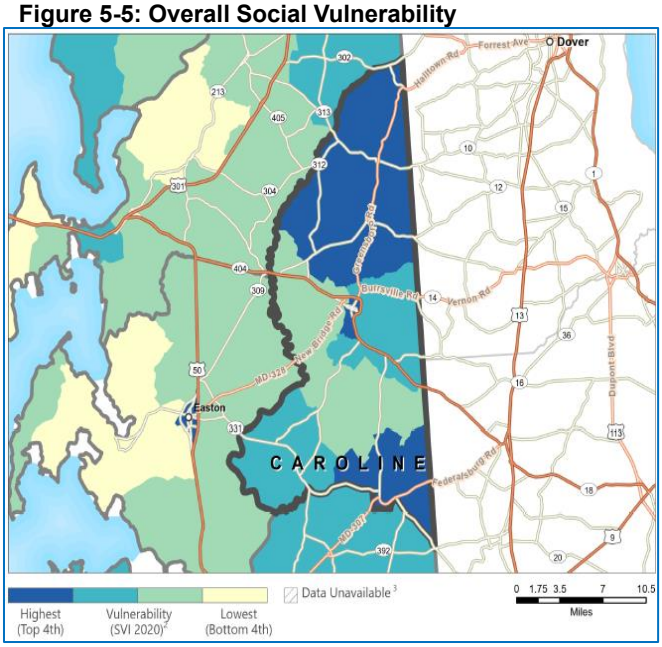
Source: Maryland's National Register Properties, Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County (Updated December 2022), Maryland Department of Assessments and Taxation-Real Property Data Search-Base Values

Social Vulnerability

Reviewing the CDC's Social Vulnerability Index (SVI) for Caroline County, the dark blue census tracks indicate the areas with the highest social vulnerability. As shown on Figure 5-5, the southern and norther portions of the County contain the higher socially vulnerable populations.

The hurricane storm surge inundation area does impact the Town of Federalsburg by traveling up the Marshyhope Creek. The Towns of Denton and Greensboro are impacted as well due to the Choptank River. The remaining municipalities are not subject to hurricane storm surge.

Figure 5-5: Overall Social Vulnerability



Source: CDC/ATSDR Social Vulnerability Index 2020 – Caroline County

Figure 5-6: Hurricane Preparedness

Prepare for Hurricanes

Know your Hurricane Risk

Hurricanes are not just a coastal problem. Find out how rain, wind, water, even tornadoes could happen far inland from where a hurricane or tropical storm makes landfall. Start preparing now.

Make an Emergency Plan

Make sure everyone in your household knows and understands your hurricane plan. In your hurricane plans include the office, kids' daycare, and anywhere you frequent. Ensure your business has a continuity plan to continue operating when disaster strikes.

Discuss the latest Centers for Disease Control (CDC) guidance on Coronavirus (COVID-19) and how it may affect your hurricane planning.

Know your Evacuation Zone

You may have to evacuate quickly due to a hurricane if you live in an evacuation zone. Learn your evacuation routes, practice with household, pets, and identify where you will stay.

Those with Disabilities

If you or anyone in your household is an individual with a disability identify if you may need additional help during an emergency.

Review Important Documents

Make sure your insurance policies and personal documents like ID are up to date. Make copies and keep them in a secure password protected digital space.

Strengthen your Home

De-clutter drains and gutters, bring in outside furniture, consider hurricane shutters.

Get Tech Ready

Keep your cell phone charged when you know a hurricane is in the forecast and purchase backup charging devices to power electronics.

Help your Neighborhood

Source: https://www.ready.gov/hurricanes

Considering the occurrence and severity of natural hazards cannot be reduced, reducing vulnerability is one of the main opportunities for reducing disaster risk. Therefore, communities identified should be targeted for outreach on preparedness activities. Ready.gov is a FEMA Ready Program developed to educate community members on how to prepare for and respond to emergencies caused by natural and man-made hazards. Information is provided for hurricanes and floods. The site also offers preparedness materials for business owners.

Future Vulnerability

According to Climate and Energy Solutions' article Hurricanes and Climate Change, frequency and intensity vary from basin to basin. In the North Atlantic Basin, the long- term (1966-2009) average number of tropical storms is about 11 annually, with about 6 becoming hurricanes. More recently (2000-2014), the average is over 15 tropical storms per year, including about 7 hurricanes. This increase in frequency is correlated with the rise in North Atlantic Sea surface temperatures, which could be partially related to global warming.

According to a study published in the journal Science Advances, the number of hurricanes and typhoons rated as Category 3 storms and higher could double by the year 2050, due to climate change. Using computer modeling, as global air and water temperatures continue to rise due to excess greenhouse gas emissions, the increase in the number of major hurricanes and typhoons will affect a larger number of people.

The study states that climate change will increase the wind speeds of major hurricanes by as much as 20% over the next 28 years, as well as the overall frequency of Category 4 and 5 storms by more than 200% in some parts of the world. The study projected Miami to see a modest annual increase in probability of experiencing a major hurricane in a given year (from 3.6% at present to 4.0% by 2050), while Honolulu is forecasted to see that probability more than double (from 4.0% to 8.6%) over the same span.

Considering scientists are uncertain whether climate change will lead to an increase in the number of hurricanes, there is more confidence that warmer ocean temperatures and higher sea levels are expected to increase their intensity and impacts. For the 21st century, some models project no change or a small reduction in the frequency of hurricanes, while others show an increase in frequency.

Colorado State University developed a new methodology for calculating tropical cyclone impacts to counties along the east coast. According to the Tropical Cyclone Impact Probabilities table, the average probability of a hurricane impact to Maryland was 11%, while the average probability of a major hurricane impact was 1%. These future probabilities for hurricanes and tropical storms would apply to Caroline County.

Chapter 6 Shoreline Erosion & Sea Level Rise

Hazard Ranking

- **Hazard Mitigation Planning Committee** – Concerned
- **Municipalities**
  - Denton – Concerned
  - Federalsburg – Concerned
  - Goldsboro – Somewhat Concerned
  - Greensboro – Very Concerned
  - Henderson – Not Concerned
  - Hillsboro – Somewhat Concerned
  - Marydel – Not Concerned
  - Preston – Not Concerned
  - Ridgely – Not Concerned
  - Templeville – Somewhat Concerned
- **State** – Medium
- **National** – Not Ranked
- **Public** – Somewhat Concerned

Public Survey Responses

- Only 3% of residents have experienced damage from shoreline erosion or sea level rise.
- 6% of residents have implemented floodproofing techniques such as elevating furnace, water heaters, or electric panels.
- 37% of participants indicated that the county should inform property owners of ways they can mitigate damage to their property.
- 15% of participants feel their community is at risk to shoreline erosion and sea level rise.
- Participants indicated that investment in drainage maintenance and infrastructure should be conducted on a regular basis.
- Participants indicated flooded roadways need to be addressed.

Chapter Updates

- Characteristic information was updated with current information.
- Sea level rise characteristics section was expanded to include information from the 2021 State of Maryland Hazard Mitigation Plan and Maryland's Coastal Resiliency Assessment.
- 2023 Maryland Sea Level Rise Projections have been integrated into the chapter.
- New images have been included.
- All maps have been updated.
- History event data has been updated with the most current available data.
- The Coastal Resiliency Assessment Shoreline Hazard Index was incorporated and used for the vulnerability analysis.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Risk assessment using the new critical facilities were conducted and incorporated in the vulnerability section of the chapter.
- New 100-foot risk zone loss estimates using current MD Property View Tax Assessment values.
- A risk assessment for historic structures is new element in the chapter.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.
- A new section discussing nuisance flooding has been added to this chapter.

Shoreline Erosion & Sea Level Rise Hazard Characterization

Shoreline Erosion

Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, and surface water/groundwater conditions. Caroline County has 120 miles of shoreline, which consist of very fine or unconsolidated silts, clays, or lighter organic material, such as marshes are particularly at risk.

The rise in sea level is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events. The rise in sea level creates results in increased storm surge.

Although shoreline erosion is a natural process, man-made factors can exacerbate its effects. These factors include land use, shoreline reinforcement activities, surface water usage, ground water usage, and the placement of buildings, roads, and other infrastructure. In general, erosion problems tend to be the greatest where sediments are unconsolidated; fetch is greater than one-mile, upland areas that generate significant runoff of saturated soils, and adjacent shorelines are hardened with protective structures. It is important to note that no documentation/data exists stating that structures in Caroline County have been damaged due to shoreline erosion.

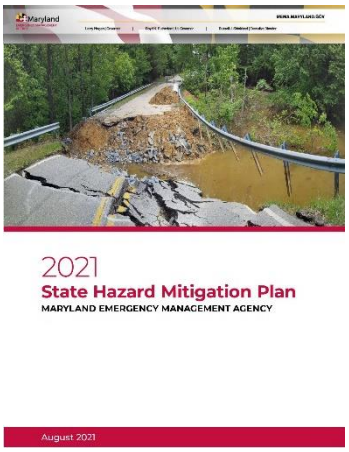
Marshyhope Creek Shoreline

Source: https://www.myeasternshoremd.com/news/caroline_county/marshyhope-receives-a-facelift/article_28e4e3db-ffec-546f-a976-

Sea Level Rise

According to FEMA's Coastal Hazards & Flood Mapping, sea level rise is an increase in sea level caused by a change in the volume of the world's oceans and changes in local ground elevations. Global warming is causing global mean sea level to rise in two ways. First, glaciers and ice sheets worldwide are melting and adding water to the ocean. Second, the volume of the ocean is expanding as the water warms. A third, much smaller contributor to sea level rise is a decline in the amount of liquid water on land—aquifers, lakes and reservoirs, rivers, soil moisture.[i]

In the United States, almost 30 percent of the population lives in relatively high population-density coastal areas, where sea level plays a role in flooding, shoreline erosion, and hazards from storms.[ii] Approximately 2% of Caroline County's total population resides in low-lying areas (less than 2 feet of sea level rise).[iii] Sea level rise leads to increased frequency and depth of flooding in coastal areas. Higher sea level also means more frequent high-tide flooding, sometimes called "nuisance flooding" because it isn't generally deadly or dangerous, but it can be disruptive and expensive.[iv] Tide gauge measurements in the Chesapeake Bay show that sea level rates are rising almost twice as fast as the global average.[v] The 2021 State of Maryland Hazard Mitigation Plan includes sea level rise within Coastal hazard, which is ranked as "Medium Risk" for Caroline County. Results of the sea level rise rank by county within the Maryland Coastal Resiliency Assessment indicated that Caroline County was ranked as "High Risk".



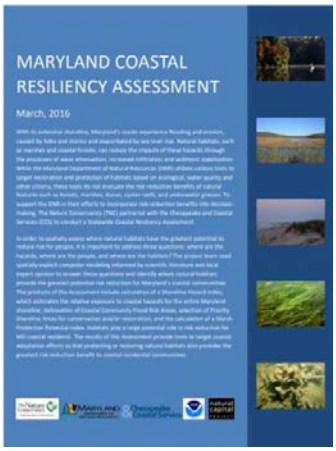
Shoreline Erosion & Sea Level Rise Hazard Risk & History

Shoreline Erosion

The Chesapeake Bay is an estuary that was the drowned, ancestral valley of the Susquehanna River, meaning that it was the alluvial plain where the river flowed when the sea level was lower.[vi] During the peak period of glaciations, sea level was approximately 400 feet lower than today. As sea level has risen over the past 10,000 years, the Chesapeake Bay has grown and essentially created the features associated with a shoreline of submergence. This produces a highly irregular, embayed shoreline typical of the eastern shore. In geologic terms, the Bay shoreline is still in youthful form with small bays, long peninsulas, and offshore islands. Eventually, as sea level continues to rise, these bays, peninsulas and islands will be submerged, leaving a smoother, nearly straight shoreline.

According to Maryland DNR information, approximately 69 percent of Maryland's coast is currently eroding at an average rate of erosion along the coast being 0.58 feet per year.[vii] Nearly 43% of the Choptank River tidal shore had been hardened as of 2003-2004, therefore decreasing the erosion rate. A minimal section of the Choptank River's shoreline in Caroline County has a high erosion rate. This is later discussed and mapped in the Chapter.

Ongoing research suggests that land subsidence in the region due to post-glacial crust movement and groundwater withdrawals are the contributing factor to the increased rate of sea level rise in Maryland. Approximately 260 acres of tidal shoreline are lost each year to shoreline erosion. This degrades water quality in the Bay by adding approximately 5.7 million pounds of nitrogen and 4.2 million pounds of phosphorus into the Bay.



As part of the Plan update for this section, shoreline erosion was assessed using the Coastal Resiliency Assessment and Coastal Atlas. In 2016 the Maryland Department of Natural Resources (DNR), Chesapeake and Coastal Service (CCS) partnering with the Nature Conservancy (TNC) conducted a Statewide Coastal Resiliency Assessment. According to the 2016 Maryland Coastal Resiliency Assessment, DNR, TNC and CCS used spatially explicit computer modeling informed by scientific literature and local expert opinion to spatially assess where natural habitats have the greatest potential to reduce risk for people.

MARYLAND COASTAL RESILIENCY ASSESSMENT

With its extensive shoreline, Maryland's coasts experience flooding and erosion, caused by tides and storms and exacerbated by sea level rise. Natural habitats, such as marshes and coastal forests, can reduce the impacts of these hazards through the processes of wave attenuation, increased infiltration, and sediment stabilization. While the Maryland Department of Natural Resources (DNR) utilizes various tools to target restoration and protection of habitats based on ecological, water quality and other criteria, these tools do not evaluate the risk-reduction benefits of natural features such as forests, marshes, dunes, oyster reefs, and underwater grasses. To support the DNR in their efforts to incorporate risk reduction benefits into decision-making.

To spatially assess where natural habitats have the greatest potential to reduce risk for people, it is important to address three questions: where are the hazards, where are the people, and where are the habitats? The project team used spatially explicit computer modeling informed by scientific literature and local expert opinion to answer these questions and identify where natural habitats provide the greatest potential risk reduction for Maryland's coastal communities. The products of the Assessment include calculation of a Shoreline Hazard Index, which estimates the relative exposure to coastal hazards for the entire Maryland shoreline; delineation of Coastal Community Flood Risk Areas; selection of Priority Shoreline Areas for conservation and/or restoration; and the calculation of a Marsh Protection Potential Index. Habitats play a large potential role in risk reduction for MD coastal residents. The results of this Assessment provide tools to target coastal adaptation efforts so that protecting or restoring natural habitats also provides the greatest risk reduction benefit to coastal residential communities.

Source: The Maryland Coastal Resiliency Assessment, March 2016 (Note, the 2016 assessment is the most recent version of this report.)

The report states that the products of the Assessment include calculation of a Shoreline Hazard Index, which estimates the relative exposure to coastal hazards for the entire Maryland shoreline, delineation of Coastal Community Flood Risk Areas, selection of Priority Shoreline Areas for conservation and/or restoration, and the calculation of a Marsh Protection Potential Index.

The Maryland Shoreline Hazard Index was calculated from six (6) physical variables: geomorphology, elevation, relative sea level rise, wave power, storm surge height and erosion rates, and five natural feature types (forest, marsh, dune, oyster reef and underwater grasses). Each variable is ranked from very low hazard (rank=1) to very high hazard (rank=5), based on criteria shown in Table 6-1, below, used within the within the InVEST coastal vulnerability model.

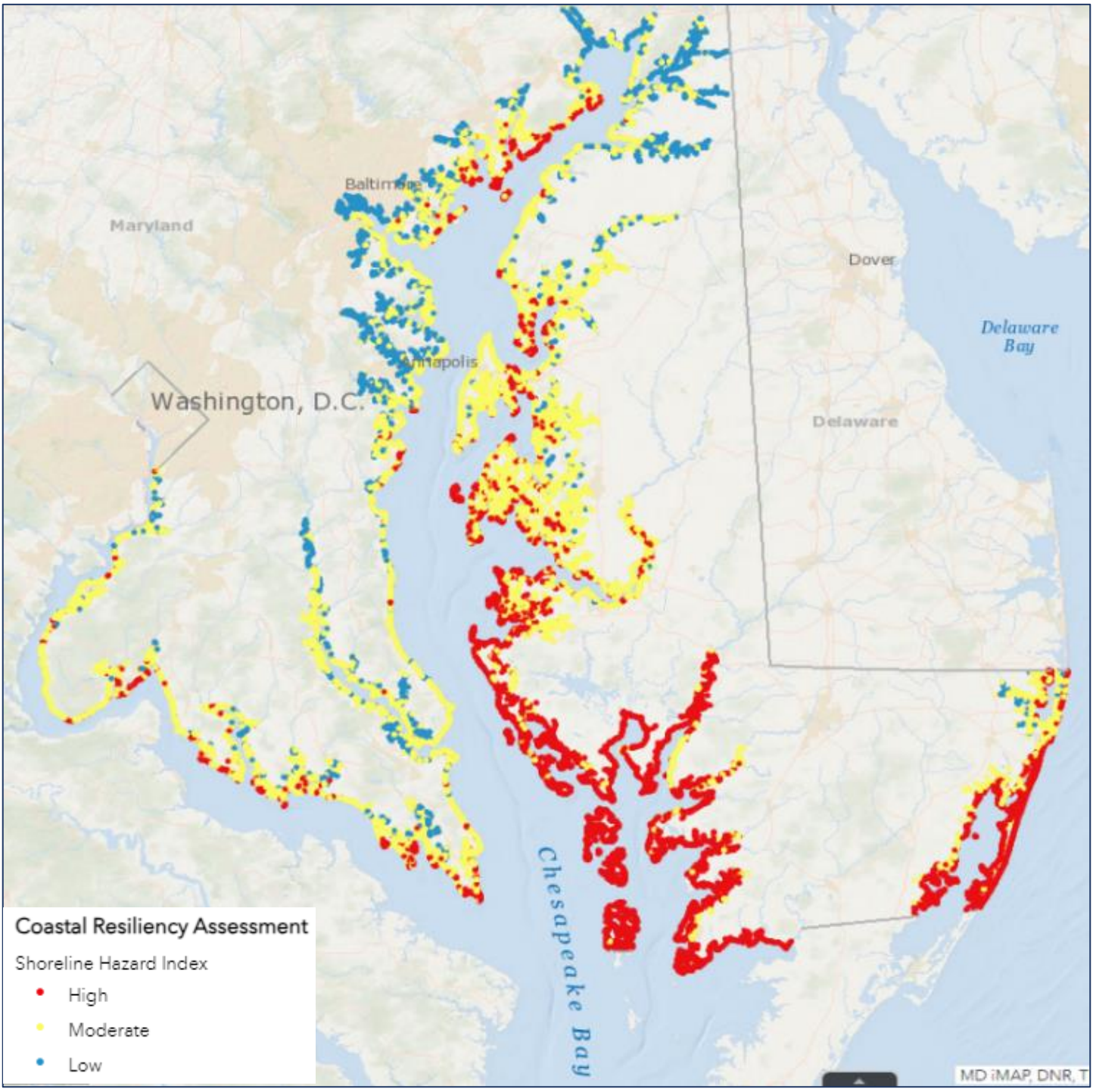
Table 6-1: Variables and Ranking System for InVEST Coastal Vulnerability Model

Variable	Very Low Hazard Rank (1)	Low Hazard Rank (2)	Moderate Hazard Rank (3)	High Hazard Rank (4)	Very High Hazard Rank (5)
Geomorphology	Bulkhead	Riprap	Groin, breakwater, jetty, unconventional structure, living shoreline	Coarse-grained sand to gravel beaches	Other natural shoreline, dilapidated bulkhead
Elevation (meters)	14.7 - 81.6	5.9 - 14.7	2.3 - 5.9	0.5 - 2.3	0 - 0.5
Natural Habitats	Forest	Marsh	Dune	Oyster reef, Underwater grass (dense = 4, less dense = 4.5)	No habitat
Sea Level Rise (meters)	None	1.32 – 1.42	1.46 – 1.48	1.49 – 1.67	2.05 – 2.35
Wave Power (kW/m)	0 - 0.02	0.02 - 0.05	0.05 - 0.16	0.16 - 0.78	Atlantic Shoreline
Storm Surge Height (feet)	0	0.1 - 2.2	2.3 - 3.5	3.6 - 4.6	4.7 - 8.9
Erosion Rate (feet/year)	Accretion or Protected	0 - 2, no change or unknown	2 - 4	4 - 8	>8

Source: Maryland Coastal Resiliency Assessment March 2016

The Maryland analysis estimated the relative exposure of each 250-meter segment of the Maryland coastline to storm-induced erosion and flooding, and the relative effectiveness of existing natural habitats to buffer the shoreline from these hazards. The Shoreline Hazard Index, depicted in Figure 6-1, represents the relative exposure to coastal hazards for the entire Maryland shoreline. Exposure is rated high, moderate, and low. As shown in Figure 6-1, the exposure rate gradually increases to high in the southern portion of the state.

Figure 6-1: Shoreline Hazard Index - Maryland



Source: [Maryland Coastal Atlas]

Figure 6-2 depicts the Shoreline Hazard Index for Caroline County. As shown Figure 6-2, the shoreline hazard index for the County's shorelines is predominately moderate (yellow points) with areas of high (red points). Therefore, the relative exposure to storm-induced erosion and flooding is moderate for most of the County's shorelines. According to the Shoreline Hazard Index data, the shoreline assessment does not extend to municipal limits. However, this does not mean municipalities are not vulnerable to shoreline erosion. Specifically, towns that intersect with waterways, such as Greensboro, Denton, Hillsboro, and Federalsburg.

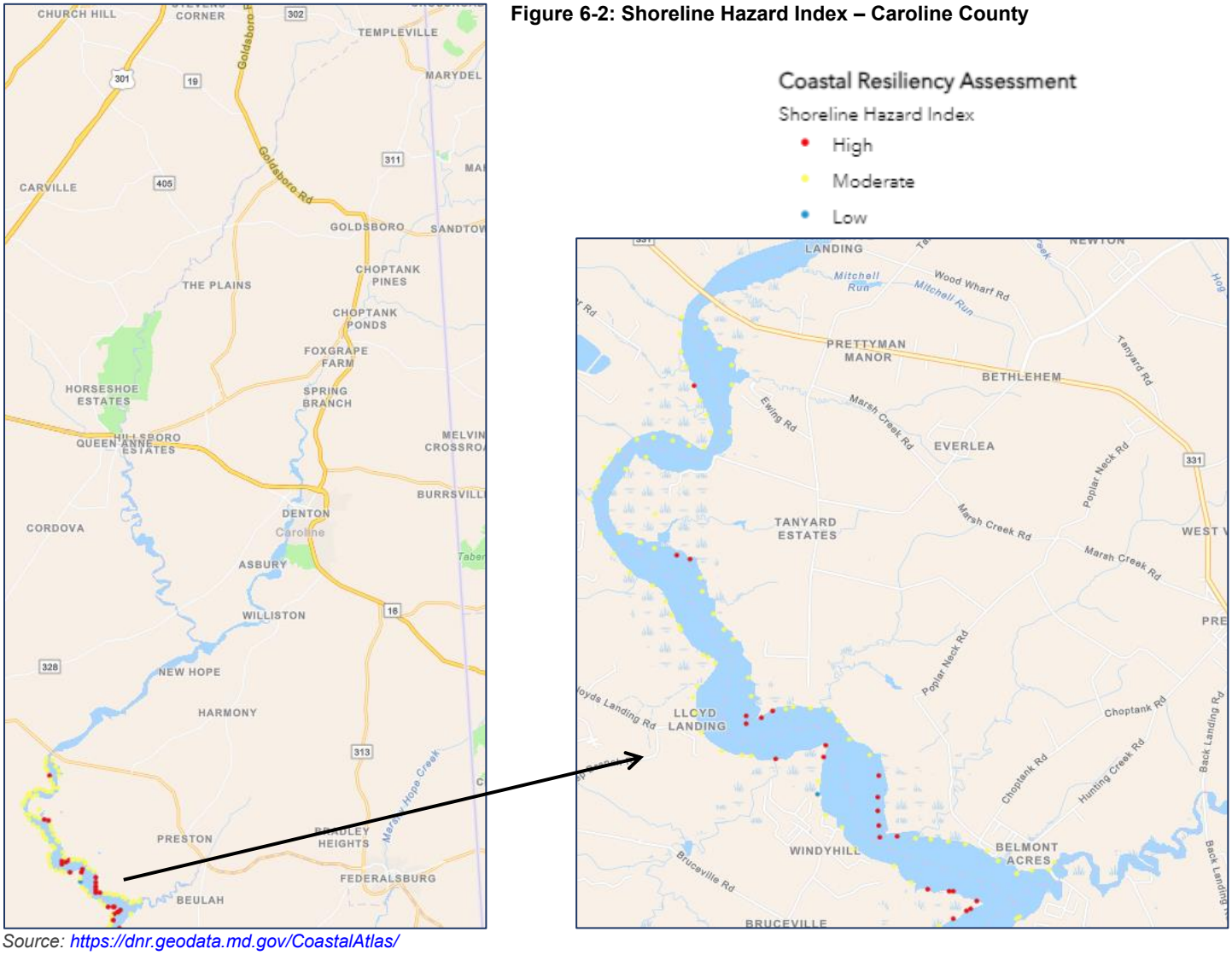


Figure 6-2: Shoreline Hazard Index – Caroline County

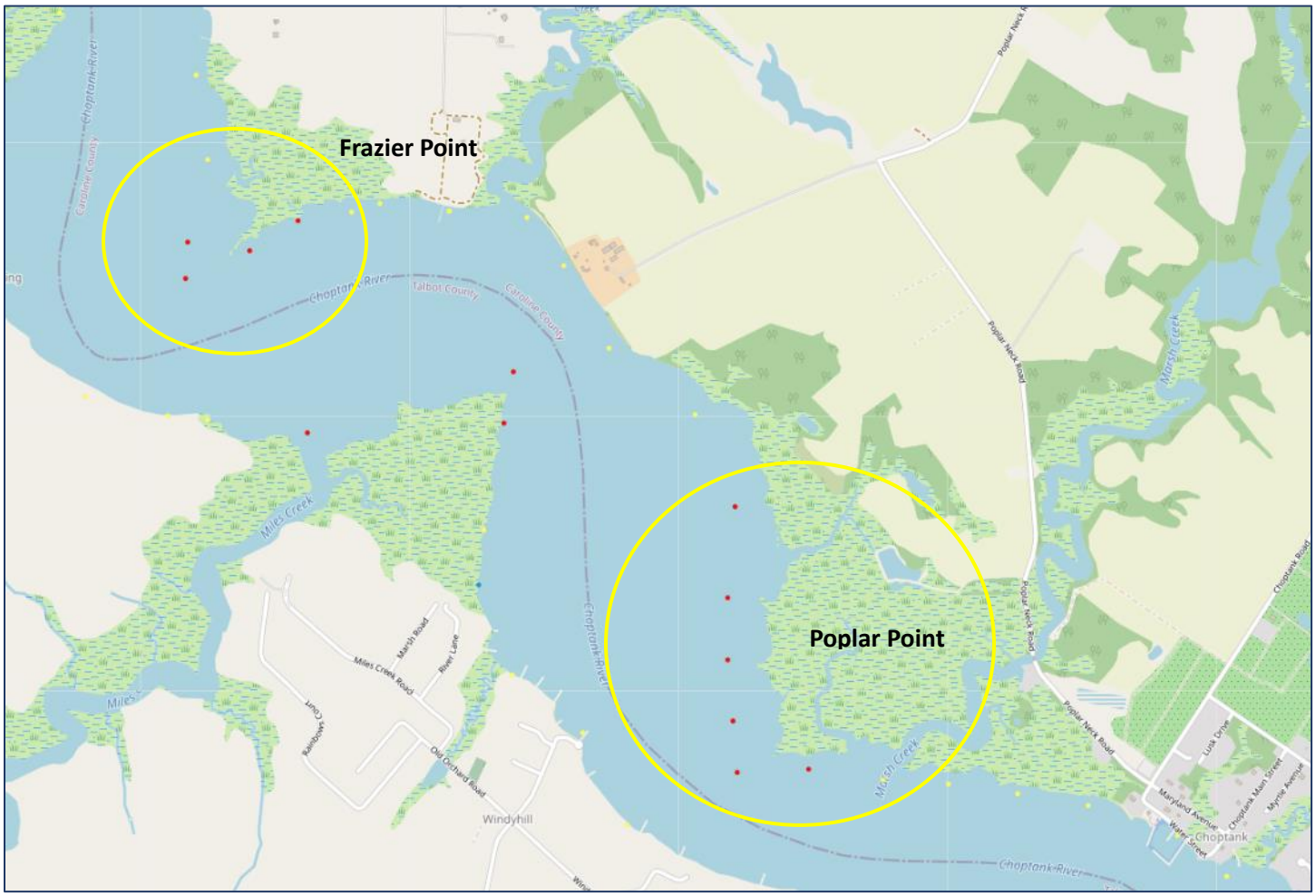
Source: https://dnr.geodata.md.gov/CoastalAtlas/

Erosion rates, one of the six (6) physical variables shown in Table 6-25, was extrapolated for use in this shoreline erosion vulnerability section. According to the Coastal Resiliency Assessment, the erosion rate variable indicates shoreline erosion as estimated by comparing recent (1988-1995) mapped shorelines to historical ones. Erosion rate hazard ranks were assigned as follows, based on categories used by the Maryland Geological Survey (MGS):

- **Very Low** = Accretion or Protected
- **Low** = No change, 0 to 2 feet/year
- **Moderate** (3) = 2 to 4 feet/year
- **High** (4) = 4 - 8 feet/year
- **Very High** (5) = > 8 feet/year

Figure 6-3 depicts the shorelines with high erosion rates in Caroline County. As shown on the figure, two (2) marsh areas, Frazier and Poplar Points, along the Choptank River have the highest erosion rates. Next steps in these areas would be to field verify the erosion rates and marsh heath. Then assess potential options to slow the erosion rates.

Figure 6-3: Shoreline Hazard Index – Choptank River



Source: https://dnr.geodata.md.gov/CoastalAtlas/

Sea Level Rise

Sea-Level Rise Projections 2023 found that sea level along Maryland's shores will very likely rise a foot between 2000 and 2050—as much as it did over the whole of the last century—and could rise a foot and a half. The sea-level rise that Maryland will experience during the first half of this century will be greater than that experienced during the whole of the last century.[viii] According to the Sea-Level Rise Projections for Maryland, a 2023 technical report, developing projections for relative sea-level rise along Maryland's coasts requires consideration of the many factors that will affect:

1) the rise in global mean sea level (GMSL),
2) regional differences in sea level with regard to the global mean,
3) vertical land movement (VLM); and
4) changes in tidal range and storm surges due to inundation.

Maryland is particularly vulnerable to sea-level rise because of a combination of rising seas and sinking land. Sea-Level Rise Projections 2023 found that sea level along Maryland's shores will very likely rise a foot

between 2000 and 2050—as much as it did over the whole of the last century—and could rise a foot and a half.[ix]

According to Guidance for Using Maryland's 2018 Sea Level Rise Projections - June 2022, Relative Sea Level Rise (RSLR) rates and projections vary slightly within Maryland due to variation in vertical land motion (the movement of land up or down). Localized RSLR projections have been calculated based on sea level trends measured by six tide gauges (devices that measure water level) in or near Maryland that have been consistently operating for at least 40 years.

RSLR estimates for **High** tolerance for flood risk correspond to the upper end of the "likely" range (17% probability RSLR meets or exceeds value), RSLR estimates for **Medium** tolerance for flood risk correspond to the 1-in-20 chance (5% probability RSLR meets or exceeds value), and RSLR estimates for **Low** tolerance for flood risk correspond to the 1-in-100 chance (1% probability RSLR meets or exceeds value).

RSLR projections are available for Annapolis, MD; Baltimore, MD; Cambridge, MD; Lewes, DE; Solomons Island, MD; and Washington, DC. RSLR estimates differ among these tide gauges by only a few inches a hundred years into the future. The Cambridge Tide Gauge best represents and is the closest tide gauge to Caroline County.

Table 6-2: Tide Gauge: Cambridge, MD

Emissions Pathway beyond 2050	Stabilized (RCP 4.5)		
Year	**High Tolerance for Flood Risk**	**Medium Tolerance for Flood Risk**	**Low Tolerance for Flood Risk**
2030	0.9 ft	1.1 ft	1.3 ft
2040	1.2 ft	1.5 ft	1.8 ft
2050	1.7 ft	2.0 ft	2.4 ft
2060	1.9 ft	2.3 ft	2.9 ft
2070	2.3 ft	2.8 ft	3.5 ft
2080	2.7 ft	3.3 ft	4.2 ft
2090	3.1 ft	3.8 ft	5.0 ft
2100	3.5 ft	4.3 ft	5.7 ft
2110	3.9 ft	4.9 ft	6.7 ft
2120	4.3 ft	5.5 ft	7.7 ft
2130	4.7 ft	6.1 ft	8.7 ft
2140	5.1 ft	6.7 ft	9.7 ft
2150	5.5 ft	7.3 ft	10.9 ft

Source: Guidance for Using Maryland's 2018 Sea Level Rise Projections - June 2022

According to the *GIS Data Products to Support Climate Change Adaptation Planning Caroline County Maryland, Summer 2018*, in general, Caroline County is resistant to the impacts of sea-level change through 2050. However, by 2100, rising levels of the Bay and subsidence of the land surface will create some local negative impacts. Caroline County is in a floodplain with low lying elevations. Areas such as Federalsburg and Greensboro will see significant negative impacts, particularly during higher tides.

Shoreline Erosion & Sea Level Rise Vulnerability

Vulnerability and Impacts to People, Systems, and Resources from Shoreline Erosion & Sea Level Rise

To describe the impacts of shoreline erosion and sea level rise within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 6-3.

Table 6-3: Shoreline Erosion & Sea Level Rise Vulnerability and Impacts to People, Systems, and Resources

People	• Destruction and/or loss of land and property, displacement of populations, and negative economic impacts to coastal tourism. • Public health and safety, in the short term first responders will not face adverse impacts to SLR. • Significant sea level rise is expected to occur over a period of 50-100 years, which means it is unlikely that sea level rise will result in injury or loss.
Systems (including networks and capabilities)	• Infrastructure may experience impacts in the form of damage to roads/ bridges and/or the complete loss of transportation routes.
Natural, Historic, and Cultural Resources	• Sea level rise will alter the landscape. • Changes in the shoreline will occur, with some areas of shore becoming completely inundated, while others are damaged from erosion. • Vegetation and wildlife habitat along the coast may be damaged or destroyed within inundated areas. • Shoreline erosion would negatively impact beaches, wetlands, marshes, and coastal habitats. With the loss of environments, coastal areas may experience more frequent and destructive flooding.

Shoreline Erosion

To determine the appropriate risk area size, several sources of information were reviewed. For instance, according to Local Government Assistance Guide: Lot Coverage, the definition of lot coverage is as follows: "the percentage of a total lot or parcel that is: 1) occupied by a structure, accessory structure, parking area, driveway, walkway, or roadway; or 2) covered with gravel, stone, shell, impermeable decking, a paver, permeable pavement, or any manmade material." This amendment also states the lot coverage within a 100-foot buffer is not permitted; "amendments to the law also clarify that there is no allowable, by right, percentage of lot coverage within the 100-Foot Buffer." However, there are grandfathering provisions that address existing lots developed within the buffer.

Additionally, the Local Government Assistance Guide: Critical Area Buffer, COMAR 27.01.09.01, defines a buffer as "the area immediately adjacent to the mean high-water line of tidal waters, the edge of each bank of tributary streams and the landward edge of tidal wetlands. It includes areas that are not naturally vegetated and may be developed or disturbed." The regulation also states the buffer measurement is expanded when "highly erodible soils and hydric soils to the landward edge of the soil or 300-feet (which include the minimum 100-foot Buffer), whichever is less." This regulation applies to all new development effective of March 8, 2010, however an alternate method for buffer expansion for parcels that existed prior to January 1, 2010 with highly erodible soils; "a development activity may be located in the expansion area, without a variance, provided that the Buffer and any expansion for hydric or highly erodible soils occupies at least 75 percent of the lot or parcel and mitigation occurs at a 2:1 ratio based on the lot coverage of the proposed development activity."

located within the tidal floodplain, Caroline County is moderately susceptible to shoreline erosion.

Therefore, a shoreline erosion risk zone was determined to analyze critical facilities' vulnerability. A 100-foot risk zone was placed around the current shoreline displayed on Map 6-2. Structures located within the 100-foot risk zone may need to implement mitigation measures to minimize the effects of shoreline erosion. Critical facilities located within this 100-foot risk zone are not only susceptible to damage caused by flooding but also can the impacts from shoreline erosion.

Therefore, a shoreline erosion risk zone along the Choptank River was determined to analyze facilities' vulnerability. A 100-foot risk zone was placed around the current shoreline displayed on Map 6-2. Structures located within the 100-foot risk zone may need to implement mitigation measures to minimize the effects of shoreline erosion. Critical facilities located within this 100-foot risk zone are not only susceptible to damage caused by flooding but also can the impacts from shoreline erosion.

Critical facilities are facilities that are critical to the health and welfare of the population and are important to the type of hazard event such as shelters, police and fire stations, and hospitals. These facilities warrant special attention in preparing for a disaster and are of vital importance in maintaining the function of the community. The vulnerability analysis resulted in no critical facilities were located within the 100-foot risk zone.

Loss estimates for all structures located within the 100-foot risk zone areas were calculated. These calculations were derived from the 2017 Maryland Tax Assessment values, which were last updated in December 2022.

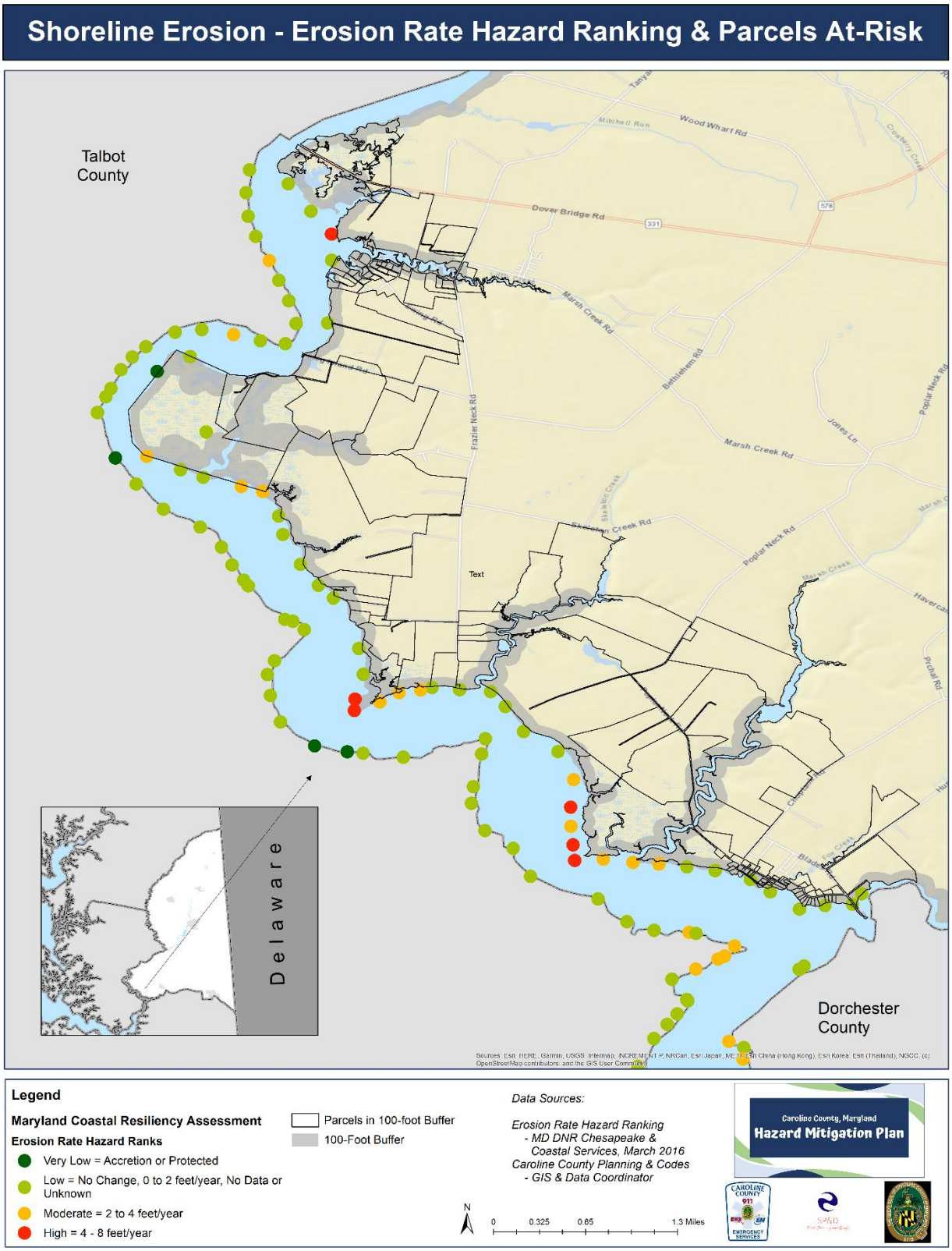
Table 6-4: Loss Estimates for All Facilities by Land Use - 100-foot Risk Zone

Land Use	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Agricultural	$2,545,730	$509,146	$1,272,865
Apartments	$148,700	$29,740	$74,350
Commercial	$0	$0	$0
Commercial Residential	$224,200	$44,840	$112,100
Exempt	$322,200	$64,440	$161,100
Exempt Commercial	$0	$0	$0
Industrial	$0	$0	$0
Marsh Land	$192,100	$38,420	$96,050
Residential	$6,452,180	$1,290,436	$3,226,090
Residential Commercial	$0	$0	$0
Total			

Source: Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County (Updated December 2022)

The vulnerability assessment conducted for historic structures identified in Chapter 2 concluded that no historic structures are located within the 100-foot risk zone.

Map 6-2: Shoreline Erosion – Erosion Rate Hazard Ranking & Parcels At-Risk



Erosion Rate Hazard Ranks were assigned as follows, based on categories used by the Maryland Geological Survey (MGS): Very Low (1)=Accretion or Protected; Low (2)=No Change, 0 to 2 feet/year, No Data or Unknown; Moderate (3)=2 to 4 feet/year; High (4)= 4 to 8 feet/year; and Very High (5)= >8 feet/year.

Sea Level Rise

As shown on Map 6-1, the Towns of Preston, Ridgely, Goldsboro, Henderson, Marydel, and Templeville are not subjected to sea level rise. The vulnerability assessment for critical facilities was conducted using the data developed by the Maryland State Highway Administration (MDSHA), the projected flood depth for the 2050 Mean Sea Level Rise and the 2100 Mean Sea Level Rise for Caroline County. The analysis indicated that critical facilities are not located within either projected Mean Sea Level Rise inundation areas, as shown on Map 6-1 in blue and green.

The 2019 Plan indicated that one (1) facility is located within proximity to both projected 2050 and 2100 Mean Sea Level Rise. The Caroline County Sheriff's Office was located on 101 Gay Street, which is adjacent to the Choptank River. However, since 2019, this facility has relocated to no longer at-risk to the projected 2050 and 2100 Sea Level Rise inundation areas.

Eastern Shore Land Conservancy-Risk Management for the 21st Century

A planning initiative was undertaken by the ESLC in coordination with the Eastern Shore Climate Adaptation Partnership (ESCAP). The sea level rise planning initiative included flood risk planning scenarios and potential mitigation strategies. Highlights from the plan have been incorporated herein.

Vulnerability Analysis: Sea Level Scenarios

The vulnerability analysis conducted included:

- 2015 (baseline, 1% chance (previously known as the 100-year flood event), and the 0.2% chance (previously known as the 500-year flood event); and,
- Maryland 2050 and 2100 Sea Level Rise (SRL) projections, plus 1% chance flood.

The Eastern Shore Climate Adaptation Partnership (ESCAP) was established in 2016 to assist vulnerable communities with preparing for climate change impacts. The partnership is an informal regional collaboration of staff from seven local governments, state agencies, academic institutions, and nonprofit organizations.

As shown on Figures 6-4 through 6-6, using Maryland Sea Level Rise Projections for both 2050 and 2100 and flood depth from the 1% chance flood event, shown in both blue and pink, respectively, the extent of flooding increases significantly from that of 2015 1% chance flood event, the current level of risk planning, shown in green. The extent of inland flooding is substantially increased in both scenarios. *Note the additional buildings at-risk to these flood scenarios, as shown in yellow.*

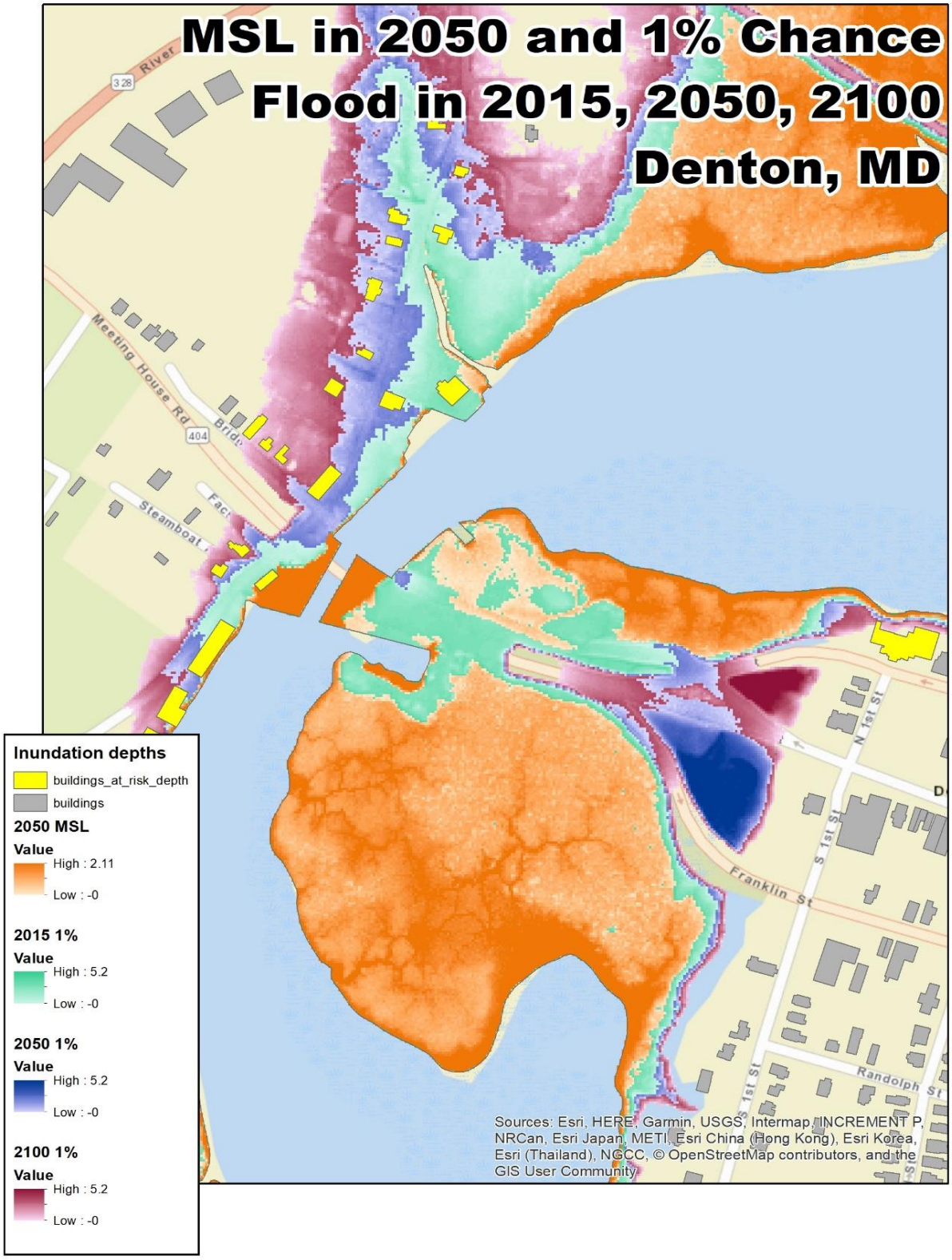
In addition, a comparison between structures at-risk presently to the 1% chance (previously known as the 100-year flood event) and those in 2050 are shown on Table 6-5.

Table 6-5: Vulnerability Analysis: 2015 Sea Level Scenarios-Structure Analysis

	1% Chance Flood Event Today	1% Chance Flood Event Plus 2050 SLR
# Buildings Flooded	82	**184 (2.25x increase)**
Cumulative Damage	$643K	**$2.4 M (4x increase)**
Residential	$306K	**$1.5 M (5x increase)**
Commercial	$230K	**$300 K (1.3x increase)**
Damage estimates are for structures and contents. Excludes loss of revenues, etc.		

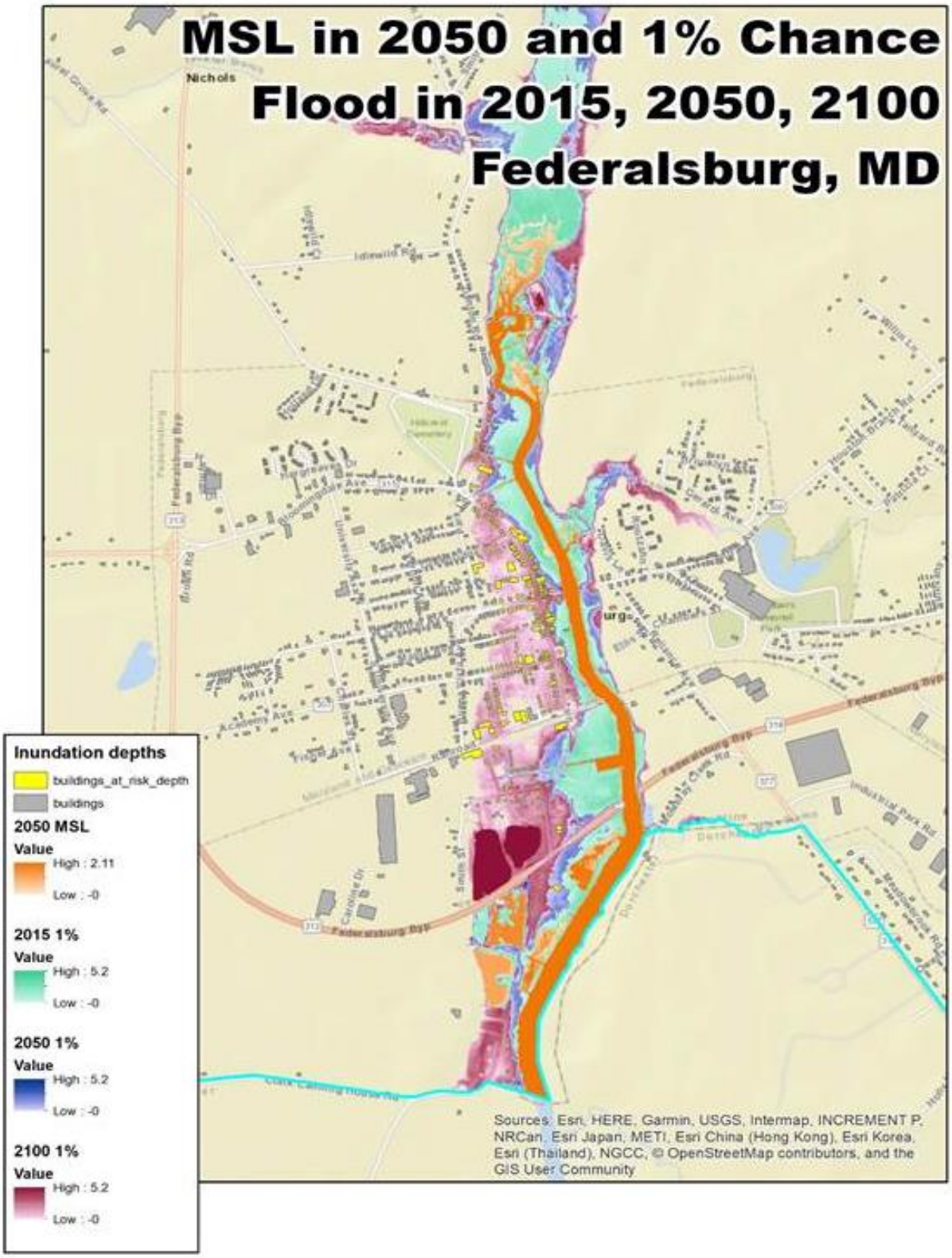
Source: Eastern Shore Land Conservancy (ESLC)

Figure 6-4: Mean Sea Level in 2050 & 1% Chance Flood in 2015, 2050,2100 – Denton, MD



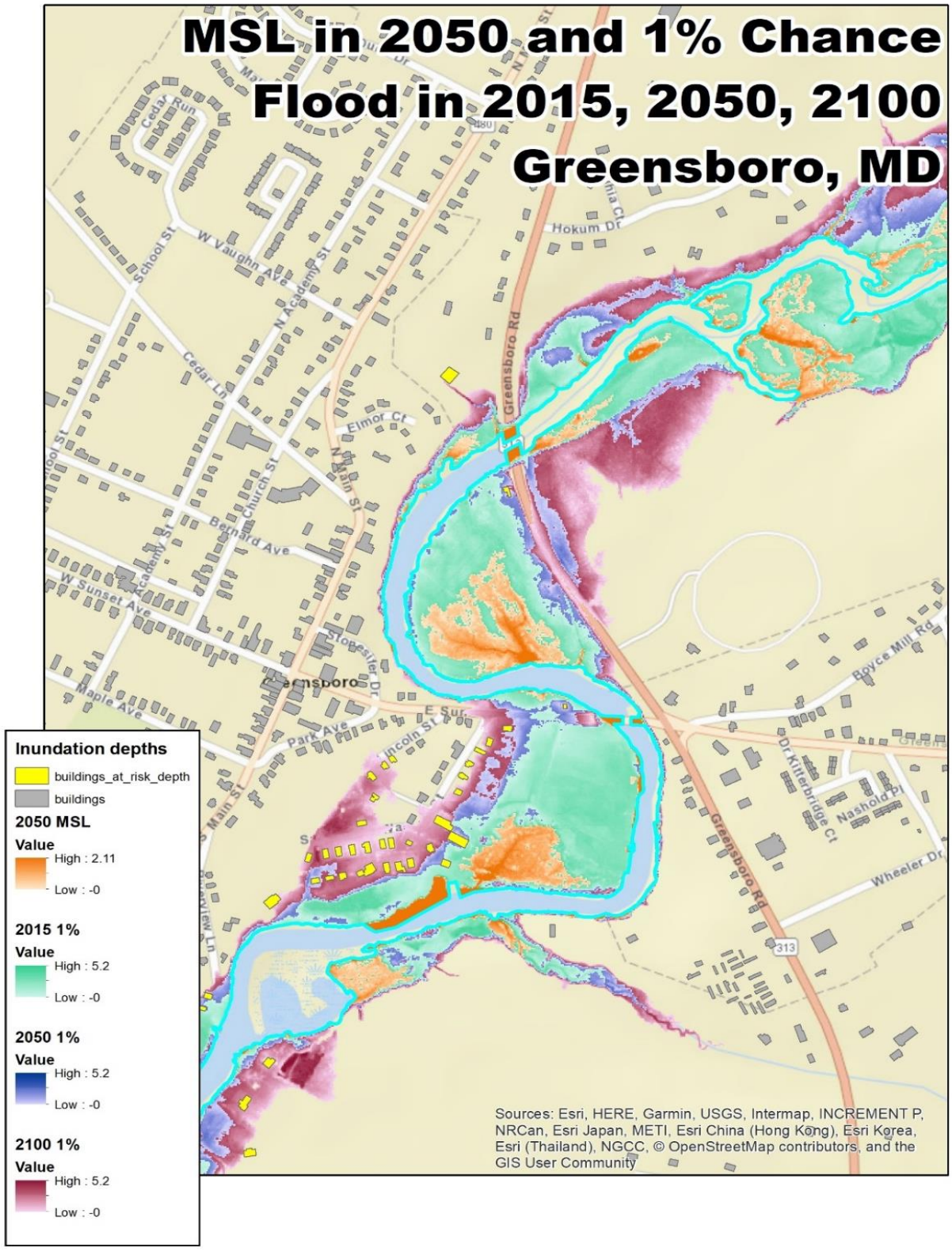
Source: PowerPoint Presentation by Jim Bass, Eastern Shore Land Conservancy (ESLC)

Figure 6-5: Mean Sea Level in 2050 & 1% Chance Flood in 2015, 2050,2100 – Federalsburg, MD



Source: PowerPoint Presentation by Jim Bass, Eastern Shore Land Conservancy (ESLC)

Figure 6-6: Mean Sea Level in 2050 & 1% Chance Flood in 2015, 2050,2100 – Greensboro, MD



Source: PowerPoint Presentation by Jim Bass, Eastern Shore Land Conservancy (ESLC)

Sea Level Rise Mitigation Strategies- Eastern Shore Land Conservancy-Risk Management for the 21st Century Floodplain

The following mitigation strategies are from the past planning initiative that was undertaken by the ESLC in coordination with the Eastern Shore Climate Adaptation Partnership (ESCAP). During this Plan update, each strategy was review and status updates have been provided.

Mitigation Strategy #1: Higher Floodplain Standards

- Regulate the height and extent of the 2050 SLR plus the 1% chance flood rather than the 1% chance flood only.
  - # of buildings within the FEMA 1% chance floodplain: approximately **80**
  - # of buildings within the FEMA 0.2% chance floodplain: approximately **120**
  - # of buildings within the modeled 1% chance floodplain and 2050 SLR risk area: approximately **200**
- Consider higher freeboard requirements, especially for critical and county/municipal –owned facilities.
- Map Coastal A Zones based on SLR models.

Status Update: Chapter 4 Flood, Tables 4-13 and 4-14, provides an updated number of buildings located in the 1% annual chance flood hazard area. The updated number of structures was included in the FEMA 2019 Caroline County Flood Risk Report. A new mitigation action item was included in Chapter 13, Table 13-5.

Freeboard is a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed. Freeboard is not required by NFIP standards, but communities are encouraged to adopt at least a one-foot freeboard to account for the one-foot rise built into the concept of designating a floodway and the encroachment requirements where floodways have not been designated. Freeboard results in significantly lower flood insurance rates due to lower flood risk.

Source: Floridadisaster.org

Mitigation Strategy #2: Nuisance Flooding Plan

By July 1, 2019, a local jurisdiction that experiences nuisance flooding shall:

- Develop a plan to address nuisance flooding.
- Update the plan at least once every 5 years.
- Publish the plan on the local jurisdiction's website.
- Submit a copy of the plan to the Maryland Department of Planning.

Definition: "high-tide flooding that causes a public inconvenience"

Status Update: As part of the Plan update, the Nuisance Flooding Section was added to this Chapter in order to satisfy the State's requirements.

Mitigation Strategy #3: Post Disaster Redevelopment Plan

- A long-term rebuilding plan that guides smarter rebuilding after a disaster.
- Required for local governments in Florida.
- Benefits: Faster and More Efficient Recovery.
  - Plans are already in place.
  - Take advantage of disaster recovery funds quickly. Develop competitive grant proposals.
- Opportunities to Build Back Better Superstorm Sandy in NJ illustrated the rush to rebuild the same things in the same place, missed opportunity to build smarter.

- Local Control Over Recovery.

Status Update: No action has been taken, however, new mitigation action item #60 on Table 13-5 relates to this strategy.

Historic structures were analyzed in addition to critical facilities, residential and commercial structures to determine sea level rise vulnerability, using the Maryland State Highway Administration (MDSHA). The projected flood depth for the 2050 Mean Sea Level Rise is 2.11 feet, while the 2100 Mean Sea Level Rise is 5.78 feet for Caroline County. Chapter 2, Historic Properties, provides the full listing of Caroline County's National Register Properties, which were added during this Plan update. Of the twenty-three (23) properties, a total of eight (8) are within the projected 2050 and 2100 Mean Sea Level Rise inundation areas and are listed below.

- Daffin House - Building
- Denton Historic District
- Federalsburg West Historic District
- Leonard House - Building
- Linchester Mill - Building
- Potter Hall - Building
- West Denton Warehouse/Wharf - Building
- Williston Mill Historic District

Loss estimates were determined utilizing building footprints for National Register Properties that are categorized as buildings in Table 6-6.

Table 6-6: Loss Estimations for Caroline County National Register Properties

National Register Property	Estimated Building Value	20% Loss Estimate	50% Loss Estimate
Daffin House - Building	$1,042,800	$208,560	$521,400
Leonard House - Building	$108,200	$21,640	$54,100
Linchester Mill - Building	$257,400	$51,480	$128,700
Nanticoke Lodge No. 172 AF & AM- Building	$158,400	$31,680	$79,200
Potter Hall- Building	$339,400	$67,880	$169,700
West Denton Warehouse/Wharf - Building	$37,500	$7,500	$18,750

Source: Maryland's National Register Properties, Maryland Department of Planning- 2017 Maryland Property View Data for Caroline County, Maryland Department of Assessments and Taxation-Real Property Data Search-Base Values

All eight (8) historic properties are also within the 1% annual chance flood hazard area. In addition, five (5) National Register Properties intersect with the hurricane storm surge inundation area. These five (5) historic properties include:

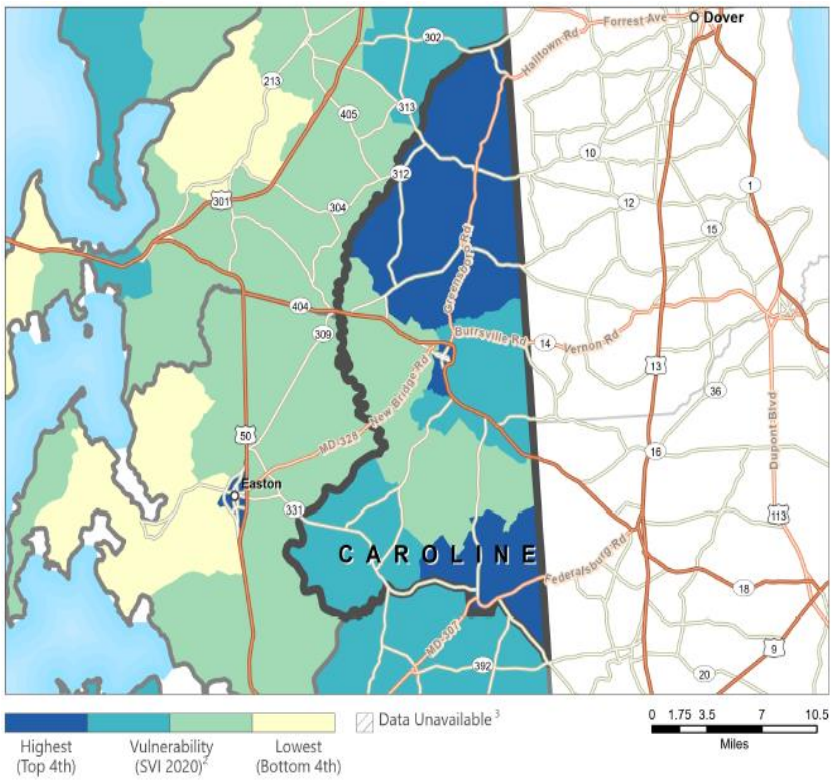
- Daffin House - Building
- Denton Historic District
- Federalsburg West Historic District
- Linchester Mill - Building
- Williston Mill Historic District

These historical properties should be evaluated for mitigate strategies to ensure continued preservation of the history and culture of the citizens in the County.

Social Vulnerability

Reviewing the CDC's Social Vulnerability Index (SVI) for Caroline County, the dark blue census tracks indicate the areas with the highest social vulnerability. As shown on Figure 6-7, the southern and northern portions of the County contain the higher socially vulnerable populations.

Figure 6-7: Overall Social Vulnerability



Source: CDC/ATSDR Social Vulnerability Index 2020 – Caroline County

In relation to shoreline erosion, the area potentially impacted is located along the southwestern area of the county, Figure 6-2. The social vulnerability index is moderate in this area. The Town of Preston is in the moderate SVI, however not located within the 100-foot risk zone. In terms of social vulnerability and shoreline erosion, the highest social vulnerability areas, shown in blue on Figure 6-7 are not within the moderate or high shoreline erosion areas shown on Figure 6-2.

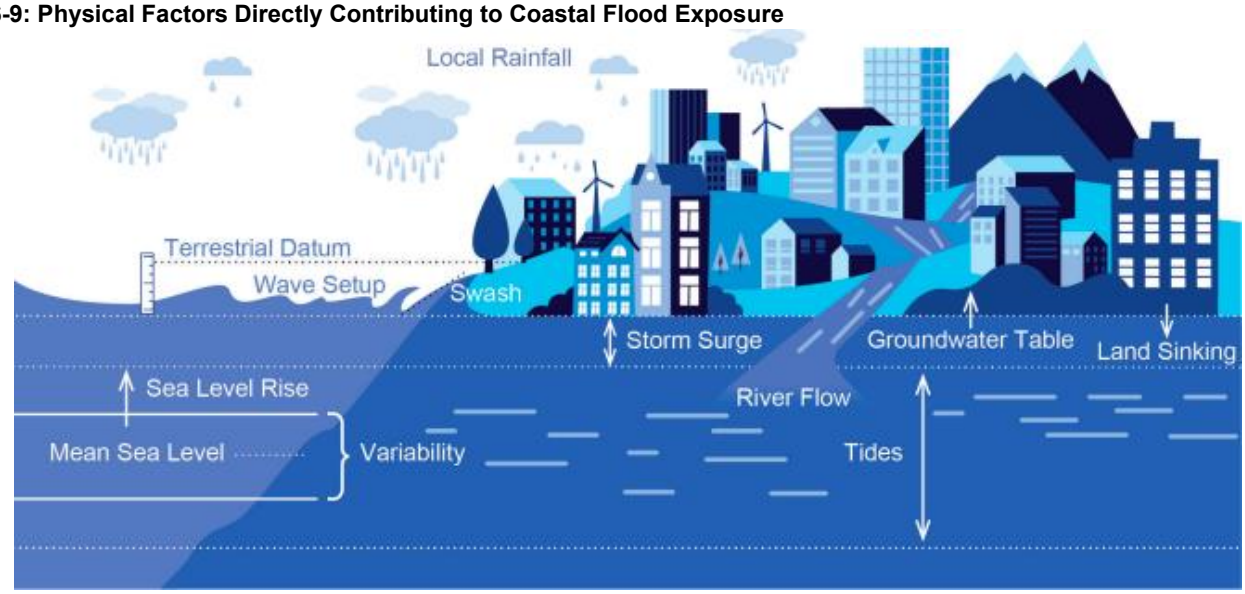
The 2050 and 2100 Mean Sea Level Rise inundation areas does impact the Town of Federalsburg by traveling up the Marshyhope Creek. The Towns of Denton and Greensboro are impacted as well due to the Choptank River. The remaining municipalities are not subject to sea level rise. In terms of social vulnerability and sea level rise, the majority of the highest social vulnerability areas are not within the highest sea level rise risk areas.

Future Conditions

Mean sea level rise and its acceleration are projected to aggravate coastal erosion over the 21st century, which creates a major challenge for coastal adaptation. According to the NOAA's 2022 Global and Regional Sea Level Rise Scenarios for the United States, sea level rise driven by global climate change is a clear and present risk to the United States today and for the coming decades. Sea levels will continue to rise due to the ocean's sustained response to the warming that has already occurred— even if climate change mitigation succeeds in limiting surface air temperatures in the coming decades.

Rising sea levels and land subsidence are combining, and will continue to combine, with other coastal flood factors, such as storm surge, wave effects, rising coastal water tables, river flows, and rainfall (Figure 6-9), some of whose characteristics are also undergoing climate-related changes. The net result will be a dramatic increase in the exposure and vulnerability of this growing population, as well as the critical infrastructure related to transportation, water, energy, trade, military readiness, and coastal ecosystems and the supporting services they provide.

Figure 6-9: Physical Factors Directly Contributing to Coastal Flood Exposure



Source: NOAA's 2022 Global and Regional Sea Level Rise Scenarios for the United States, Section 1: Introduction

According to the 2021 State of Maryland Hazard Mitigation Plan, based on the frequency of previous occurrences, the future probability of coastal hazards in Maryland is highly likely. Additionally, according to NCA4, climate change will impact coastal hazards. NCA4 projects various major trends over the next 25 to 100 years relevant to coastal hazards impacts and future event probability. The strongest hurricanes are expected to "become both more frequent and more intense," and result in more rainfall. Additionally, coastal hazard events interacting with sea level rise amplify many hazard impacts. In the Northeast region of the United States, sea level rise is anticipated to exceed global mean sea rise with an average increase by 2 feet ("Intermediate-Low" sea level rise scenario) and 4.5 feet ("Intermediate" sea level rise scenario). The most extreme sea level rise scenario estimates 11 feet of sea level rise by 2100. Storm surges are higher as a result of sea level rise. Coastal flooding is also exacerbated, among other phenomena such as erosion.

According to the U.S. Climate Resilience Toolkit – Coastal Erosion, sea level rise will cause an increase in coastal erosion and the human response will be critical. If communities choose to build hard structures in an attempt to keep the shoreline position stable, beach area could be lost due to scour. If shorelines migrate naturally, communities can expect to see erosion rates increase, especially in regions of the coast that are already dealing with starved sediment budgets and rapid shoreline migration. Increases in storm frequency and intensity in the future will also cause increased coastal erosion.

[i] NOAA - Climate Change: Global Sea Level- What's causing sea level to rise?
[ii] NOAA - Climate Change: Global Sea Level- Why sea level matters
[iii] NOAA DIGITAL COAST TOOL - Coastal County Snapshots – Caroline County
[iv] NOAA - Climate Change: Global Sea Level- Why sea level matters
[v] Sea Level Rise Report Final revised 81303 - Maryland DNR
[vi] USGS - The Chesapeake Bay: Geologic Product of Rising Sea Level; Chesapeake Bay
[vii] State of the Beach/State Reports/MD/Beach Erosion
[viii] UMD Center for Environmental Science – Sea-Level Rise Projections
[ix] Sea-level Rise Projections for Maryland 2023

Chapter 7 Winter Storms

Hazard Ranking

- **Hazard Mitigation Planning Committee** – Concerned
- **Municipalities**
  - Denton – Very Concerned
  - Federalsburg – Concerned
  - Goldsboro – Concerned
  - Greensboro – Not Concerned
  - Henderson – Very Concerned
  - Hillsboro – Somewhat Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Concerned
  - Templeville – Somewhat Concerned
- **State** – Medium
- **National** – Relatively Low
- **Public** – Somewhat Concerned

Public Survey Responses

- Only 29% of residents have experienced damage from winter storms.
- Participants indicated that they have experienced frozen water pipes and road closures due to winter storms.
- 8% of residents have Installed alternate power/water supply and purchased a portable generator as mitigation measures.
- 49% of participants indicated that the county should retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.
- 50% of participants feel their community is at risk to winter storms.
- Participants indicated the county should create family and pet friendly shelters.

Chapter Updates

- Characteristic information was updated with current information.
- Additional winter storm events were included in the hazard risk and history section.
- New images have been included.
- History event data has been updated with the most current available data.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Risk assessment using the new critical facilities were conducted and incorporated in the vulnerability section of the chapter.
- A new section discussing social vulnerability has been added to this chapter.
- Data from the HHS emPower Map tool was incorporated into the social vulnerability section.
- A new section discussing future vulnerability has been added to the chapter.

Winter Storm Hazard Characterization

A winter storm is characterized as a winter weather event that contains more than one significant hazard. Sleet, freezing rain, snow, and extremely cold temperatures are all associated with winter storms. Flooding and flash flooding may also occur from warming temperatures that result from rapid snowmelt.

A winter storm warning is issued when snowfall is expected to accumulate more than 6 inches in 12 hours or 8 inches in 24 hours is expected. According to the National Weather Service (NWS), the highest average snowfall by month for Maryland is February.

A wide variety of impacts from winter storms may result including:

- School Closures,
- Government and business closures,
- Traffic accidents,
- Power outages,
- Loss of communication, and
- Damage to buildings, specifically roof collapse.

Source: https://www.heraldmailmedia.com/story/news/local/2022/02/09/ten-notable-major-snow-storms-blizzards-noreasters-maryland-history-baltimore-hagerstown-salisbury/9253602002/

Winter Storm Hazard Risk & History

In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west. Caroline County has an average January low temperature of 29° F.

Presidential Declarations for Caroline County over the past decade:

- Maryland Severe Winter Storm and Snowstorm (DR-1875) – February 19, 2010
- Maryland Severe Winter Storms and Snowstorms (DR-1910) – May 6, 2010
- Maryland Hurricane Irene (DR-4034) – September 16, 2011
- Maryland Hurricane Sandy (DR-4091) – November 20, 2012
- Maryland Severe Winter Storm and Snowstorm (DR-4261) – March 4, 2016

Source: FEMA

While each winter season brings with it the possibility of major snow and ice storms, including nor'easters, some winter storms do stand out due to their severity and duration. Winter storms that stand out include an ice storm in February 1994 that resulted in widespread power outages in Caroline County, the President's Day storm in 2003 that resulted in more than 16 inches of snow recorded at Denton, and two major storms in the same week in February 2010 that dropped a combined total of 30 inches recorded at the Town of Denton. Furthermore, a major nor'easter, producing record snowfall in parts of Maryland on January 23, 2016. The nor'easter moved out to sea after passing by the mid-Atlantic coast early on January 24, 2016. Snowfall totals recorded were 16.0 inches in Newton and 15.7 inches in Denton. Maryland Governor Larry Hogan declared a State of Emergency on Friday, January 22, 2016 as well as a presidential disaster declaration. On March 4, 2016, President Obama declared the following counties federal disaster areas: Caroline, Cecil, Kent, and Queen Anne's. On January 7, 2017, snowfall began early in the morning and continued throughout the day accumulating as much as 9 inches in some areas of Caroline County.

The southern areas of the County received the most snowfall. On March 20, 2018, precipitation began as rain and turned into snowfall by late morning of the next day. Snow became heavy at times towards the evening hours resulting in reports of accumulations in Greensboro of 6.8 inches and 7.5 inches in Griffin. On January 28, 2022 a strong coastal storm affected the eastern mid-Atlantic and Northeast US. The heaviest snow fell near the coast, from the night of the 28th through the morning of the 29th. A Community Collaborative Rain, Hail &Snow Network (CoCoRaHS) observer near Greensboro reported 7.2 inches of snow, and a trained spotter in Henderson reported 6.0 inches of snow.

A total of 131 winter storm events were recorded for Caroline County in the NCEI storm event database. These events include blizzard, frost/freeze, heavy snow, sleet, winter storm, winter weather. Of these, 35 significant events (i.e., events that produced 6 inches or more snow) are detailed on Table 7-1.

In terms of number of occurrences, the NCEI listed a total of 35 significant winter storm events affecting Caroline County from 1996-2022. Therefore, Caroline County experiences an average of 1.35 significant (6 inches +) winter storm events per year. The likelihood of future events is high. In addition, projections for increased precipitation in the Northeast Region of the United States may affect the current frequency statistics resulting in an even higher likelihood of occurrences. Mitigating current conditions based on hazard risk is important, however, understanding of future conditions must be factored into mitigation initiatives.

Table 7-1: Winter Storm Events

Blizzard Events– 2010-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
1	0	0	0	0.08
Frost/Freeze Events– 2007-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
1	0	0	0	0.06
Heavy Snow Events– 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
24	0	0	0	0.89
Sleet Events– 1997-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
4	0	0	0	0.15
Winter Storm Events– 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
24	0	0	200.00k	0.96
Winter Weather Events– 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
77	0	0	0	2.85

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Note:
Winter Storm (Z) - *A winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Normally, a Winter Storm would pose a threat to life or property. In cases of winter storms, the preparer should be careful to classify the event properly in Storm Data. In general, the event should be classified as a Winter Storm event (rather than an Ice Storm event or a Heavy Snow event) only if more than one winter precipitation type presented a significant hazard. Some Winter Storm and Blizzard events may have had sustained or maximum wind gusts that met or exceeded High Wind criteria. Rather than document an additional High Wind event, the Storm Data preparer should just mention the time, location, and wind value in the Winter Storm or Blizzard event narrative. This is permissible even if only light snow and minor blowing snow (no serious reduction in visibility below 3 miles) occurred with the high winds, as long as the high wind report is deemed reliable and was generated by the same synoptic storm system that resulted in the Winter Storm or Blizzard event. This scenario would be most likely in the mountains of the western United States.*

Winter Weather (Z) *- A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle). The Winter Weather event can also be used to document out-of-season and other unusual or rare occurrences of snow, or blowing/drifting snow, or freezing rain/drizzle. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Note that, in Storm Data, Blizzard events should cover a time period of 3 hours or*

more. Therefore, if blizzard-like conditions occur for less than 3 hours, the event should be entered as a Winter Storm, Heavy Snow, or Winter Weather, noting in the event narrative that near-blizzard or blizzard-like conditions were observed at the height of the event.

As far as extreme cold weather is concerned, in 1912, temperatures dropped to nearly -20° F over much of the state. During a prolonged cold spell in 1977, much of the Chesapeake Bay froze over for an extended period. A more recent event, one of the harshest arctic outbreaks in years occurred across the Eastern Shore on January 7, 2014. Record breaking calendar day low temperatures occurred and combined with strong northwest winds to produce wind chill factors as low as 10 to 20 degrees below zero throughout the County. High temperatures struggled to reach double digits that day.

The National Centers for Environmental Information (NCEI) operating under National Oceanic and Atmospheric Administration (NOAA) reported 24 cold/wind chill and 1 extreme cold/wind chill events; their descriptions are provided in Table 7-2. In terms of number of occurrences, the NCEI listed a total of 24 cold/wind chills and 1 extreme cold event affecting Caroline County from 1996-2023. Therefore, Caroline County experiences on average 0.89 cold/wind chill events per year for and 0.11 extreme cold/wind chill events per year.

Table 7-2: Cold, Extreme Cold, & Wind Chill Events

Cold/Wind Chill Events – 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
24	0	0	0	0.89
Extreme Cold/Wind Chill Events – 2014-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
1	0	0	0	0.11

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Note:
***Cold/Wind Chill (Z)** - Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -180 F or colder) conditions. If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. There can be situations where advisory criteria are not met, but the combination of seasonably cold temperatures and low wind chill values (roughly 150 F below normal) may result in a fatality.*
***Extreme Cold/Wind Chill (Z)** - A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -350 F or colder). If the event that occurred is considered significant, even though it affected a small area, it should be entered into Storm Data. Normally these conditions should cause significant human and/or economic impact. However, if fatalities occur with cold temperatures/wind chills but extreme cold/wind chill criteria are not met, the event should also be included in Storm Data as a Cold/Wind Chill event and the fatalities are direct.*

Winter Storm Vulnerability

The impacts associated with a winter storm are previously described in the hazard characterization of this chapter. The main impact that a winter storm will have on critical and public facilities is closure of operations at government and public facilities and power outages. While winter storms and extreme cold effects the entire County and all municipalities, socially vulnerable populations are likely to be impacted more severely.

Source: https://www.myeasternshoremd.com/

Vulnerability and Impacts to People, Systems, and Resources from Winter Storm

To describe the impacts of winter storm within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 7-3.

Table 7-3: Winter Storm Vulnerability and Impacts to People, Systems, and Resources

People	• Populations aged 65 and older and children aged 5 and younger are most at-risk for extreme cold. The highest socially vulnerable populations are located in the northeast and southeast portions of Caroline County. • Other at-risk populations are those with health problems. Power outages caused by winter storms and cold weather affect people's ability to heat their homes, and access health related products.
Systems (including networks and capabilities)	• Winter storms, icing, and extreme cold have been known to create problems with utility services, such as power outage due to stress on power systems. • Outages impact the availability of emergency and government services.
Natural, Historic, and Cultural Resources	• Extreme cold can cause stress to local wildlife. • Disruption of soil structure, especially in permafrost. • Increased rates of deterioration in metals from thermal stress. • Surface cracking, flaking, and sugaring building stone and spalling of brick due to increase in wet frost.

Generators are necessary for critical facilities to continue to operate during power outages. Facilities such as emergency management, police, fire, and EMS stations must be able to operate during winter storm power outages to provide their services to the public.

In addition, critical facilities built in or prior to 1967 with flat roofs may be susceptible to damage caused by heavy snow loads. There are fourteen (14) critical facilities built in or prior to 1967 within Caroline County. Roof geometry affects the ability of structure to shed snow. Simple roofs with steep slopes shed snow most easily. Roofs with geometric irregularities and obstructions collect snowdrifts in an unbalanced pattern. These roof geometries include flat roofs with parapets, stepped roofs, saw-tooth roofs, and roofs with obstructions such as equipment or chimneys. Note, there are eleven (11) critical facilities, which are aging structures, built in or prior to 1967, all having flat roofs, denoted on the table below.

Table 7-4: Critical Facilities constructed 1967 and Prior

Facility Type	Facility Name	Municipality	Year Built	Flat Roof
1. EMS	Greensboro EMS- Station 16	Greensboro	1930	✓
2. EMS	Ridgely EMS – Station 14	Ridgely	1961	✓
3. EMS	Federalsburg EMS – Station 11	Federalsburg	1964	✓
4. Fire	Federalsburg VFD – Station 100	Federalsburg	1964	✓
5. Fire	Greensboro VFD – Station 600	Greensboro	1930	
6. Fire	Ridgely VFD – Station 400	Ridgely	1930	✓
7. Police	Ridgeley Police Department	Ridgely	1890	
8. Police	Federalsburg Police Station	Federalsburg	1962	Partial ✓
9. Police	Greensboro Police Department	Greensboro	1924	
10. School	The Benedictine School	Ridgeley	1900	Partial ✓
11. School	Career & Technology Center	Ridgeley	1955	✓
12. School	Federalsburg Elementary	Federalsburg	1935	✓
13. School	North Caroline High	Ridgeley	1955	✓
14. Tower	Denton Transmitter Building	Denton	1954	✓

Source: 2023 Critical Facility Database

The Caroline County Sheriff's Office was included on this listing in the 2019 Plan. However, since the previous planning process, the Caroline County Sheriff's Office relocated to 9305 Double Hills Road and now has an A-frame style roof.

Social Vulnerability

Elderly populations are considered particularly vulnerable to cold weather as a person's ability to thermoregulate can become impaired with age. Underlying diseases, such as diabetes, and medications can modify blood pressure, circulation, perspiration rates, and some mental capacities such as warmth perception, thus complicating people's ability to identify when they are experiencing cold.

People 65 years and older comprise 16.8% of the total population of Caroline County and its municipalities. As shown in Figure 7-1, the higher percentages of people 65 years and older are in the southern portion of the County, which includes the Towns of Preston, Federalsburg, Hillsboro and portions of Denton and Ridgely. Cold weather conditions can also be associated with other types of health impacts. For example, icy and snowy weather can increase the number of slips and falls, leading to injuries. During wintertime power outages, cases of carbon monoxide poisoning often increase, as people use devices such as barbeques or portable generators indoors for cooking or heating. People who are fuel deficient oftentimes experiences problems due to extreme cold events, particularly extended prolonged events. U.S. Census 2020 American Community Survey 5-Year Estimates indicate that 13.1% of Caroline County population is living in poverty.

Figure 7-1: Population Aged 65 & Over

Source: 2020 Census Demographic Data Map Viewer

Home weatherization attached housing and energy assistance programs are examples of cold weather adaptation and mitigation strategies that may be encouraged by local government.

In addition, HHS emPower Map tool, users can select different geographies, as needed, to identify at-risk populations and download selected data results to inform their emergency preparedness, response, recovery, and mitigation public health activities. Users can also access near real-time natural hazard data layers to anticipate and address the needs of at-risk community members in emergencies. For more instructions and information, review the detailed job aids in the top right corner. Medicare data indicates that there are 7,252 beneficiaries within Caroline County. Beneficiary means a person who is entitled to Medicare benefits and/or has been determined to be eligible for Medicaid. Medicare beneficiaries rely on electricity-dependent durable medical and assistive equipment (DME) and devices to live independently in their homes, and some of those individuals also have health care service dependencies.

Utilizing the Electricity Dependent option, total at-risk beneficiaries to snow and ice accumulations on day one of the storm equals 318 beneficiaries. A listing of these beneficiaries that have electric dependent medical equipment should be established. This would assist in well checks extended power outages during a winter storm event.

Future Vulnerability

According to Climate Communication Science and Outreach, climate change is fueling an increase in the intensity and snowfall of winter storms. The atmosphere now holds more moisture, and that in turn drives heavier than normal precipitation, including heavier snowfall in the appropriate conditions. The following list includes known U.S. winter storm trends as it relates to climate change:

January 5, 2018 – Caroline County Public Schools announced schools would be closed due to inclement weather. This closure marked the second consecutive day of school closures after Winter Storm Grayson dumped more than 6 inches of snow on the County.

- National Oceanic and Atmospheric Administration (NOAA) scientists, examining 120 years of data, found that there were twice as many extreme regional snowstorms in the U.S. between 1961 and 2010 compared to 1900 to 1960.
- According to the U.S. Fourth National Climate Assessment, "Heavy precipitation events [defined as the heaviest 1 percent of all daily events] in most parts of the United States have increased in both intensity and frequency since 1901."
- From 1958 to 2016, the amount of precipitation falling in very heavy events (the top 1 percent of all daily precipitation events) increased by 55 percent in the Northeast.
- The 5th Assessment Report of the Intergovernmental Panel on Climate Change states: It is likely that since about 1950 the number of heavy precipitation events over land has increased in more regions than it has decreased. Confidence is highest for North America and Europe where there have been likely increases in either the frequency or intensity of heavy precipitation with some seasonal and regional variations. It is very likely that there have been trends towards heavier precipitation events in central North America.

Given the above information, planning for more extreme winter weather conditions in the future makes good sense. Undertaking preparedness campaigns, as well as infrastructure and utilities upgrades, and preparedness initiatives will strengthen resilience.

Chapter 8 Drought & Excessive Heat

Hazard Ranking

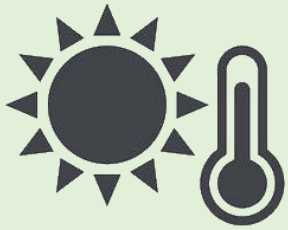
- **Hazard Mitigation Planning Committee** – Concerned
- **Municipalities**
  - Denton – Very Concerned
  - Federalsburg – Somewhat Concerned
  - Goldsboro – Concerned
  - Greensboro – Somewhat Concerned
  - Henderson – Very Concerned
  - Hillsboro – Somewhat Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Somewhat Concerned
  - Templeville –Concerned
- **State** – Medium-High
- **National** – Relatively Moderate
- **Public** – Somewhat Concerned

Public Survey Responses

- 19% of residents have experienced damage from drought and excessive heat.
- 8% of residents have installed alternate power/water supply and purchased a portable generator as mitigation measures.
- 44% of participants feel their community is at risk to winter storms.
- Participants indicated the county should accept climate change to respond appropriately. Increases in heat and drought will impact the agriculture-based economy.

Chapter Updates

- Characteristic information was updated with current information.
- National Drought Mitigation Center information was incorporated into the characterization section.
- New images have been included.
- History event data has been updated with the most current available data.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Discussion on aquifers has been included in the vulnerability section.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.



Drought & Excessive Heat Hazard Characterization

Drought

Drought is a normal part of virtually all climates, including areas with high and low average rainfall. Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Although maintaining water supplies for human use is an important aspect of drought management, drought can also have many other dramatic and detrimental effects on the environment and wildlife.

The simplest definition of a drought is “an extended period of dry weather;” there are four different types of droughts including:

- **Meteorological drought:** A measure of departure from normal precipitation due to climatic differences. What is considered a drought in one location may not be in another location.
- **Agricultural drought:** The amount of moisture in the soil no longer meets the needs of a particular crop.
- **Hydrological drought:** Surface and subsurface water levels are below normal.
- **Socioeconomic drought:** This occurs when physical water shortage begins to affect people.

Droughts may result in damage to crops, livestock, wildlife, and wildfires. During a prolonged drought, land values may decrease, and unemployment may increase. Negative economic impacts on water-dependent businesses may occur as well due to water restrictions implemented during a drought.

According to the University of Maryland Extension, Home & Garden Center webpage, when drought conditions are prolonged, landscape plants, trees and lawns may suffer temporary or permanent damage.

Wayne Palmer developed the Palmer Drought Severity Index (PDSI) in the 1960s which uses temperature and rainfall information in a formula to determine dryness, Table 8-1. It has become the semi-official drought index. The Palmer Index is most effective in determining long-term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

Extended droughts result in crop losses.
Source: https://www.baltimoresun.com/weather/bs-md-drought-impact-20120718-story.html

Table 8-1: Drought Severity Classification

DROUGHT SEVERITY	RETURN PERIOD (YEARS)	DESCRIPTION OF POSSIBLE IMPACTS	DROUGHT MONITORING INDICES		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.79	D0	-1.0 to -1.99
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing, or imminent, voluntary water use restrictions requested.	-0.8 to -1.29	D1	-2.0 to -2.99
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-1.3 to -1.59	D2	-3.0 to -3.99
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions	-1.6 to -1.99	D3	-4.0 to -4.99
Exceptional Drought	44 +	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies	Less than -2	D4	-5.0 or less

Source: National Drought Mitigation Center

Excessive Heat

NOAA defines extreme heat as a combination of high temperatures (significantly above normal) and high humidity. At certain levels, the human body cannot maintain proper internal temperatures and may experience heat stroke. The "Heat Index" is a measure of the effect of the combined elements on the body, Table 8-2. NOAA also states that heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes, and hurricanes combined. In the disastrous 1980 US Heat Wave, more than 1,700 people died. In the heat wave of 1995, more than 700 deaths in the Chicago area were attributed to heat. In August 2003, a record heat wave in Europe claimed an estimated 50,000 lives.

Table 8-2: National Weather Service Forecast Office - Possible effects of heat on higher risk groups.

Heat Index	Possible Heat Disorders For People In Higher Risk Groups
130 or higher	Heatstroke/sunstroke highly likely with continued exposure.
105-130	Sunstroke, heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.
90-105	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity.
80-90	Fatigue possible with prolonged exposure and/or physical activity.

Source: NOAA

Drought & Excessive Heat Hazard Risk & History

Drought

The 2021 State of Maryland Hazard Mitigation Plan ranks Caroline County as “Medium-High” for drought. Since the 2016 State Plan, no federally declared drought events have occurred in Maryland. The Hazard Mitigation Planning Committee was concerned about drought. Historically Caroline County is listed as one of six counties within Maryland to have the highest number of drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses.

The worst drought in Maryland occurred from December 1929 to February 1931, with 1930 being the driest year since 1869 (U.S. Weather Bureau 1930). During this 15-month agricultural drought, rainfall was 21.5 inches below normal. Crop losses in 1930 dollars were estimated at $40 million. In June 2010, unseasonably hot weather made June the second hottest June on record in Maryland. In addition, on September 9, 2010, the Maryland Department of the Environment issued a drought watch for the Maryland Eastern Shore except Cecil County. Furthermore, the Maryland Department of Natural Resources Forest Service advised against outdoor burning until the state received significant steady rainfall of one inch or more. It was the hottest summer on record in the State of Maryland. The drought and summer heat took its toll on Eastern Shore farmers and the United States Secretary of Agriculture, Thomas Vilsack, declared all counties in the Eastern Shore natural disaster areas.

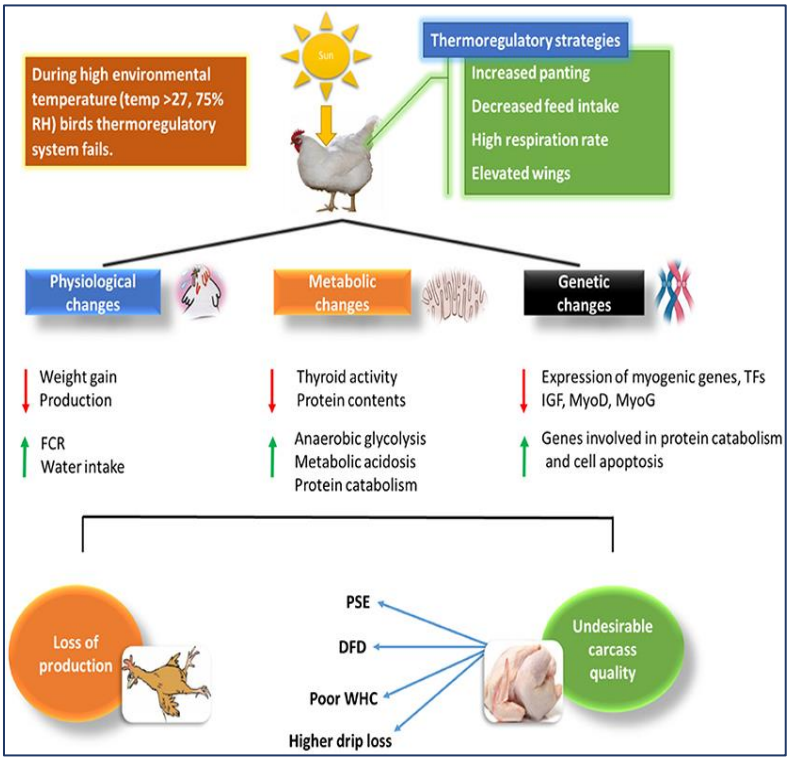
Recently, the most oppressive (combination of heat and humidity) hot spell of the summer season affected the Eastern Shore from July 15, 2015 through July 20, 2015. Widespread high temperatures reached into the mid-90s, and the most oppressive days occurred on the 18th and 19th. Afternoon heat indices reached near 110 degrees.

Maryland generally experiences average to higher-than-average stream flow. However, it is normal for Maryland to experience drought cycles as well. In 2002, 72 average monthly low stream flow records were set across Maryland. In 2000, more wells broke monthly record lows than any other recorded period. In 1966, the worst year of the 1958-1971 droughts, 32 monthly low stream flow records were set. Between the years of 1951 -1999, streams flowing into the Chesapeake Bay in 1999 had the fourth lowest annual flow. Lower flows were experienced only in 1963, 1965, and 1966.

The primary effect of these prolonged dry periods has been felt by the agricultural community. Agriculture is the largest commercial industry in Maryland, employing about 350,000 people on almost 13,000 farms covering two million acres. Water supply has also been affected, particularly where ground water is relied on to supply community systems as well as for the agricultural industry which relies on ground water for crop irrigation. Maryland is expected to experience an increase in short-term droughts in the summer.

Warming temperatures will affect the farming industry, such as poultry. According to the Maryland Food System Map, Figure 8-1, 14% of Maryland's poultry farms are located in Caroline County.

Figure 8-1: Excessive Heat Impact on Poultry Industry



Source: https://www.frontiersin.org/articles/10.3389/fvets.2021.699081/full

In terms of total occurrences, the NWS, NCEI listed 60 drought events affecting Caroline County from 1997-2023, Table 8-3. Therefore, Caroline County experiences on average 2.31 drought events per year. Since the last Plan update there have been no new drought events recorded for Caroline County.

Table 8-3: Drought Events

Drought – 1997-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
60	0	0	0	2.31

Source: NWS, National Centers for Environmental Information (NCEI), as of June 2023.

Excessive Heat

The National Weather Service, National Centers for Environmental Information (NCEI) operating under National Oceanic and Atmospheric Administration reported the following excessive heat and heat events for Caroline County.

Table 8-4: Heat and Excess Heat Events

Heat Events – 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
59	9	0	0	2.19
Excessive Heat Events – 2000-2023				
# of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
16	0	0	0	0.70

Source: NWS, National Centers for Environmental Information (NCEI), as of June 2023

In terms of occurrences, the NWS, NCEI listed a total of 16 excessive heat events affecting Caroline County from 2000-2023. Therefore, Caroline County experiences an average of 0.70 extreme heat events per year. The NWS, NCEI also reported 9 injuries from heat events. Since the last plan the frequency of extreme heat events in Caroline County has decreased from 1.45 to 0.70 but still remains prevalent as a potential hazard risk. Projections for increased high heat events in the Northeast Region of the United States may affect the current frequency statistics resulting in an even higher likelihood of occurrences. Mitigating current conditions based on hazard risk is important, however, understanding of future conditions is essential.

Drought & Excessive Heat Vulnerability

According to the most recent Caroline County Comprehensive Plan, groundwater sources in Caroline County include the Piney Point, Columbia, and Aquia Aquifers, and the Chesapeake Group, which includes aquifers within the Calvert and Choptank Formations.

Aquifers within the Choptank and Calvert Formations yield small amounts of water, primarily to shallow; domestic wells. The Columbia aquifer is the surficial aquifer on most of the Eastern Shore. The Piney Point aquifer is tapped by wells in an area of about 40 miles wide between Caroline and St. Mary's Counties and is a major water source for Caroline County. The Aquia Aquifer is a major water source for parts of the Eastern Shore (including northern Caroline County), southern Maryland, and Anne Arundel County.

In the western half of Caroline County, which contains gently rolling, well-drained land, the water table lies between 10 and 30 feet below the surface. The eastern half of the County is comparatively flat with poorly drained land, and the water table is generally within 10 feet of the surface.

There are no impoundments used for water supply in Caroline County; residents rely exclusively on groundwater for water supply. While not frequent, extended periods of little or no precipitation are not uncommon in Caroline County, resulting in decreased stream flows and groundwater levels.

In addition, it is evident from past events that extreme heat is dangerous and can cause human related illnesses and death. As temperatures go up so do the number of people hospitalized for heat related illnesses.

Therefore, it is important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Additionally, extreme heat can cause damage to buildings or contents by overheating HVAC or air conditioning systems, contributing to jurisdictional losses. It is unlikely that an entire building would be impacted in an extreme heat event, though.

Vulnerability and Impacts to People, Systems, and Resources from Drought & Excessive Heat

To describe the impacts of drought and excessive heat on Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update, Table 8-5.

Table 8-5: Drought & Excessive Heat Vulnerability and Impacts to People, Systems, and Resources

People	• Lack of adequate amounts of water during a drought event, combined with an extreme heat event, will impact all people negatively, but especially the oldest and youngest amongst residents. • According to the National Risk Inventory, the Expected Annual Loss Rating for Drought is Relatively Moderate. *Note: Expected Annual Loss scores for hazard types are calculated using data for only a single hazard type and reflect a community's relative expected annual loss for only that hazard type*. • Populations aged 65 and older are most at-risk for extreme heat. The highest socially vulnerable populations are located in the northeast and southeast portions of Caroline County. One of the factors included in the determining social vulnerability using the CDC Social Vulnerability Index, Figure 8.1, is age. • Other at-risk populations are those with health problems such as asthma and other breathing issues. • Power outages caused by extreme heat exacerbate heat related disorders due to lack of air conditioning.
Systems (including networks and capabilities)	• Long-term economic impacts to the agricultural economy are caused by drought, specifically crop damages. • According to the National Risk Inventory, Agriculture Expected Annual Losses Rate (per agriculture value) for Caroline County is $1 per $135.01. • Extreme heat has been known to create problems with utility services, such as power outage due to stress on power systems. • Outages impact the availability of emergency and government services.
Natural, Historic, and Cultural Resources	• Increased withdrawal of ground water for irrigation may lead to saltwater intrusion and depressed water table. • Shrink and swell cycle of soils may lead to decrease in soil health, pipe damage, and damage to foundations. • Lower water levels impact waterfowl. • Loss of surface water inputs to ponds, swimming area closures, and loss of habitat/biodiversity (inland aquatic habitat). • Extreme heat can cause stress to local wildlife. • Warming water temps lead to less dissolved oxygen, which harms fish and crabs. Loss of surface water inputs to ponds, swimming area closures, and loss of habitat/biodiversity (inland aquatic habitat).

While extreme heat effects the entire County and all municipalities, socially vulnerable populations are more likely to be impacted. The elderly, just like small children, are more susceptible to temperature extremes. Additionally, buildings of significant age may be more susceptible to temperature extremes from extreme heat. Facilities need to be maintained to ensure that they operate in appropriate conditions for people. Temporary periods of extreme hot temperatures typically do not have significant environmental impact. However,

prolonged periods of hot temperatures may be associated with drought conditions and can damage or destroy vegetation, dry up rivers and streams, and reduce water quality.

Social Vulnerability

Social Vulnerability refers to the socioeconomic and demographic factors that affect the ability for communities to respond to hazardous events. The CDC Social Vulnerability Index utilizes sixteen factors from the 2020 US Census to determine four common themes that summarizes the extent in which a specific area within Caroline County is socially vulnerable to disaster. This includes but is not limited to economic data, education, housing, language ability, ethnicity, and vehicle access. The overall social vulnerability depicted in the figure below combines all of these variables to provide a comprehensive assessment. Due to the poorly drained land, and water table within ten feet of service in the eastern portion of the County, this area is more susceptible to drought. Both the northeast and southeast portion are shown to have the highest social vulnerability per Figure 8-2.

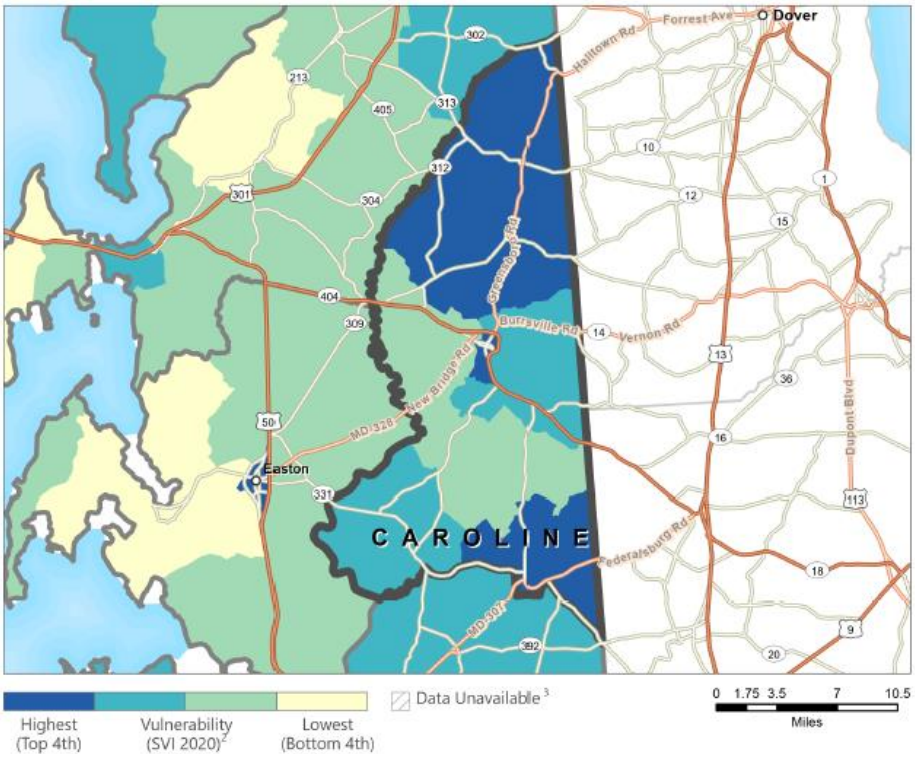


Figure 8-2: CDC Overall Social Vulnerability for Caroline County

Source: CDC/ATSDR Social Vulnerability Index
https://svi.cdc.gov/Documents/CountyMaps/2020/Maryland/Maryland2020_Caroline.pdf

Future Vulnerability

Increasingly frequent drought conditions have long been forecasted as a consequence of warming temperatures, but a study from the National Center for Atmospheric Research (NCAR) projects serious impacts as soon as the 2030's. Impacts by century's end could go beyond anything in the historical record.

Scientists use a measure called the Palmer Drought Severity Index (PDSI) to measure drought as introduced in Table 8-1. A positive score indicates wetter conditions, and a negative score indicates drier conditions; a score of zero is neither overly wet nor dry. According to the NCAR study, the most severe drought in recent history, in the Sahel region of western Africa in the 1970s, had a PDSI of -3 or -4. By contrast, the study indicates that by 2100 some parts of the U.S. could see -8 to -10 PDSI. By the 2030's, the central and western U.S. could see average readings dropping to -4 to -6, the study projected. At present, most of the Northeast (including Maryland) is expected to see only slightly drier conditions by the end of the 2030's, that is, a decreasing PDSI of -0.5 to -1.0. Short-term drought forecasting (e.g., daily, weekly, and up to 3 months) is completed by NOAA via the National Integrated Drought Information System (NIDIS) and is available at www.Drought.gov.

In regard to extreme heat, the Center for Climate and Energy Solutions reported the following information regarding extreme heat and climate change. During the past decade, daily record high temperatures have occurred twice as often as record lows across the continental United States, up from a near 1:1 ratio in 1950. By midcentury, if greenhouse gas emissions are not significantly curtailed, scientists expect 20 record highs for

every low. The ratio could be 50:1 by the end of the century. By the 2050's, many of the Mid-Atlantic States including urban parts of Maryland and Delaware could see a doubling of days per year above 95 degrees F. Extreme heat can also increase the risk of other types of disasters. When heat occurs in conjunction with a lack of rain, drought can occur. This, in turn, can encourage more extreme heat, as the sun's energy acts to heat the air and land surface, rather than to evaporate water. Hot dry conditions also increase the risk of wildfires, like the ones in 2013 in Colorado that were fueled by record high heat and an ongoing drought. Highlights from the April 2016 Maryland Climate and Health Profile produced by the Maryland Department of Health indicate that the occurrence of summertime extreme heat events more than doubled during the 1980's, 1990's, and 2000 in Maryland compared to the 1960's and 1970's. Modeling indicates that extreme heat events are projected to rise across all counties in Maryland into 2040. Additional highlighted data includes:

- Extreme heat events increased the risk of heart attacks in Maryland by 11%.
- The increase in heart attack related extreme heat events was much higher among non-Hispanic blacks compared to non-Hispanic whites (27% vs. 9%).
- Compared to 2010, increases in the frequency of extreme heat events during summer months in 2040 are projected to result in a higher rate of hospitalization for heart attack in Maryland.
- Compared to 2010, increases in the frequency of extreme heat events during summer months in 2040 are projected to result in a higher rate of hospitalization for asthma in Maryland.

Chapter 9 Thunderstorm

Hazard Ranking

- **Hazard Mitigation Planning Committee**
  Concerned
- **Municipalities**
  - Denton – Concerned
  - Federalsburg – Somewhat Concerned
  - Goldsboro – Concerned
  - Greensboro – Somewhat Concerned
  - Henderson – Very Concerned
  - Hillsboro – Not Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Very Concerned
  - Templeville –Concerned
- **State**
  Thunderstorm – Medium
  Thunderstorm Wind – Medium-High
- **National**
  Thunderstorm – Relatively Low
- **Public**
  Thunderstorm – Somewhat Concerned

Public Survey Responses

- 62% of residents have experienced damage from thunderstorm.
- 5% of residents have installed high impact windows or doors to withstand high winds and 49% have removed dead/drying trees and vegetation from around the home as mitigation measures.
- 66% of participants feel their community is at risk to thunderstorms.
- Participants indicated the county should maintain trees near power lines.

Chapter Updates

- Characteristic information was updated with current information.
- New images have been included.
- History event data has been updated with the most current available data.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Discussion on aquifers has been included in the vulnerability section.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.

Introduction

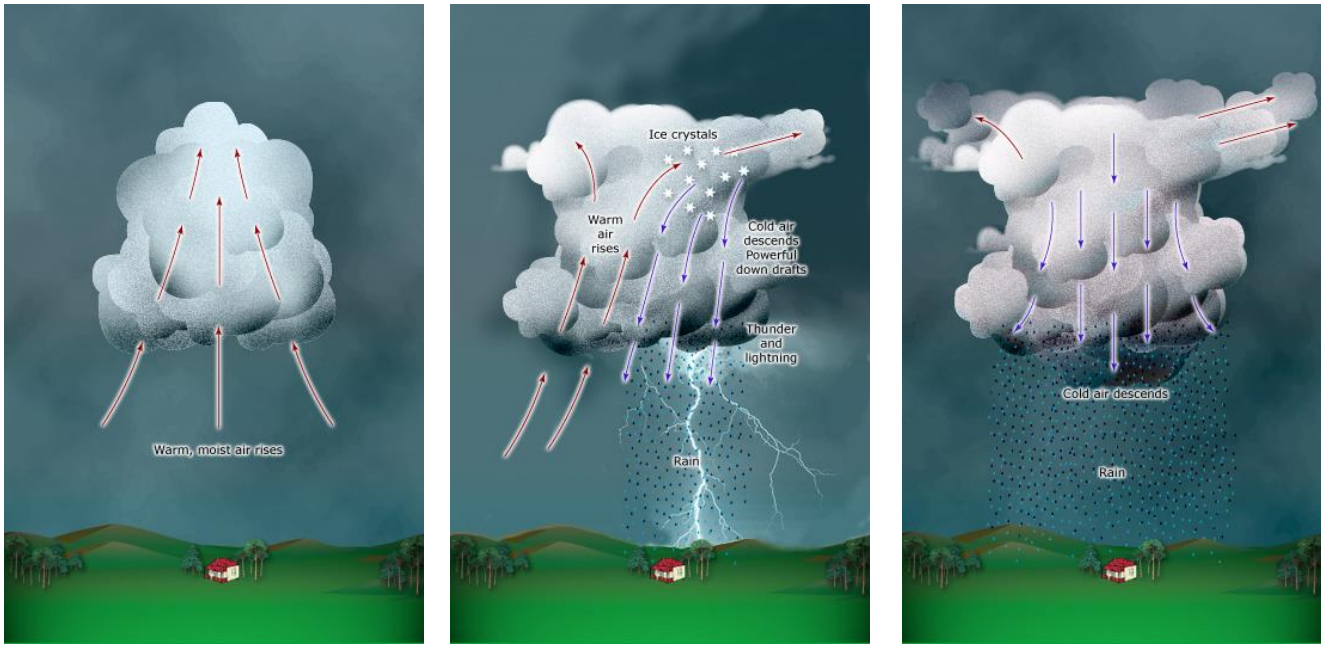
Thunderstorm as described herein includes thunderstorms, lightning, high wind, and hail. The effects of thunderstorms, hail, lightning, and high wind may cause many different impacts including power outages, communication failures, road closures, and loss of infrastructure. These hazards do not have a well-defined geographic extent and are therefore random in nature and can occur anywhere in the County and with equal potential to impact municipalities.

Thunderstorm Hazard Characterization

Thunderstorms are generally high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. The process of convection in the atmosphere brings about the release of moisture from the warm air mass as it rises, cools, and condenses. This condensation proceeds until most of the moisture in the air mass has been precipitated. Since the motion of the air is nearly vertical, and attains high velocities, rainfall is intense and generally concentrated over a small area in a brief period. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes.

The National Weather Service (NWS) considers a thunderstorm severe only if produces wind gusts of at least 58 mph or higher, hail at least 1 inch in diameter, or tornados. Furthermore, “downbursts” cause high winds in a thunderstorm. Downburst winds result from the sudden descent of cool or cold air toward the ground. As the air hits the ground, it spreads outward, creating high winds. Unlike tornadoes, downburst winds move in a straight line, without rotation.

Figure 9-1: Thunderstorm Formation



This diagram sequence shows the stages in the development of a thunderstorm:

Stage 1: Warm moist air is forced upwards, forming a cumulus cloud.

Stage 2: The warm air meets very cold air in the middle levels of the atmosphere. The two air masses collide, creating thunder and lightning.

Stage 3: Eventually the warm moist air condenses as rain and the storm dies out.

Source: Terra - How a Thunderstorm Forms

According to NOAA, hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice. Hail is only formed during a thunderstorm event. Property damage, specifically crop damage, can be caused because of hail. Nationally, hail causes approximately $1 billion in damage to property and crops each year. In fact, on April 10, 2001, hail caused $2 billion in damage to Kansas City. Due to the complexities and numerous factors involved in the formation of hail, particle size and weight can vary tremendously. The typical size of hail is less than 2 inches in diameter; however, in June of 2015, a thunderstorm event in Baltimore County generated hail up to 4 inches in diameter.

Property damage of $50,000 was reported from a hail event in 1993 by the NCEI for Caroline County. No crop damage was reported. Most hail events that have occurred in Caroline County are before the peak of the growing season. In more recent years, there is an increasing trend in thunderstorm events, which could potentially cause more severe damage.

Thunderstorm Hazard Risk & History

Between 1956 and 2023, the NCEI reported 138 thunderstorm wind events that have occurred in Caroline County giving a frequency of 2.06 possible thunderstorm wind events per year, Table 9-1. However, in recent years, thunderstorm wind events have increased significantly. Reviewing NCEI thunderstorm wind data between 2012 and 2023, a total of 70 events occurred in the County, which is a frequency of 6.36 events per year. Considering future conditions, these events are likely to become more frequent or more intense with human-induced climate change.

Table 9-1: Thunderstorm Wind Events

Thunderstorm Wind Events– 1956-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
138	0	0	405.00K	2.06

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Thunderstorms can also produce lightning and high winds. The NCEI reported the following lightning and high wind events for Caroline County. In terms of number of occurrences, the NCEI listed a total of 8 lightning events impacting the County from 1996-2023. Therefore, Caroline County experiences on average 0.30 lightning events per year, Table 9-2.

Table 9-2: Lightning Events

Lightning Events – 1996-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
8	1	0	59.00k	0.30

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Between 1999 and 2023, the NCEI reported 7 high wind events that have occurred in Caroline County giving a frequency of 0.29 possible high wind events per year, Table 9-3.

Table 9-3: High Wind Events

High Wind – 1999-2023 *High Wind Events 50kts Or Stronger*				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
7	0	0	26.50K	0.29

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Between 1999 and 2023, the NCEI reported 7 high wind events that have occurred in Caroline County giving a frequency of 0.29 possible high wind events per year, Table 9-4.

Table 9-4: Hail Events

Hail Events – 1991-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
15	0	0	50.00k	0.47

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Thunderstorm Vulnerability

Winds associated with thunderstorms can cause damage to buildings, down trees which can block roads, and cause power outages from downed poles and lines. Annualized events for this hazard are high when compared to other hazards; most events cause little or no damage to buildings such as critical and public facilities.

Vulnerability and Impacts to People, Systems, and Resources from Thunderstorm

To describe the impacts of thunderstorms to Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update, Table 9-5.

Table 9-5: Thunderstorm Vulnerability and Impacts to People, Systems, and Resources

People	• Power outages associated with high winds and thunderstorm lightning create vulnerable groups of people, particularly those that rely on at home medical equipment. • People may be directly injured by lightning strikes or hail strikes. • Flying debris caused by high winds may injure citizens. • Property is also likely to be damaged by high wind, large hail, and lightning strikes. • Damage to infrastructure (electric, cable, internet) negatively impacts businesses. • Trees and debris pose a risk to property if they are damaged and fall on structures. • Blocked roadways from large debris prevent people from traveling to work, school, or medical facilities. • Lack of communication affects the ability of emergency services to respond to vulnerable populations in the event of an emergency. • Without power those with illnesses requiring life saving devices reliant on said power become at-risk.
Systems (including networks and capabilities)	• Outages impact the availability of emergency and government services. • Communication may be damaged or delayed in the event of damage to this infrastructure system. • Public safety radio can be knocked out during high wind events, which cripples citizen alerts and warnings. • Emergency and medical personnel must contend with possible roadblocks from large debris as result of high winds. This slows down overall care during a hazard event.
Natural, Historic, and Cultural Resources	• Habitat loss in the form of damaged trees from high wind, lightning strikes, or wildfires resulting from lightning strikes. • Historical structures that are not built to modern building code are more likely to be damaged from hail, particularly structures with large glass installations. • Debris fields/marine debris become a hazard to divers, boaters, and watermen.

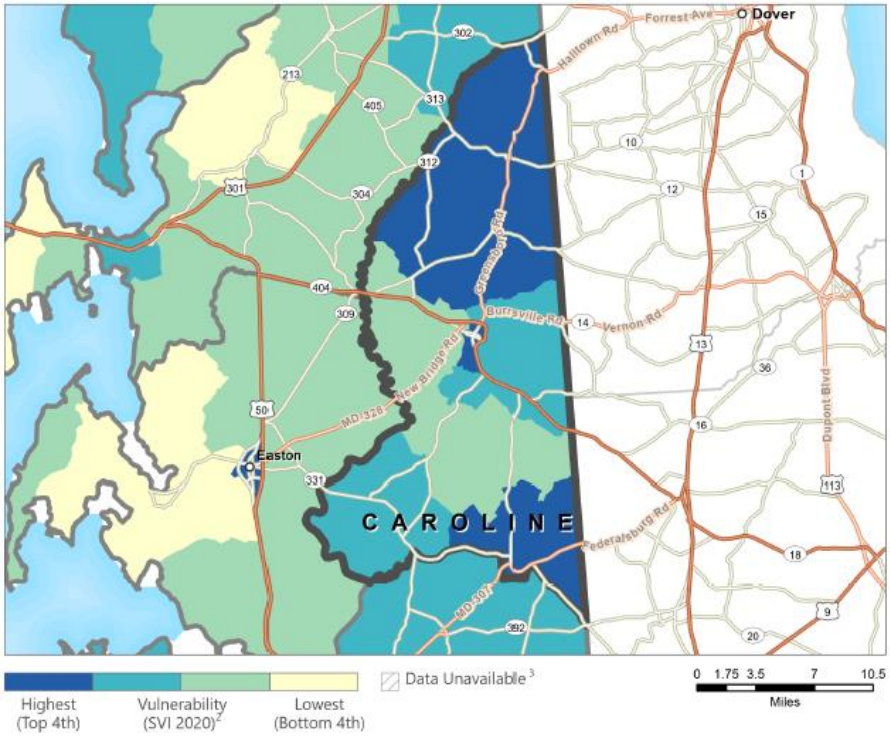
	• Damage to water quality and stormwater BMPS, which presents both an economic impact and an impact to the overall ability of the BMP to do its job. • Loss of power affects communication (cable, internet) and negatively impacts businesses located in historic structures/districts.

Social Vulnerability

Social Vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities. In disaster events the socially vulnerable are more likely to be adversely affected. The capacity to anticipate, cope with, resist, and recover from a disaster determines which of the population is most vulnerable.

In terms of thunderstorms, impacts such as power outages, loss of communication, damage to infrastructure, road blockages, and loss of water supply affect our socially vulnerable populations the most. An example of socially vulnerable populations includes those without access to health insurance, burden of housing costs, elderly civilians, and children. Figure 9-2 shows the Overall Social Vulnerability status for residents in Caroline County.

Figure 9-2: CDC Overall Social Vulnerability for Caroline County



Source: CDC/ATSDR Social Vulnerability Index
https://svi.cdc.gov/Documents/CountyMaps/2020/Maryland/Maryland2020_Caroline.pdf

The northern and southern portions of the County, including the Towns of Marydel, Henderson, Goldsboro, Greensboro, Denton, and Federalsburg are areas with the highest social vulnerability. These areas may be more vulnerable to thunderstorms, hail, wind, and tornado hazard impacts. These areas of concern should contain tornado warnings systems/sirens.

Future Vulnerability

High winds accompany tropical cyclones, thunderstorms, and tornadoes. It is known that climate change will increase the intensity and frequency of tropical cyclones and thus the high wind associated with these events. However, as is the case with tornadoes, it is not well known how climate change might impact the strength and frequency of thunderstorm wind.

Climate modeling predicts that conditions conducive to severe thunderstorms will arise more often as the Earth warms. Modeling suggests that weather conditions which lead to severe storms will rise 5% to 20% more often per one degree Celsius of global temperature change, primarily due to increased atmospheric instability.

However, because severe storms do not always arise even in the most favorable conditions, any associated increase in severe thunderstorms is expected to be smaller. Compared with other regions, the Northern Hemisphere is predicted to experience the largest increase in convective environments (i.e., environments favorable to creating severe storms).

Given this information, the future annual average rate of thunderstorms can be estimated for Caroline County given two possible scenarios considering the incidence of 7 thunderstorm events annually. The most conservative scenario – a 5% increase in severe weather conditions – would mean the County would average approximately 7.35 thunderstorm events per year in the future. In the most extreme scenario – a 20% increase in severe weather conditions – the County would average approximately 8.4 thunderstorm events per year in the future.

Chapter 10 Tornado

Hazard Ranking

- **Hazard Mitigation Planning Committee**
  Somewhat Concerned
- **Municipalities**
  - Denton – Somewhat Concerned
  - Federalsburg – Somewhat Concerned
  - Goldsboro – Somewhat Concerned
  - Greensboro – Somewhat Concerned
  - Henderson – Somewhat Concerned
  - Hillsboro – Not Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Very Concerned
  - Templeville – Concerned
- **State**
  Medium-Low
- **National**
  Very Low
- **Public**
  Somewhat Concerned

Public Survey Responses

- 8% of residents have experienced damage from tornadoes.
- 5% of residents have installed high impact windows or doors to withstand high winds and 49% have removed dead/drying trees and vegetation from around the home as mitigation measures.
- 43% of participants feel their community is at risk to tornado.
- Participants indicated the county should maintain trees near power lines.

Chapter Updates

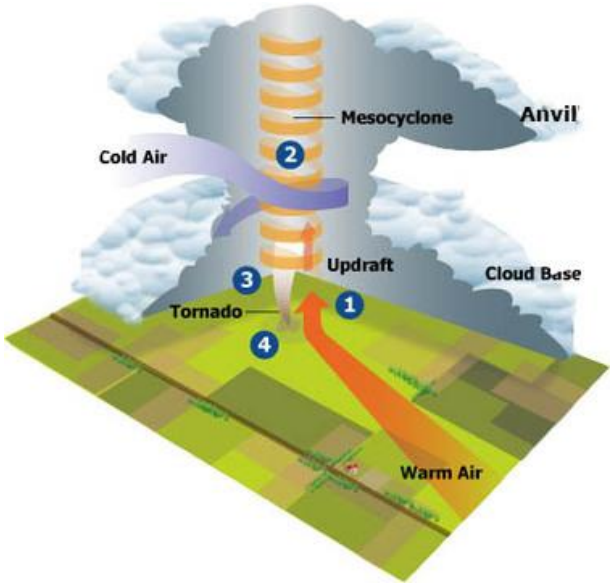
- Characteristic information was updated with current information.
- New images have been included.
- History event data has been updated with the most current available data.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Discussion on aquifers has been included in the vulnerability section.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.

Tornado Hazard Characterization

A tornado is defined by Strahler in his Physical Geography Text as a violently rotating column of air extending from a thunderstorm to the ground. Normally thunderstorms and tornados develop in warm, moist air in advance of strong eastward moving cold fronts in late winter and early spring. Tornados can also occur along a "dryline" which separates very warm, moist air to the east from hot, dry air to the west. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore.

According to NOAA, tornados were previously measured on the Fujita Scale (F-Scale), named for Dr. Tetsuya Theodore Fujita. The operational Fujita scale ranges from an F0 to an F5. The strongest tornadoes observed to date have been F5 (winds between 261-318 mph). A new Enhanced Fujita Scale (EF Scale) was developed and employed by the NWS in 2007. The EF Scale is a set of wind estimates (not measurements) based on damage. The new scale uses three-second gusts estimated at the point of damage based on 28 detailed damage indicators.

Figure 10-1: Tornado Formation



Source: Tornados and How They Form

Table 10-1: Fujita Scale and Enhanced Fujita Scale

Fujita Scale			Enhanced Fujita Scale	
F Number	Fastest ¼ mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85
1	73-112	79-117	1	86-110
2	113-157	118-161	2	111-135
3	158-207	162-209	3	136-165
4	208-260	210-261	4	166-200
5	261-318	262-317	5	Over 200

Source: NOAA

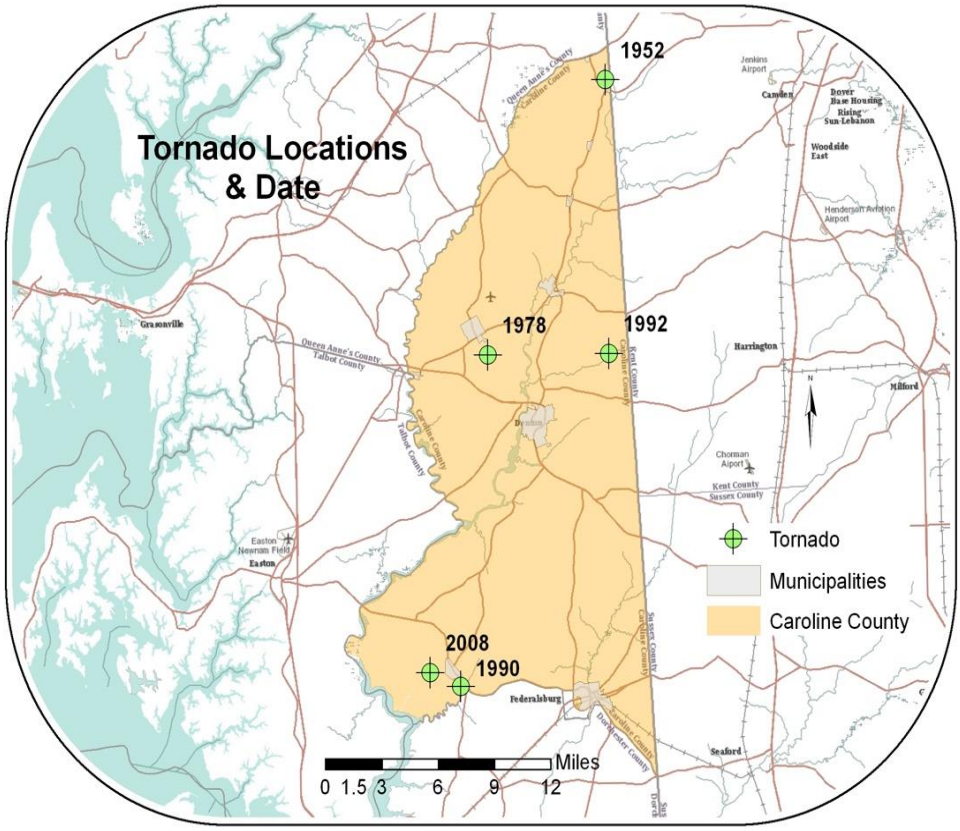
Local *National Weather Service* (NWS) offices are responsible for issuing tornado warnings. Tornado warnings indicate that a tornado has been spotted or that Doppler radar detects a thunderstorm circulation capable of spawning a tornado. Nationally, tornado season is from March through August.

According to the *State of Maryland 2021 Hazard Mitigation Plan*, tornadoes are one of the top five hazards that impact Maryland. According to an article in *US Tornadoes*, July is the peak month for activity in Maryland. Maryland averages about four and a half tornado events annually, although, in 1995 there were 24 reported tornados for the State. Counties west of the Chesapeake Bay generally experience a higher frequency of tornados than those on the Eastern Shore. Tornadoes do not have a well-defined geographic extent and are therefore random in nature and can occur anywhere in the County and with equal potential to impact municipalities.

Tornado Hazard Risk & History

Between 1952 and 2023, there have been a total of five tornados reported in Caroline County and two funnel clouds. Additional information on these events is provided within the composite tables below, while Map 9-1 details the areas of tornado impact within Caroline County.

Map 10-1: Tornado Locations



In terms of total occurrences, the NCEI listed five (5) tornado events occurring in Caroline County from 1952-2023, Table 10-2. Therefore, Caroline County experiences 0.07 tornado events per year. NCEI also reported two (2) funnel clouds within Caroline County between 2002 and June 2023. In addition, projections for increased extreme weather in the Northeast Region of the United States may affect the current frequency statistics resulting in an even higher likelihood of occurrences. Mitigating current conditions based on hazard risk is important, however, understanding of future conditions is essential.

Table 10-2: Tornado Events

Tornado Events – 1952-2023				
# Of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
5	0	0	375.25K	0.07

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Table 10-3: Funnel Clouds Events

Funnel Cloud Events – 2002-2023				
# of Events	**Injuries**	**Deaths**	**Damages**	**Frequency**
2	0	0	0	0.10

Source: National Centers for Environmental Information (NCEI), Events through June 2023

Tornado Vulnerability

According to data from the NCEI, there has been $375,300 in property damage due to tornado activity. The entire state of Maryland is subject to the possibility of strong tornados. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County. However, all new development within Caroline County is required to withstand 100 mph wind speeds.

Vulnerability and Impacts to People, Systems, and Resources from Tornado

To describe the impacts of tornado to Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update, Table 10-4.

Table 10-4: Tornado Vulnerability and Impacts to People, Systems, and Resources

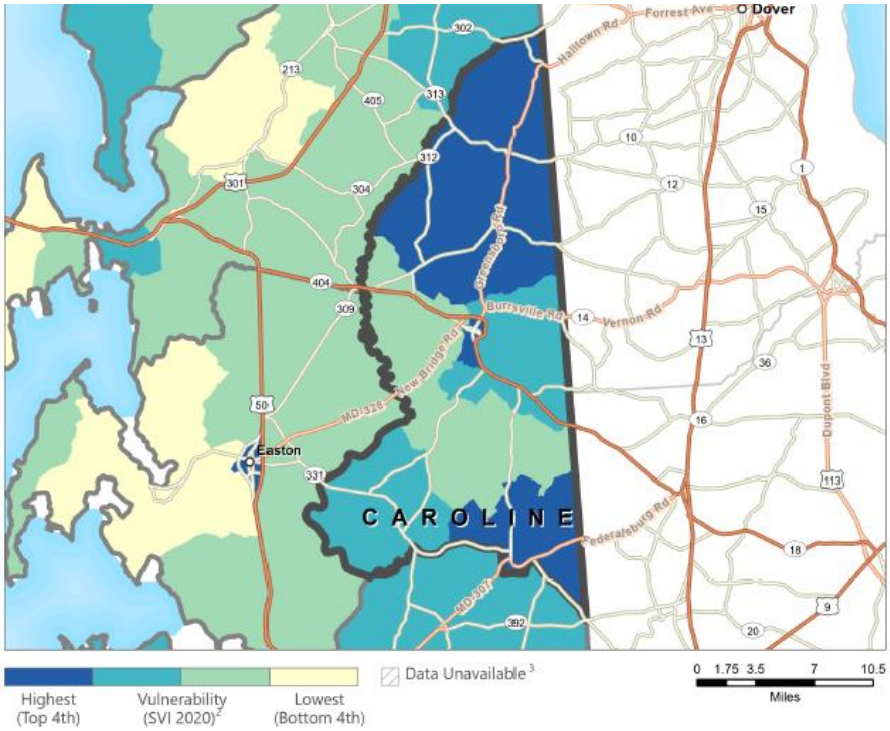
People	• Trees and debris pose a risk to property if they are damaged and fall on structures. • Blocked roadways from large debris prevent people from traveling to work, school, or medical facilities. • Power outages caused by high winds associated with tornadoes create vulnerable groups of people. • People may be injured by tornadoes, particularly from flying debris or getting caught in the tornadoes path or a collapsing building. • Property is also very likely to be damaged if it is within the path of a tornado or waterspout. • Damage to infrastructure (electric, cable, internet) negatively impacts businesses. • Lack of communication affects the ability of emergency services to respond to vulnerable populations in the event of an emergency. • Without power those with illnesses requiring life saving devices reliant on said power become at-risk.
Systems (including networks and capabilities)	• Communication may be damaged or delayed in the event of damage to this infrastructure system. • Public safety radio can be knocked out during tornado events, which cripples citizen alerts and warnings. • Emergency and medical personnel must contend with possible roadblocks from large debris as result of tornadoes. This slows down overall care during a hazard event. • Outages caused by failing power and phone lines impact the availability of emergency and government services.
Natural, Historic, and Cultural Resources	• Historical structures that are not grounded or built to modern building code are more likely to be damaged from hail, particularly structures with large glass installations. • Debris fields/marine debris become a hazard to divers, boaters, and watermen. • Habitat can be damaged or destroyed in the form of damaged trees from a tornado. • Fuel spills from above ground storage tanks are possible if they are not properly secured, which has environmental and water quality consequences. • Damage to water quality and stormwater BMPS, which presents both an economic impact and an impact to the overall ability of the BMP to do its job. • Historic structures, such as churches, monuments, taverns, marinas, and other areas of cultural significance could be destroyed if they are directly in the path of a strong enough tornado. • Loss of power affects communication (cable, internet) and negatively impacts businesses located in historic structures.

Social Vulnerability

Social Vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities. In disaster events the socially vulnerable are more likely to be adversely affected. The capacity to anticipate, cope with, resist, and recover from a disaster determines which of the population is most vulnerable.

In terms of severe weather, impacts such as power outages, loss of communication, damage to infrastructure, road blockages, and loss of water supply affect our socially vulnerable populations the most. An example of socially vulnerable populations includes those without access to health insurance, burden of housing costs, elderly civilians, and children. Figure 10-2 shows the Overall Social Vulnerability status for residents in Caroline County.

Figure 10-2: CDC Overall Social Vulnerability for Caroline County



Source: CDC/ATSDR Social Vulnerability Index
https://svi.cdc.gov/Documents/CountyMaps/2020/Maryland/Maryland2020_Caroline.pdf

During severe tornadoes, socially vulnerable populations face heightened risks due to their physical limitations and financial constraints. These vulnerable groups include the elderly, young children, and individuals with disabilities or specific access needs. Here's why:

- Elderly Individuals: The elderly require extra time to react and move during emergencies. Additionally, they are more likely to need medical attention, which may not be readily available during a storm due to potential isolation.
- Access and Functional Needs: People with disabilities or specific access requirements (such as wheelchair users) may struggle to evacuate promptly during tornadoes.
- Inadequate Warning: Some vulnerable individuals might not receive timely alerts from emergency warning systems (like television or radio broadcasts). This includes both residents and visitors in the affected area.
- Transportation Challenges: Even beyond the immediate disaster zone, those who rely on affected roads for transportation can also be adversely impacted by tornadoes.

It's crucial to consider these factors when planning emergency responses and ensuring the safety of all community members. The areas with the highest social vulnerability should be targeted.

Future Vulnerability

National Geographic states that predicting whether climate change will have an effect on the frequency and power of tornadoes is challenging. Tornadoes are small compared to other extreme weather events, such as hurricanes, which can span hundreds of miles. The largest tornado on record measured “only” 2.6 miles wide. Tornadoes are also very short lived, lasting from a few seconds to a few hours as opposed to days or weeks at a time. These two factors make them very difficult to model in the climate simulations that are used to project the effects of climate change. Instead, scientists must attempt to predict how climate change may impact the individual weather components that support the development of supercell thunderstorms (the type that produce tornadoes). These weather components include:

- warm, moist air;
- an unstable atmosphere; and
- wind shear.

As global temperatures rise, the warmer atmosphere can hold more moisture. This increases atmospheric instability, a vital supercell component. However, as the planet warms, wind shear is likely to decrease. These two forces work against each other, so it is difficult to anticipate which might have a greater impact on tornado formation. The fourth National Climate Assessment summarizes the complicated relationship between tornadoes and climate change: “Some types of extreme weather (e.g., rainfall and extreme heat) can be directly attributed to global warming. Other types of extreme weather, such as tornadoes, are also exhibiting changes which may be linked to climate change, but scientific understanding isn’t detailed enough to project direction and magnitude of future change.” One thing known for certain is that we live in a warmer and wetter world due to climate change, and this is likely to have an effect on extreme weather events, including tornadoes. Unfortunately, in the case of tornadoes we cannot yet predict what that effect might be.

Between 1952 and 2023, the NCEI reported five (5) tornado events in Caroline County. This indicates that the annual probability of encountering a tornado in the region is relatively low. Although the likelihood of being struck by a tornado is minimal, the potential damage from a tornado touchdown can be severe. An F4 tornado, with a 0.01% annual probability, can generate wind speeds of up to 200 mph, exerting a force exceeding 100 pounds per square foot of surface area. This “wind load” surpasses the design limits of most buildings. Given the increase in tornado occurrences on the Eastern Shore, it is possible that Caroline County may experience a rising number of tornadoes in the future.

Chapter 11 Mass Power Outage

Hazard Ranking

- **Hazard Mitigation Planning Committee**
  Concerned
- **Municipalities**
  - Denton – Very Concerned
  - Federalsburg – Concerned
  - Goldsboro – Concerned
  - Greensboro – Concerned
  - Henderson – Concerned
  - Hillsboro – Somewhat Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Very Concerned
  - Templeville – Very Concerned
- **State**
  Not Ranked
- **National**
  Not Ranked
- **Public**
  Power Outages – Somewhat Concerned

Public Survey Responses

- 39% of residents have experienced damage from power outages.
- 5% of residents have installed high impact windows or doors to withstand high winds and 49% have removed dead/drying trees and vegetation from around the home as mitigation measures.
- 61% of participants feel their community is at risk power outages.
- Participants indicated the county should maintain trees near power lines.

Chapter Updates

- Characteristic information was updated with current information.
- New images have been included.
- History event data has been updated with the most current available data.
- Vulnerability and impacts to people, systems, and resources is a new element.
- Discussion on aquifers has been included in the vulnerability section.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.

Mass Power Outage Hazard Characterization

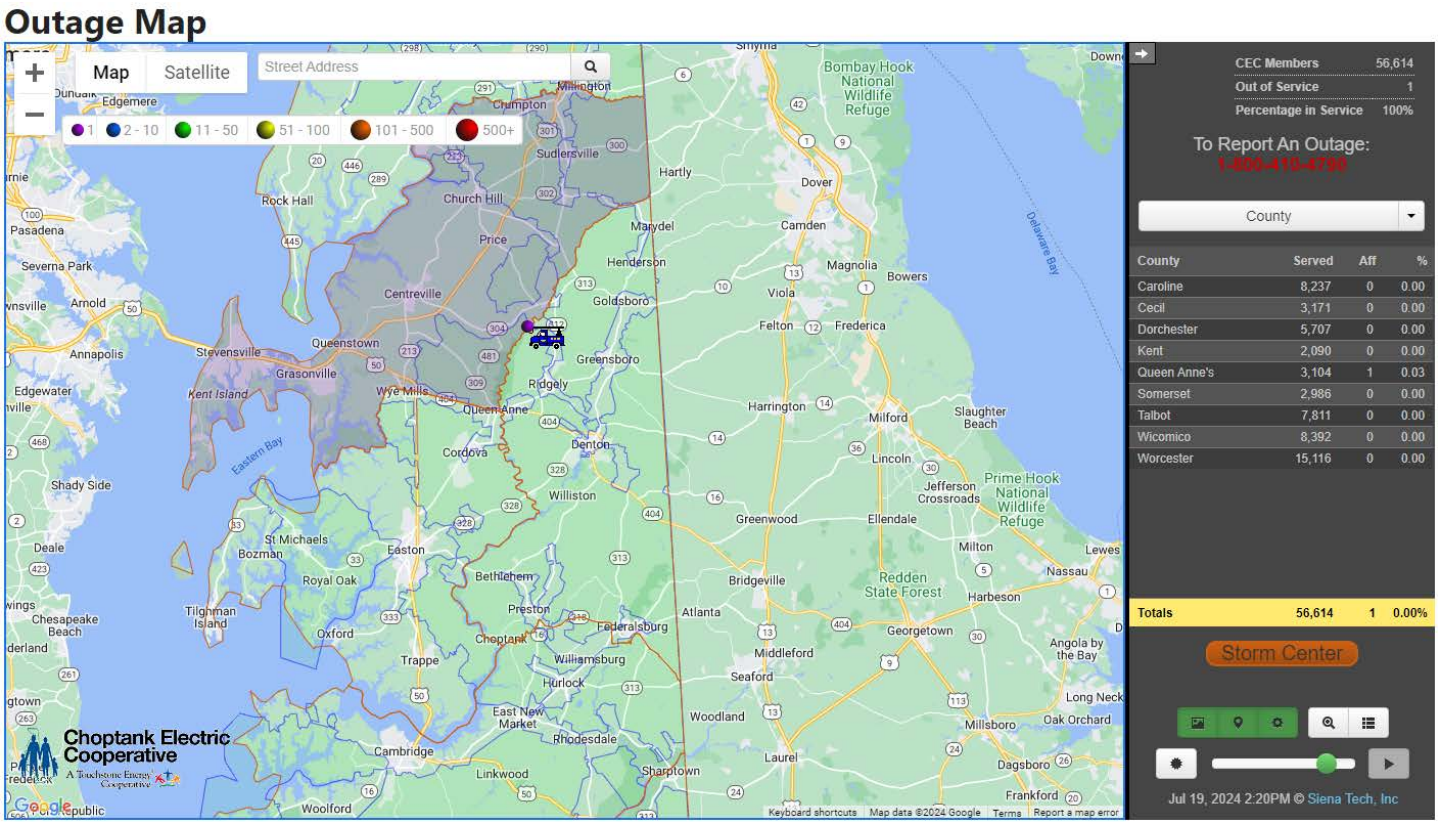
Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Natural causes include strong storms, heat, and sometimes small animals. Strong storms may result in trees or branches falling on power lines. Lightning strikes can damage substations, power lines and equipment. High winds, heavy rains, salt, snow, and ice can damage equipment as well.

In terms of heat, there are several reasons why high temperatures can cause outages. For instance, equipment may overheat, cables may expand and stretch due to the demand for air conditioning resulting in high currents and finally some equipment shuts down to protect itself from high temperatures.

Mass power outages do not have a well-defined geographic extent and can occur anywhere in the County and with equal potential to impact municipalities. Therefore, depending on the severity of the disaster event coupled with mass power outage, poses significant public health and safety risk prompting local emergency management to coordinate resources such as, opening shelters and distributing food and water.

Two utility companies provide power to Caroline County: Delmarva Power and Choptank Electric Cooperative. During mass power outages, each utility company compiles an average interruption time. CAIDI, Customer Average Interruption Duration Index, is an index utilized by electric companies to compute the average outage time period. This method is capable of measuring in units of minutes or hours by calculating the sum of all customer interruption durations then dividing by the total number of customer interruptions. The outcome represents the average length of time that any given customer would experience during a power outage.

Figure 11-1: Choptank Electric Interactive Outage Map



Source: [Choptank Electric Interactive Outage Map]

Mass Power Outage Hazard Risk & History

Mass power outages in Caroline County reported by the Star Democrat, MyEasternShore.com and the County Planning Department that have occurred in recent years include:

- August 19, 1999 – Lightning - Thunderstorms with frequent lightning caused 10,000 homes and businesses to lose power on the Maryland Eastern Shore. Power outages also occurred in northern Caroline County.
- April 15, 2007 – Heavy Rain - The gusty northwest winds on Monday the 16th caused scattered power outages for both Delmarva Power and Choptank Electric Cooperative
- February 7, 2010 – Snowstorm – Weekend snowstorm caused the County to open an emergency shelter and more than 3,000 businesses and residences were without power.
- June 23, 2011 – Thunderstorm – caused power outages across the County.
- June 30, 2012 – Severe Storms – toppled trees cause 1,600 Caroline County Delmarva Power customers to go without power Saturday morning as well as 562 Caroline Choptank Electric customers.
- October 30, 2012 – Hurricane Sandy - about 30 roads were closed, 2,400 residents were still without power and residents of one village were under an advisory to boil water for health concerns.
- February 15, 2015 – High Wind - Peak wind gusts averaged around 55 mph and knocked down or snapped down trees and tree limbs. This caused downed wires and widely scattered power outages.
- March 21, 2018 – Winter Storm - Freezing rain led to ice accretion up to 0.20 across the northern portion of the eastern shore of Maryland, causing downed trees and limbs, which impacted power lines, and lead to power outages.
- July 1, 2021 – Thunderstorms - After a significant heatwave, a cold front approached the mid-Atlantic. This strong upper level forcing combined with the approaching front and a lingering warm, moist air mass ahead of it caused widespread thunderstorm development. Straight line wind damage was the primary hazard, with several reports of downed trees and power outages due to winds.

According to *Choptank Electric*, the average CAIDI over the past seven years was 127.41 for the Caroline County region. The most significant impact that a power outage can have is the inability of businesses and government offices to function properly. Because most power outages occur during severe weather storms, when public emergency services are depended upon by the citizens of the County, it is extremely important that these buildings and offices be equipped with generators to ensure public safety.

Currently, the County is unaware of increased temperatures contributing to grid failure and brown outs. However, due to the probability of increasing high heat events, the County will continue to work with *Choptank Electric* to monitor power outages and trends that may emerge due to changing conditions.

Mass Power Outage Vulnerability

Electrical power is a fundamental commodity of modern life, and its disruption can pose immense consequences for commerce and public health. Power outages, whether caused by natural calamities, aging infrastructure, or physical or cyber-attacks, have profound financial consequences that extend far beyond the immediate inconvenience to households and businesses. When the lights go out, factories halt production, servers go down, and shops close their doors.[i]

Vulnerability and Impacts to People, Systems, and Resources from Mass Power Outages

To describe the impacts of mass power outages to Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update, Table 11-1.

Table 11-1: Mass Power Outage Vulnerability and Impacts to People, Systems, and Resources

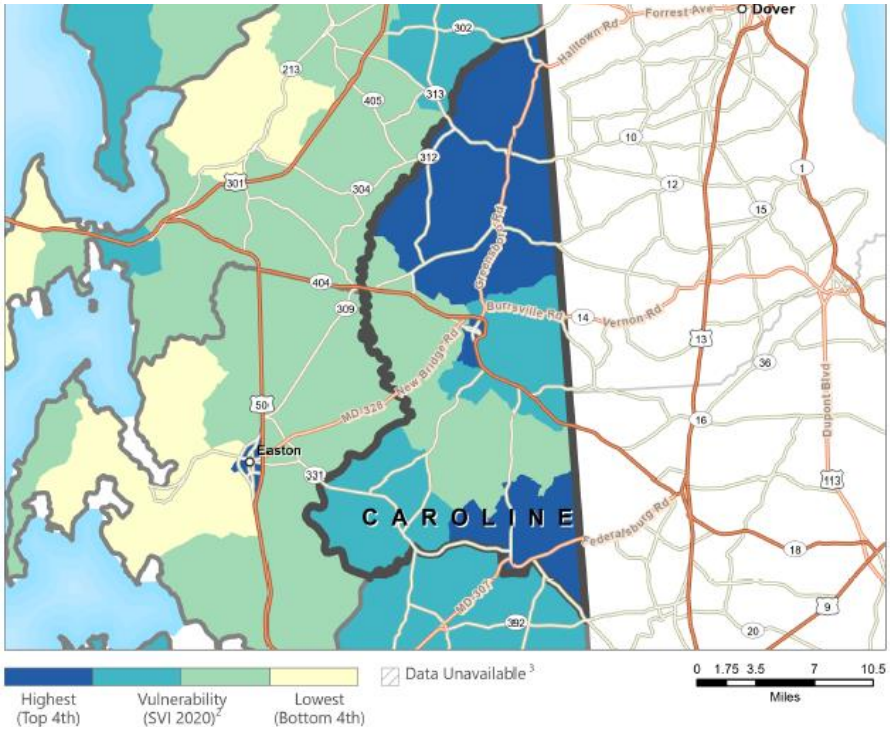
People	• Power outages associated with high winds and thunderstorm lightning create vulnerable groups of people, particularly those that rely on at home medical equipment. • Damage to infrastructure (electric, cable, internet) negatively impacts businesses. • Lack of communication affects the ability of emergency services to respond to vulnerable populations in the event of an emergency. • Without power those with illnesses requiring life saving devices reliant on said power become at-risk. • In the event of a power outage during extreme weather such as cold or heat vulnerable populations without immediate access to backup resources become at-risk.
Systems (including networks and capabilities)	• Communication may be damaged or delayed in the event of damage to this infrastructure system. • Public safety radio can be knocked out during a mass power outage event, which cripples citizen alerts and warnings. • Outages caused by failing power and phone lines impact the availability of emergency and government services. • Communication may be damaged or delayed in the event of damage to this infrastructure system. • Power outages have a ripple effect on supply chains.
Natural, Historic, and Cultural Resources	• Loss of power affects communication (cable, internet) and negatively impacts businesses located in historic structures. • Historic structures, such as churches, monuments, taverns, marinas, and other areas of cultural significance could be impacted power outages.

Social Vulnerability

Social Vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities. In disaster events the socially vulnerable are more likely to be adversely affected. The capacity to anticipate, cope with, resist, and recover from a disaster determines which of the population is most vulnerable.

In terms of severe weather, impacts such as power outages, loss of communication, damage to infrastructure, road blockages, and loss of water supply affect our socially vulnerable populations the most. An example of socially vulnerable populations includes those without access to health insurance, burden of housing costs, elderly civilians, and children. Figure 11-2 shows the Overall Social Vulnerability status for residents in Caroline County.

Figure 11-2: CDC Overall Social Vulnerability for Caroline County



Source: CDC/ATSDR Social Vulnerability Index
https://svi.cdc.gov/Documents/CountyMaps/2020/Maryland/Maryland2020_Caroline.pdf

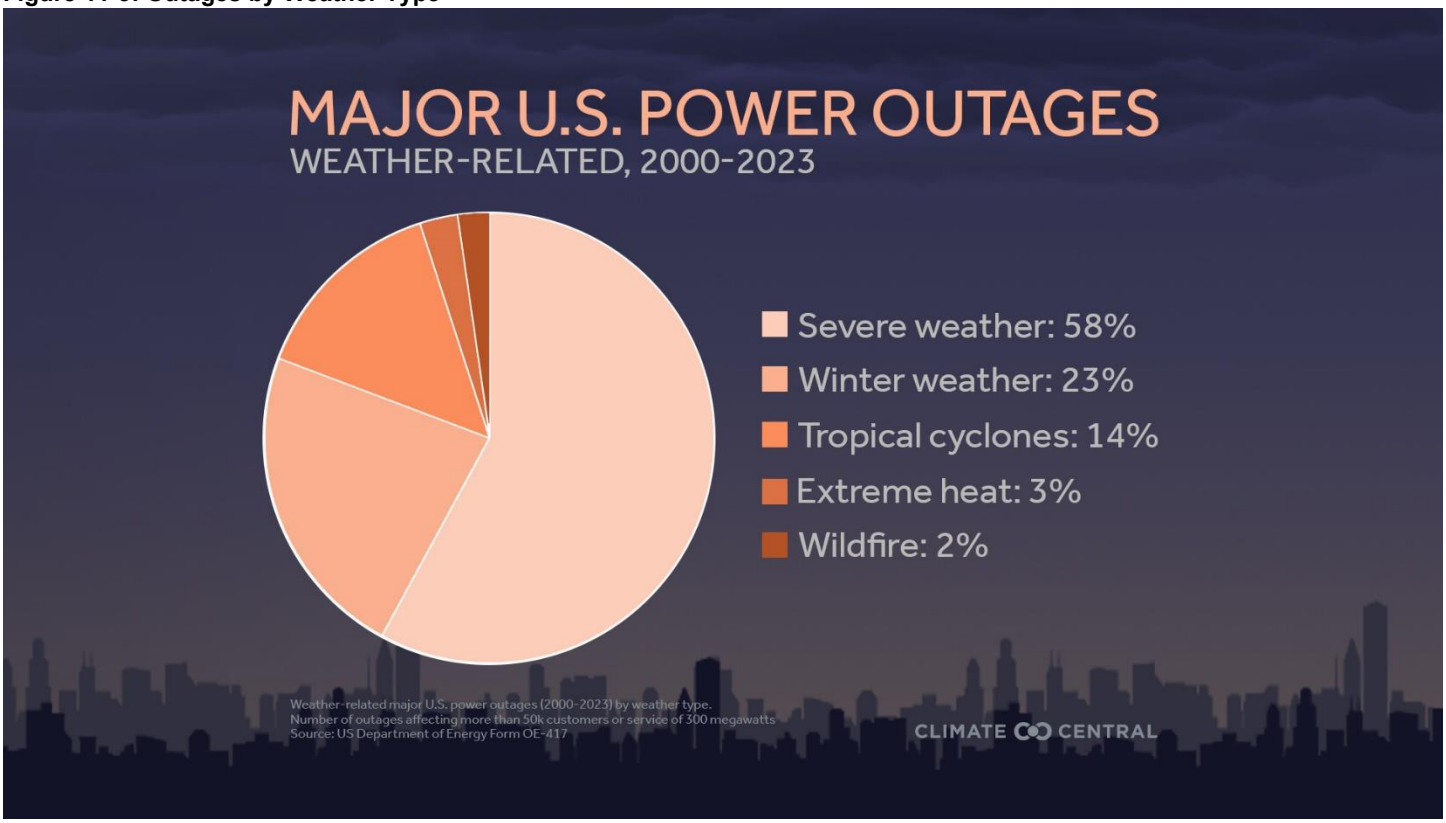
Mass power outages affect socially vulnerable populations the most. For example, in the event of a power outage during a winter storm, exposure to extreme cold can be fatal. To those with preexisting conditions such as the elderly, extreme temperatures, combined with lack of access to life saving devices, and loss of communication to emergency services due to loss of power dramatically exacerbates these issues leaving these at-risk populations most vulnerable.

As discussed in Chapter 7, Winter Storms, the HHS emPower Map tool should be utilized to access near real-time natural hazard data layers to anticipate and address the needs of at-risk community members in emergencies. Medicare data indicates that there are 7,252 beneficiaries within Caroline County. A mass power outage could have a major impact on these Medicare beneficiaries who rely on electricity-dependent durable medical and assistive equipment (DME) and devices to live independently in their homes, and some of those individuals also have health care service dependencies.

Future Vulnerability

Many types of extreme weather are becoming more frequent or intense because of human-caused climate change. These events put stress on aging energy infrastructure and are among the leading causes of major power outages in the U.S. Climate Central analyzed U.S. power outage data between 2000 and 2023, as reported by utility companies. Major outages are events that affect at least 50,000 customers (homes or businesses) or interrupt service of 300 megawatts or more. Of all major U.S. power outages reported from 2000 to 2023, 80% (1,755) were due to weather-related events. Weather-related power outages are on the rise. The U.S. experienced about two times more weather-related outages during the last 10 years (2014-2023) than during the first 10 years analyzed (2000-2009).[ii]

Figure 11-3: Outages by Weather Type



Source: Climate Central – Outages by Weather Type

The Eastern Shore region is expected to see large increases in precipitation and numbers of very hot and very cold days (Climate Central, 2022). These factors can increase the occurrence of hazards such as flooding, hurricanes and tropical storms, landslides, tornados and windstorms, wildfires, and winter storms. Impacts from any of these hazards can lead to utility interruption on a range of scales. In addition, aging infrastructure, specifically utility systems, include a large portion of equipment and facilities dating from the growth periods of the 1950s and 1960s that followed World War II. Aging equipment will reach a point at which it will either fail on its own or because of outside forces (storms, loads it was designed to handle but no longer can, etc.). For instance, transmission equipment continues to age and eventually breaks down. These breakdowns will likely lead to more frequent utility disruptions as time goes by.

[i] Pinkerton - The Impact of Power Outages
[ii] Climate Central – Weather-Related Power Outages Rising

Chapter 12 Emerging Infectious Disease

Hazard Ranking

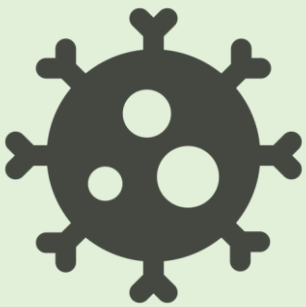
- **Hazard Mitigation Planning Committee** – Somewhat Concern
- **Municipalities**
  - Denton – Concerned
  - Federalsburg – Concerned
  - Goldsboro – Somewhat Concerned
  - Greensboro – Concerned
  - Henderson – Very Concerned
  - Hillsboro – Not Concerned
  - Marydel – Somewhat Concerned
  - Preston – Somewhat Concerned
  - Ridgely – Very Concerned
  - Templeville – Concerned
- **State** – Medium-High
- **National** – Not Ranked
- **Public** – Somewhat Concerned

Public Survey Responses

- 30% of participants stated the following mitigation action should be taken to strengthen the community: provide better information about hazard risk and high-hazard areas.
- 29% of participants feel their community is at risk to emerging infectious diseases.
- Participants suggested educating the public should be conducted to reduce risk.

Chapter Updates

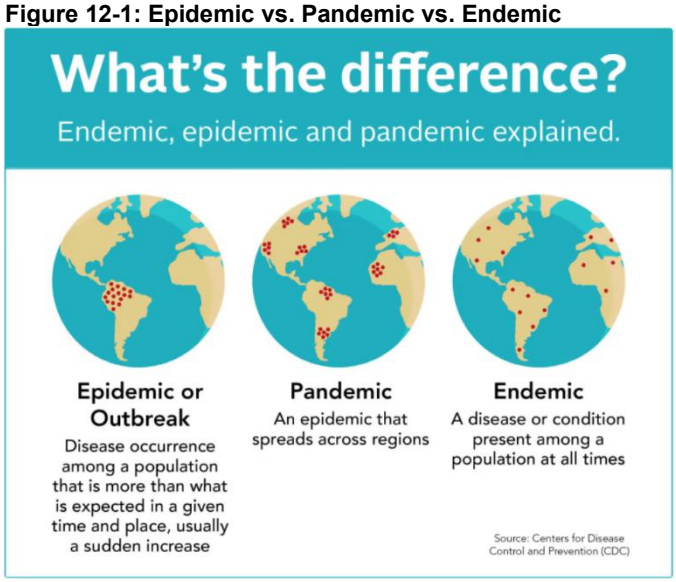
- This is a **new chapter** developed for the plan.
- Characteristic information includes information on endemic, epidemic, and pandemic events.
- New images have been included.
- History event data reviewed some of the worst pandemics the United States. The list was not an all-inclusive historical account of pandemics that have occurred in the United States. Epidemic history included examples diseases that have affected the county as well as Maryland specific.
- The vulnerability assessment provided statistics on Maryland overall and Caroline County.
- Caroline County Department of Health's capabilities to assist the community was included.
- Waterborne illnesses were addressed in the chapter.
- A new section discussing social vulnerability has been added to this chapter.
- A new section discussing future vulnerability has been added to the chapter.



Emerging Infectious Diseases Hazard Characterization

The amount of a particular disease that is usually present in a community is referred to as the baseline or endemic level of the disease. This term refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area. Figure 12-1 provides a visual representation of the difference between endemic, pandemic, and epidemic. The State of Marland Hazard Mitigation Plan provided the following definitions:

Figure 12-1: Epidemic vs. Pandemic vs. Endemic



- **Endemic**: A disease that belongs to a population, environment, or region. Examples of an endemic include chicken pox that occurs at a predictable rate among young school children in the United States and malaria in sub-Saharan areas.
- **Epidemic**: An infectious disease that rapidly affects a large number of people within a community, population, or region. An example epidemic was the 2003 severe acute respiratory syndrome (SARS) event. Although this event took the lives of nearly 800 people, it did not result in a worldwide spread.
- **Pandemic**: An infectious disease outbreak that spreads across countries or continents. It affects more people and takes more lives than an epidemic. The World Health Organization (WHO) declared COVID-19 to be a pandemic when it became clear that the illness was severe and that it was spreading quickly over a wide area.

Epidemics may also take the form of large-scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service. An epidemic may also be a secondary effect from other disasters such as flooding, tornadoes, hurricanes, or hazmat incidents. The Maryland Department of Health (MDH) maintains counts for 86 diseases, conditions, outbreaks, and unusual manifestations as reported by health care providers and 43 diseases notifiable by laboratories in Maryland. The surveillance and reporting of these diseases are the responsibility of the local Department of Health, which investigates and completes reporting both electronically and manually as per MDH regulations. Example of notifiable diseases include measles, Hepatitis B, AIDS, salmonellosis, giardiasis, malaria, Lyme disease, and rabies.

Processes followed for day-to-day surveillance and reporting of diseases establishes the baseline for public health response in a large-scale outbreak of a disease. One of the greatest potentials for an epidemic to occur is the emergence of an infectious disease that has newly appeared in a population or that has been known for some time but is rapidly increasing in incidence or geographic range which is referred to as an emerging infectious disease. According to the CDC, emerging infectious diseases are those whose incidence in humans has increased in the past two decades or threaten to increase in the near future. These diseases, which respect no national boundaries, can challenge efforts to protect the residents of Caroline County as prevention and control recommendations may not be immediately available. These diseases include:

- New infections resulting from changes or evolution of existing organisms;
- Known infections spreading to new geographic areas or populations;
- Previously unrecognized infections appearing in areas undergoing ecologic transformation;

- Old infections reemerging as a result of antimicrobial resistance in known agents or breakdowns in public health measures.

Two examples of emerging infectious diseases that had posed a real threat for Maryland were the Ebola Virus and the Zika Virus. Both of these emerging diseases were related to travelers bringing the disease to Maryland. For this reason, preparedness efforts in Maryland were critical in mitigating the spread of emerging diseases. Likewise, mitigation and preparedness are key in the current Opioid Crisis response at state and local levels. While opioid use is not an infectious illness, the increased rates of opioid use have created numerous public health concerns including an increase in overdose deaths and a potential for increase in rates of HIV, Hepatitis C, etc.

In terms of **pandemics**, the most recent public health emergency to affect every Maryland jurisdiction was the global COVID-19 Pandemic. The World Health Organization (WHO) defines a pandemic as the worldwide spread of a new disease. A pandemic happens when a new strain of a virus appears for which people have little or no immunity. As a result, it spreads easily from person to person around the world, causing widespread illness and death. Individuals, families, caregivers, healthcare workers, and teachers can all take steps to get ready for a pandemic before it happens.

Emerging Infectious Disease Risk & History

Pandemic History

Evidence suggests that the likelihood of pandemics has increased over the past century because of increased global travel and integration, urbanization, changes in land use, and greater exploitation of the natural environment. These trends likely will continue and will intensify. Significant policy attention has focused on the need to identify and limit emerging outbreaks that might lead to pandemics and to expand and sustain investment to build preparedness and health capacity.

The most common risk factors related to pandemics and infectious diseases include the following:

- Pandemics have occurred throughout history and appear to be increasing in frequency, particularly because of the increasing emergence of viral disease from animals.
- Pandemic risk is driven by the combined effects of spark risk (where a pandemic is likely to arise) and spread risk (how likely it is to diffuse broadly through human populations).
- Some geographic regions with high spark risk, including Central and West Africa, lag behind the rest of the globe in pandemic preparedness.
- Probabilistic modeling and analytical tools such as exceedance probability (EP) curves are valuable for assessing pandemic risk and estimating the potential burden of pandemics.
- Influenza is the most likely pathogen to cause a severe pandemic. EP analysis indicates that in any given year, a one (1) percent probability exists of an influenza pandemic that causes nearly 6 million pneumonia and influenza deaths or more globally.

Historically, some of the worst pandemics the United States has endured include the smallpox pandemic, cholera pandemic, SARS, H1N1 pandemic, and the COVID-19 pandemic. These pandemic events are described in further detail, below. Note: this is not an all-inclusive historical account of pandemics that have occurred in the United States.

Smallpox: 1633-1634

Smallpox came to North America in the 1600s. Symptoms included high fever, chills, severe back pain, and rashes. It began in the Northeast and the Native American population was ravaged by it as it spread to the west.

In 1721, more than 6,000 cases were reported out of a Boston population of 11,000. Around 850 people died from the disease. In 1770, a vaccine was developed by Edward Jenner from cow pox.

Cholera (three waves): 1832-1866

The United States had three serious waves of cholera, an infection of the intestines, between 1832 and 1866. The pandemic began in India and swiftly spread across the globe through trade routes.

New York City was the first U.S. city to feel the impact. Between five and ten percent of the total population died in large cities. While it is not clear how the pandemic ended, it was likely due to the combination of climate change and the use of quarantine measures; by the early 1900s, outbreaks of cholera had ended.

Present: Cholera is responsible for nearly 95,000 deaths a year worldwide, according to the CDC. Modern sewage and water treatment have helped eradicate cholera in some countries, but the virus is still present elsewhere. Vaccinations for cholera are available for those planning to travel to high-risk areas. The most effective way to prevent cholera is regular hand washing with soap and water and avoiding consumption of contaminated water.

H1N1 Flu: 1918

H1N1 is a strain of flu that still circulates the globe annually. In 1918, it was the type of flu behind the influenza pandemic, sometimes referred to as the "Spanish flu" (though it did not actually originate from Spain). After World War I, cases of the flu slowly declined. None of the suggestions provided at the time (wearing masks, drinking coal oil) were effective cures. Today's treatments include bed rest, fluids, and antiviral medications.

Severe Respiratory Acute Syndrome (SARS): 2003

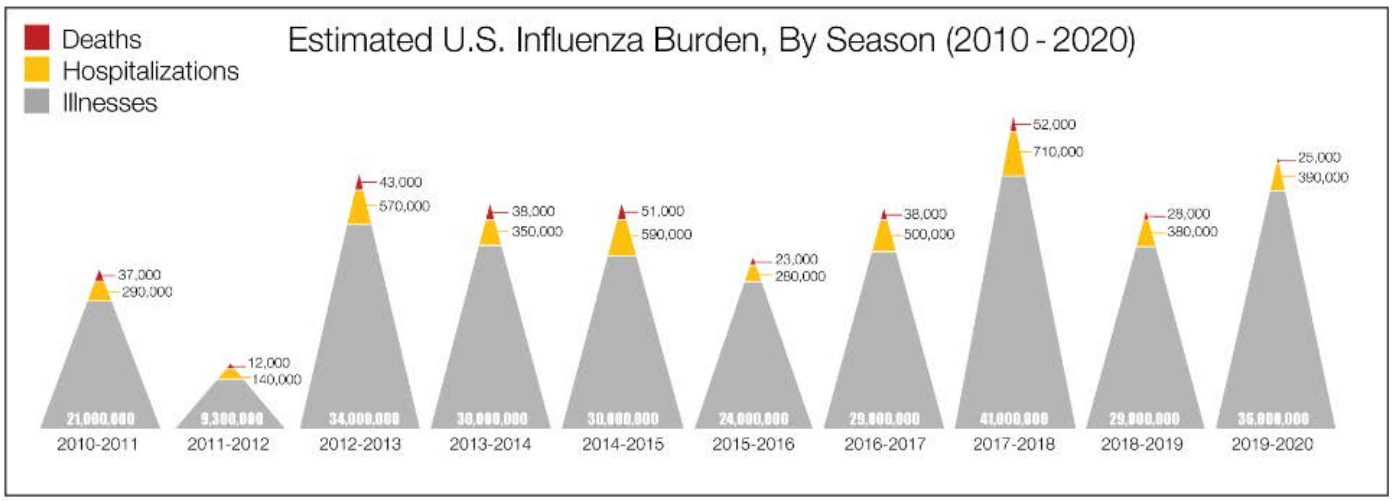
According to the World Health Organization (WHO), severe acute respiratory syndrome (SARS) is a viral respiratory disease caused by a SARS-associated coronavirus. It was first identified at the end of February 2003 during an outbreak that emerged in China and spread to 4 other countries. SARS is an airborne virus and can spread through small droplets of saliva in a similar way to the cold and influenza. It was the first severe and readily transmissible new disease to emerge in the 21st century and showed a clear capacity to spread along the routes of international air travel. In addition, it can be spread indirectly via surfaces that have been touched by someone who is infected with the virus.

Most patients identified with SARS were previously healthy adults aged 25–70 years. A few suspected cases of SARS have been reported among children under 15 years. Symptoms of SARS usually begins with a high fever (temperature greater than 100.4°F), while some have mild respiratory symptoms at the onset. Others include headache, an overall feeling of discomfort, and body aches. About 10 percent to 20 percent of patients have diarrhea. After 2 to 7 days, SARS patients may develop a dry cough, with most patients developing pneumonia.

Novel Influenza A (H1N1) Pandemic: 2009

According to the Center for Disease Control, 2009 H1N1 (sometimes called "swine flu") was a new influenza virus causing illness in people. The new H1N1 virus contained a unique combination of influenza genes not previously identified in animals or people. This virus was designated as influenza A (H1N1) pdm09 virus. This virus was first detected in people in the United States in April 2009. This virus was spreading from person-to-person worldwide, probably in much the same way that regular seasonal influenza viruses spread. Globally, 80 percent of (H1N1) pdm09 virus-related deaths were estimated to have occurred in people younger than 65 years of age. On June 11, 2009, the World Health Organization (WHO) declared that a pandemic of 2009 H1N1 flu was underway. On August 10, 2010, WHO declared an end to the global 2009 H1N1 influenza pandemic. However, (H1N1) pdm09 virus continues to circulate as a seasonal flu virus, and causes illness, hospitalization, and deaths worldwide every year. Today's treatments include bed rest, fluids, and antiviral medications.

Figure 12-2: Estimated U.S. Flu Burden, By Season



*Estimates are not available for the 2020-2021 season due to minimal flu activity.

Source: CDC – Disease Burden of Flu

Present: Influenza strains mutate every year, meaning it is important to receive an annual vaccination to decrease personal risk for the flu.

COVID-19 Pandemic

The Novel COVID-19 pandemic has exploded since cases were first reported in Wuhan, Hubei Province, China in December 2019. According to the World Health Organization (WHO) as of November 8, 2023, more than 771 million cases of COVID-19—caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection—have been reported globally, including more than 6.9 million deaths. Cases have been reported in nearly every country, including all 50 states of the United States. Additionally, the WHO reports that approximately 13.5 billion vaccine doses have been administered globally.

Prior to the release of safe and effective vaccine options for COVID-19, the United States' response to the virus was largely centered around practices such as quarantining, isolation, social distancing, wearing masks, and frequent hand washing. Additionally, economic relief was provided to citizens in the form of several congressional acts or stimulus packages, including the Consolidated Appropriations Act of 2021, the HEROES Act, the HEALS Act, and the CARES Act. The Coronavirus Aid, Relief, and Economic Security Act of 2020 provided fast and direct economic assistance for American workers, families, small businesses, and industries. This bill temporarily expanded unemployment benefits, provided tax rebates to American citizens, and suspended payments and interest on student loans. The American Association for Cancer Research provides more detailed information about each of these acts.

The State of Maryland responded by issuing a State of Emergency on March 5, 2020, which was regularly renewed until it finally came to an end on February 3, 2022. The State also enforced quarantining, social distancing, mask mandates, and restrictions on social gatherings. Economically, measures such as eviction moratoriums, reimbursement for telehealth, and preventing utility shutoffs and late fees were placed into effect. Maryland also extended unemployment coverage and provided stimulus payments for low to moderate income residents via the RELIEF Act of 2021.

According to the Maryland Department of Health, as of November 14, 2023, Maryland has reported a total of 1.41 million positive COVID-19 cases, including 16,895 confirmed deaths. Caroline County accounts for 7,518 of these total cases in which 92 resulted in death.

Epidemic History

The World Health Organization (WHO) defines an epidemic as the occurrence in a community or region of cases of an illness, specific health-related behavior, or other health-related events clearly more than normal expectancy. The community or region and the period in which the cases occur are specified precisely. The number of cases indicating the presence of an epidemic varies according to the agent, size, and type of population exposed, previous experience or lack of exposure to the disease, and time and place of occurrence.

Zika Virus Epidemic

According to the Maryland Department of Health, the Zika virus is an arboviral infection that is spread primarily through the bite of certain species of infected Aedes mosquitoes, sexually transmitted, or through blood transfusion (likely but not confirmed). Zika virus has been identified as an illness that causes multiple birth defects including microcephaly, which is defined as abnormal smallness of the head, a congenital condition associated with incomplete brain development. There is no identified vaccine or medication that can be taken to prevent Zika infection. The Eastern Shore has been mildly affected by the Zika virus in the recent past, with a few cases reported over the years. As of the latest data from 2019, no Zika cases have been reported in Caroline County, Maryland. The greatest threat from the zika virus for the eastern shore has not been local transmission, travel related cases have been the cause of spread.

Ebola Virus Epidemic

According to the Center for Disease Control, Ebola Virus Disease (EVD) is a rare and deadly disease in people and nonhuman primates. The viruses that cause EVD are located mainly in sub-Saharan Africa. People can get EVD through direct contact with an infected animal (bat or nonhuman primate) or a sick or dead person infected with Ebola virus. It is caused by an infection with a group of viruses within the genus Ebolavirus:

- Ebola virus (species Zaire ebolavirus)
- Sudan virus (species Sudan ebolavirus)
- Taï Forest virus (species Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus)
- Bundibugyo virus (species Bundibugyo ebolavirus)
- Reston virus (species Reston ebolavirus)
- Bombali virus (species Bombali ebolavirus)

Of these, only four (Ebola, Sudan, Taï Forest, and Bundibugyo viruses) are known to cause disease in people. Reston virus is known to cause disease in nonhuman primates and pigs, but not in people. It is unknown if Bombali virus, which was recently identified in bats, causes disease in either animals or people.

Ebola symptoms usually include:

- Fever;
- Headache;
- Diarrhea;
- Vomiting;
- Weakness;
- Joint and muscle aches;
- Stomach pain;
- Lack of appetite; and,
- Bleeding.

The symptoms can be similar to other, more common, infections. Symptoms appear 2-21 days after exposure to the virus, but most commonly occur 8-10 days after exposure. People are not contagious for the disease until the first symptoms appear (sudden onset of fatigue, fever, muscle pain, headache, and/or sore throat). The Ebola virus is transmitted through direct contact with the blood or body fluids of an infected person with

symptoms or through exposure to objects (such as needles) contaminated by infected body fluids. This virus poses an extremely high risk to familial caregivers and health care workers. Transmission can also occur from directly handling bats, rodents, or primates in areas where Ebola occurs. To date, there have been no cases of the disease acquired in Maryland.

The Maryland Department of Health's Emerging Infectious Plan defines Emerging Infectious Diseases as the following:

a. An infectious disease that is novel or new to a geographic area;
b. An existing infectious disease that is causing a marked increase in cases or geographic spread; or,
c. A biological agent used to cause harm or death in a population (bioterrorism).

Epidemics can be considered as part of a broad hazard category that could be termed "public health emergencies." In addition to disease epidemics, such events can take the form of large-scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service. Epidemics may also be secondary to some other disasters such as flood, tornado, hurricane, or HazMat incident.

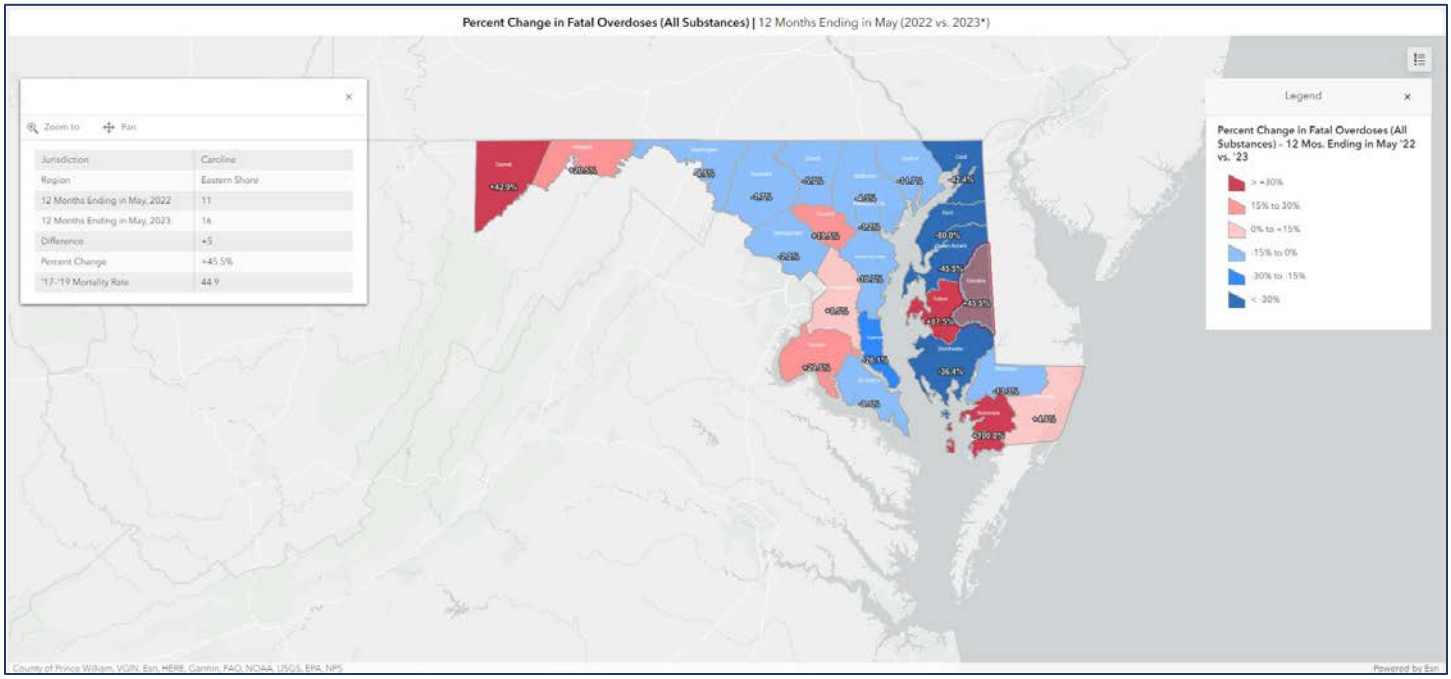
Opioid Crisis

According to the US Department of Justice Bureau of Justice Assistance FY 22 Maryland Efforts to Expand the Fight Against Opioids,

"Maryland has taken numerous steps to combat the increasing number of overdoses and deaths resulting from the heroin and opioid crisis. Some of these efforts include creating workgroups, enacting legislation, and declaring a State of Emergency. Although Maryland remains committed to addressing this crisis, overdose deaths continue to significantly impact the State at an alarming rate. According to the CDC, the overdose death rate in Maryland increased from 20.9 deaths per 100,000 in 2015 to 44.6 in 2020. In addition and based on an Overdose Detection Mapping Application Program (ODMAP), overdose deaths in Maryland increased by 8.28%, from 12,581 in 2018 to 13,623 in 2021. During the same time, heroin and non-fatal/fatal overdoses increased by 3.7%, while fentanyl overdoses increased 108%. Furthermore, there were a total of 32,405 overdoses in Maryland between January 2020 and June 2, 2022."

The Maryland Opioid Operational Command Center developed the Maryland Overdose Data Dashboard, which provides current overdose trends for each county in Maryland. Opioid Emergency Department visit rates per county can also be viewed. Reviewing the data for Caroline County, fatal overdoses in the County increased between May 2022 to May 2023. Figure 10-3 depicts the percent changes for all Maryland counties with Caroline County highlighted.

Figure 12-3: Percent Change in Fatal Overdoses (All Substances) | 12 Months



Source: Maryland Overdose Data Dashboard – Caroline County, 2023.

Emerging Infectious Disease Vulnerability

Traveling abroad can put you at risk for infectious diseases that are not widespread in the United States. Travelers who become ill in a country where treatment for these diseases may be somewhat limited are even more at risk. All people planning travel should become informed about the potential hazards of the countries they are traveling to. In addition, areas with dense populations have a greater increase to spread diseases. Caroline County's population is most dense within the Town of Denton.

The Maryland Department of Health routinely collects statistics on reportable illnesses. Table 12-1 provides an example of routine incidence of infections. An increase in the incidence rates triggers a public health response.

Table 12-1: Cases of Selected Notifiable Conditions Reported, Caroline County, Maryland 2018-2022

Cases of Selected Notifiable Conditions Reported, Caroline County, Maryland						
Condition	**2018**	**2019**	**2020**	**2021**	**2023**	**5-Year Mean**
Anaplasmosis	1	0	0	0	0	0.2
Animal Bites	100	151	105	114	83	110.6
Campylobacteriosis	10	11	14	12	16	8.84
Chlamydia	83	113	128	-	###	108.0
Cryptosporidiosis	0	4	0	3	2	1.8
Cyclosporiasis	1	1	0	0	0	0.4
Ehrliciosis	1	0	0	1	2	0.8
Giardiasis	5	2	1	1	2	2.2
Gonorrhea	20	21	46	-	14	22
H. Influenzae	1	0	0	0	0	0.2
Hepatitis B (acute symptomatic)	1	1	0	0	0	0.4
Hepatitis C (acute symptomatic)	1	0	0	0	0	0.2
Legionellosis	2	2	1	0	1	1.2
Lyme Disease	4	12	10	7	4	7.4
Mycobacteriosis	3	0	0	4	1	1.6
Pertussis	1	2	0	0	0	0.6
Rabies - Animal	7	9	3	5	2	5.2

Condition	2018	2019	2020	2021	2023	5-Year Mean
Salmonellosis	8	19	15	11	10	12.6
Shiga Toxin Producing E. coli	1	1	1	0	2	1
Shigellosis	1	1	0	1	0	0.6
Spotted Fever Rickettsiosis	1	7	1	0	1	2.0
Strep Group A	1	0	1	2	2	1.2
Strep Group B	4	3	0	4	6	3.4
Strep Pneumoniae	1	1	1	2	5	2.0
Syphilis - Congenital	0	1	0	-	0	0.2
Syphilis – Primary & Secondary	1	1	1	-	3	1.2
Tuberculosis	1	1	0	0	1	0.6
Vibriosis	1	0	2	0	2	1.0

Source: Maryland's NEDSS and PRISM databases. Data is current as of 8/03/2022. These are active databases and counts may vary slightly over time, as well as differ slightly from counts published by the Centers for Disease Control and Prevention (CDC). HIV/AIDS data are not included here but available at https://health.maryland.gov/phpa/OIDEOR/CHSE/pages/statistics.aspx.

HIV/AIDS data are not included in Table 12-1; therefore, rates have been collected from the CDC. According to the CDC, an estimated 773 people aged 13 and older were diagnosed with HIV infection in Maryland during 2021. At year-end 2021, there were 32,149 people aged 13 and older living with diagnosed HIV in Maryland. Maryland was ranked 12th among states and territories in adult/adolescent HIV diagnosis rates (per 100,000) in 2020.

According to the 2019 Maryland STI Annual Report, Maryland ranks 12th in rates of primary and secondary syphilis, 12th in chlamydia infections, and 24th in gonorrheal infections among the 50 States.

According to the CDC's Viral Hepatitis Surveillance Report 2020, incidences of Hepatitis A decreased nationally by 47% from 2019 through 2020 as compared to the increases experienced from 2015 through 2018. It is important to note that effective vaccines are available for both Hepatitis A and B. However, there is no vaccine for the Hepatitis C virus, although life-saving treatment can cure the virus.

Further information is available to the public on the Caroline County Department of Health's website. The website provides health related topics in addition to information on how to prepare for and prevent various types of disasters. The Department of Health's website also provides information on disaster mitigation, preparedness, and recovery.

Vulnerability and Impacts to People, Systems, and Resources from Emerging Infectious Diseases

To describe the impacts of emerging infectious diseases within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 12-2.

Table 12-2: Emerging Infectious Diseases Vulnerability and Impacts to People, Systems, and Resources

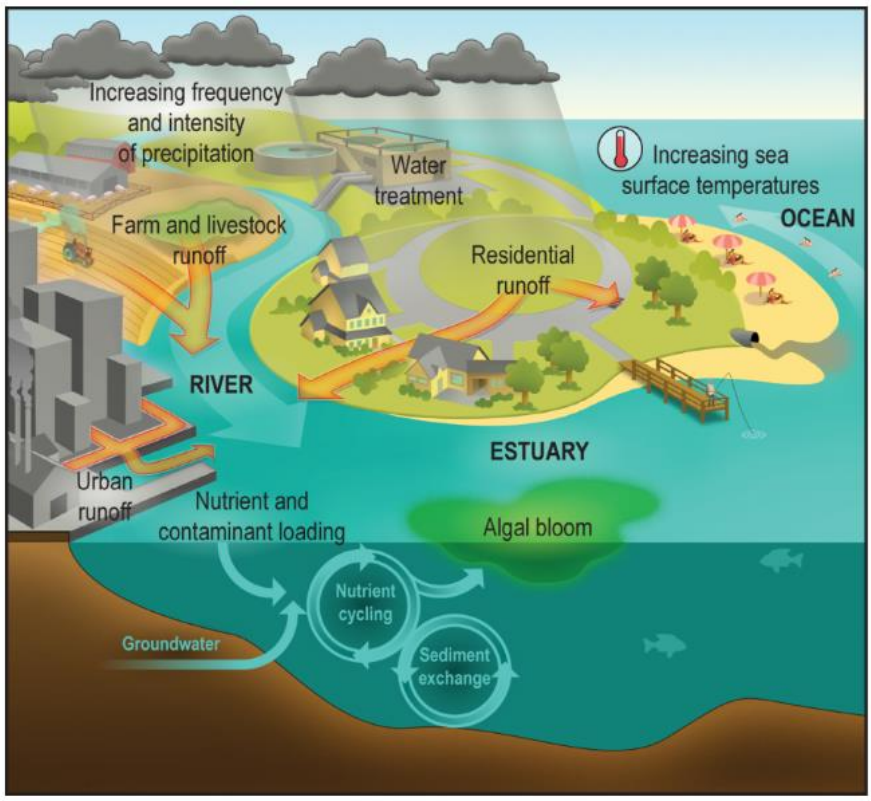
People	• Loss of life • Long-term or chronic health issues • Resource Strain – not enough resources available nationwide to effectively handle the spread in all areas for a large-scale outbreak. • Mental health issues can arrive from shame associated with stigma, or from periods of long-term isolation. • Mental health issues stemming from stress or burnout associated with long-term emergency response or caregiving. • Loss of employment • Impacts on job performance due to illness or permanent disability.
Systems (including networks and capabilities)	• Maintaining public and office spaces to be clean and sanitized to reduce the spread of EIDs. • The associated cost of increased sanitization procedures of facilities.
Natural, Historic, and Cultural Resources	• Shoreline/water quality is monitored/measured for safety levels and continued use. If adversely affected, swimming, fishing, and other water related events could be prohibited for a period of time. • Extreme heat can also become a public health event and can trigger outings and/or events to be cancelled throughout the County

The effects of climate change can impact natural marine, coastal, and freshwater systems as well as manmade water infrastructure designed for treating drinking water, wastewater, and stormwater.[i]

Extreme weather events and increased sea surface temperatures affect the growth and spread of pathogens and toxins. In most cases, water contamination and subsequent outbreaks of waterborne illnesses are caused by an extreme rainfall or weather event that produces flooding and releases industrial and agricultural runoff into a body of water. Flooding can overwhelm sewage treatment facilities causing bacteria like Legionella and Escherichia coli (E. coli) to grow and develop in stagnant water, such as in unused pipes.[ii]

Exposure to contaminated water can lead to adverse health effects from waterborne illnesses. Swimming or fishing in polluted water sources and consumption of affected seafood are the most common pathways of exposure. Some common water-related illnesses

Figure 12-4: Links between Climate Change, Water Quantity and Quality, and Human Exposure to Water-Related Illness Ending in May (2022 vs. 2023*)



Precipitation and temperature changes affect fresh and marine water quantity and quality primarily through urban, rural, and agricultural runoff. This runoff in turn affects human exposure to water-related illnesses primarily through contamination of drinking water, recreational water, and fish and shellfish.

Source: GlobalChange.gov - Water-Related Illness

are diarrhea, giardiasis, dysentery, typhoid fever, E. Coli infection, and salmonellosis. Adverse health effects can include pain in the gastrointestinal, reproductive, neurological systems, and other symptoms. Continuous exposure can have long-lasting health impacts.[iii]

Although the United States has one of the safest municipal drinking water supplies in the world, water-related outbreaks (more than one illness case linked to the same source) still occur. Public drinking water systems provide treated water to approximately 90% of Americans at their places of residence, work, or schools. However, about 15% of the population relies fully or in part on untreated private wells or other private sources for their drinking water. These private sources are not regulated under the Safe Drinking Water Act. The majority of drinking water outbreaks in the United States are associated with untreated or inadequately treated groundwater and distribution system deficiencies.[iv]

Proper and adequate disinfection is vital for any public water system. In the event of vandalism, a terrorist attack, or an equipment failure, the likelihood of these diseases increases. It is important to have equipment monitoring devices that will shut the well pump off in the event of a failure. Additionally, water treatment facilities must remain locked with very limited access to only authorized personnel. Working in cooperation with local Police as well as vigilance from residents will help ensure safe drinking water.

With the exception of the Jonestown Water System, the County does not own or operate public utilities. The Jonestown Water System's water source is supplied by two wells that accesses the Piney Point aquifer at a depth of 490 feet. The wells feed a pressurized main line distribution system to each consumer's home. The water is disinfected with chlorine in low levels to protect against any form of bacteria that may be present in the water. Monthly Bacteriological Testing, Fluoride, Phase 2 disinfection Byproducts, radioactive containments and 5 metal compounds, and Nitrate testing performed during this period of time. Test results for bacteriological testing have produced no Present/Positive result for Total Coliform or Fecal Coliform. The Ridgely water system is comprised of two wells that draw from the Piney Point aquifer as well.

According to the Caroline County Comprehensive Plan, the towns of Goldsboro, Marydel and Templeville do not maintain public water systems. The Town of Henderson is the only North County town that owns and operates a public water system. The majority of the residents of the other three North County towns access water from shallow (15 to 40 feet) wells drilled in the Columbia or Choptank Aquifer; however, a few obtain water from deeper wells in the Aquia Aquifer.45 Periods of extreme drought have resulted in a number of the shallow wells running dry; consequently, some of these have been replaced with deeper wells. Wells in the northern area of the County also are susceptible to contamination from failed septic systems, a circumstance that is reflected in nitrate levels in local drinking water. Septic systems in this area discharge inadequately treated wastewater onto the ground or into the groundwater where shallow wells are located. In many cases wells and septic systems are located less than 100 feet apart and high groundwater levels cause frequent flooding and cross-contamination of wells and septic systems.

According to the Town of Denton, their facilities are monitored daily, and all controls are monitored 24/7 via a SCADA network. Denton also uses Sodium Hypochlorite for disinfection (liquid chlorine).

The Town of Preston's water system is comprised of two wells that draw water from the Piney Point Aquifer at depths of 600 and 533 feet. An elevated tank provides 150,000 gallons of storage; chlorination is provided at the Town's water treatment plant.

Backflow is a plumbing issue that occurs when water flows in pipes, plumbing, or hoses in the opposite direction from its normal flow. This can happen when there is a change in pressure, which could allow contaminants to enter a drinking water system. A similar contamination risk can occur from cross-connections. Some ways the Town of Denton prevents this from occurring are:

1. Double check valves installed on every water meter in Town.
2. Require backflow prevention devices for businesses with a potential cross connection.

3. Forbid any contractor from connecting to any of our fire hydrants, failure to abide results in Civil and Criminal penalties.
4. Constant monitoring of system pressure to ensure it doesn't drop low enough to allow backflow.

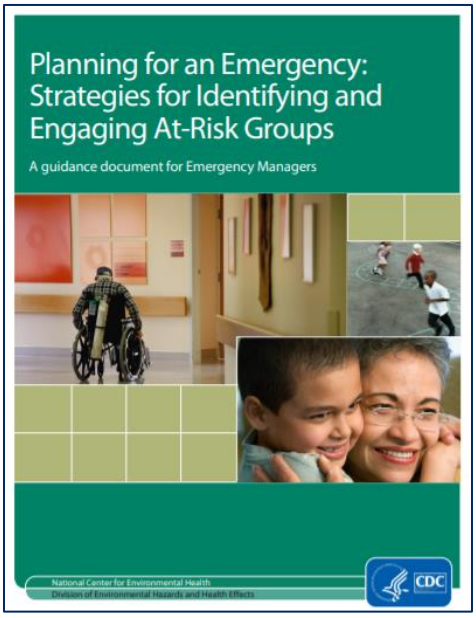
Social Vulnerability

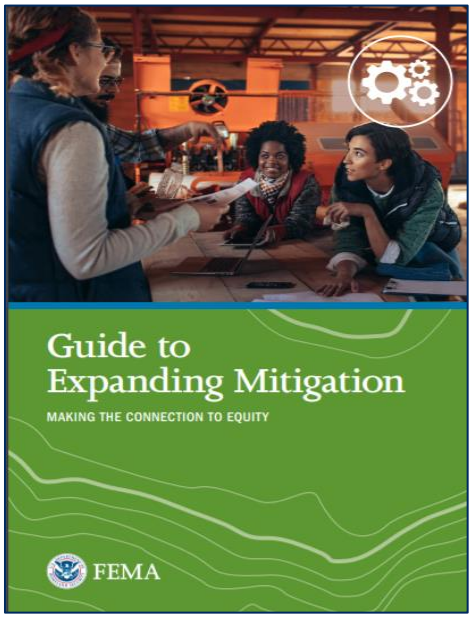
Public health emergencies may result in loss of life, long-term or chronic health issues, and mental health issues. Epidemics or other large-scale public health emergencies may result in a strain on available resources. Limited resources affecting nationwide availability, as was recently demonstrated by the COVID-19 Pandemic, result in widespread devasting impacts. Impacts include but are not limited to the health and safety of first responders and medical personnel, and the services they provide. In addition, business may be impacted by closures, loss of employees and customers due to illness, and supply chain disruptions.

When discussing vulnerability in terms of Emerging Infectious Disease, vulnerability may be defined as "increased exposure to infection; increased susceptibility to severe disease, including complications, hospitalizations, and death; and lack of access to health care." With these definitions in mind, Caroline County should consider the following four questions – developed by the CDC – when addressing the needs of vulnerable populations during a pandemic, epidemic, or disease outbreak:

1. Why is the population considered vulnerable?
2. What are the unique issues, concerns, and needs of each vulnerable population?
3. What strategies can protect these populations?
4. What specific approaches are needed for vulnerable populations, their families, and their health care and service providers to ensure their protection?

Refer to Planning for an Emergency: Strategies for Identifying and Engaging At-Risk Groups published by CDC as a resource about characteristics that influence vulnerability and FEMA's Guide to Expanding Mitigation: Making the Connection to Equity.





Future Vulnerability

Progress has been made in preventing deaths from infectious diseases, however looking forward, focus needs to be on pandemic preparedness, including detecting and containing emerging infectious disease threats while they are localized and manageable. These threats may differ widely in terms of severity and probability and also have varying consequences for morbidity and mortality, as well as for a complex set of social and economic outcomes.

The following excerpt called "Infectious Disease In An Era of Global Change" from the publication Nature Reviews Biology shows the relationship between climate change and increased infectious diseases.

"In recent decades, declines in mortality and morbidity, particularly childhood mortality, have been one of the great triumphs of public health. Greater access to care, such as therapeutics (including antibiotics), improved sanitation and the development of vaccines have been core drivers of this progress. Even as medical advances in the twenty-first century have spurred advances in population health, inequalities in access to these advances remain widespread between and within countries. Reducing inequities in access to health care and improving surveillance and monitoring for infectious diseases in low-income and middle-income countries, and in underserved populations within countries, should be a priority in tackling pathogen emergence and spread in the future.

Climate change, rapid urbanization and changing land-use patterns will increase the risk of disease emergence in the coming decades. Climate change, in particular, may alter the range of global pathogens, allowing infections, particularly vector-borne infections, to expand into new locations. A continued uptick in global travel, trade and mobility will transport pathogens rapidly, following emergence.

A changing world requires changing science to evaluate future risks from infectious disease. Future work needs to explicitly address concurrent changes: how shifting patterns of demographic, climatic and technological factors may collectively affect the risk of pathogen emergence, alterations to dynamics and global spread. At the same time, new technologies, including advances in data collection and surveillance, need to be harnessed". According to the CDC, the following steps can be taken by the United States to reduce or mitigate the impact climate change will have on emerging infectious diseases:

1. Continued investment in disease surveillance systems to track diseases and determine if they are increasing or shifting over time.
2. Maintain a strong national health system and workforce that can predict, prevent, detect, and respond to new diseases as they expand to new areas.
3. Develop new tools to aid in analyzing and interpreting data that is collected to predict where threats are most likely to occur.
4. Increase understanding of inequalities in how climate change impacts certain populations and use data to inform tailored prevention and response strategies for communities that are disproportionately impacted.
5. Invest in more research, environmental data collection, and disease/climate modeling efforts that help to predict and prepare for future climate scenarios.[v]

[i] National Institute of Environmental Health Sciences - Water-related Illnesses

[ii] National Institute of Environmental Health Sciences - Water-related Illnesses

[iii] National Institute of Environmental Health Sciences - Water-related Illnesses

[iv] GlobalChange.gov - Water-Related Illness

[v] Jones K E, Patel N G, Levy M A, Storeygard A, Balk D., and others. 2008. "Global Trends in Emerging Infectious Diseases." Nature 451 (7181): 990–93. ii www.ncbi.nlm.nih.gov/books/NBK525302/ iiisitn.hms.harvard.edu/flash/special-edition-on-infectious-disease/2014/the-fight-over-inoculation-during-the-1721-boston-smallpox-epidemic/ iv www.ncbi.nlm.nih.gov/pmc/articles/PMC2394684/ v www.cdc.gov/cholera/general/index.html vi Nature Reviews Microbiology – Infectious Disease In An Era of Global Change. October 2021.

Chapter 13 Dam Failure

Hazard Ranking

- **Hazard Mitigation Planning Committee** – Somewhat Concern
- **Municipalities**
  - Denton – Not Concerned
  - Federalsburg – Very Concerned
  - Goldsboro – Not Concerned
  - Greensboro – Somewhat Concerned
  - Henderson – Not Concerned
  - Hillsboro – Not Concerned
  - Marydel – Not Concerned
  - Preston – Not Concerned
  - Ridgely – Not Concerned
  - Templeville – Somewhat Concerned
- **State** – Medium-Low
- **National** – Not Ranked
- **Public** – Not Concerned

Public Survey Responses

- 30% of participants stated the following mitigation action should be taken to strengthen the community: provide better information about hazard risk and high-hazard areas.
- No resident has experience property damage from dam failure.
- 6% participants indicated that they have floodproofed (elevating furnace, water heaters, electric panels) their homes as a mitigation measure.
- 2% of participants feel their community is at risk to dam failure.
- Participants suggested educating the public should be conducted to reduce risk.

Chapter Updates

- This is a **new chapter** developed for the plan.
- Caroline County **does not** have any high hazard potential dams.
- Characteristic discusses incremental, non-breach, and residual risks.
- New images have been included.
- Hazard risk and history lists the dams located in Caroline County and purpose.
- Dam failures incidents that have occurred in the county have been included.
- The vulnerability and impacts to people, systems, and resources has been included.
- Social vulnerability was included in the chapter.
- Future vulnerability was included in the chapter.

Dam Failure Hazard Characterization

Dams present risks but they also provide benefits including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. States have the primary responsibility for protecting their populations from dam failure. Of the approximately 92,000 dams listed in the National Inventory of Dams (NID), State governments regulated about 70 percent. Tens of thousands more dams exist under state regulation throughout the country but are below threshold sizes to be included in the NID. According to FEMA, about 27,000 dams throughout the U.S. could incur damage or fail, resulting in significant property damage, lifeline disruption (utilities), business disruption, loss of life, displacement of families from their homes, and environmental damage. Flooding because of dam failure is the primary concern of this risk profile.

According to damsafety.org, hundreds of dam failures have occurred throughout U.S. history. These failures have caused immense property and environmental damage and have taken thousands of lives. As the nation's dams age and population increases, the potential for deadly dam failures grows. Caroline County does not have a significant history of dam failures. MDE Dam Safety Program has records of 3 failures, two (2) in 1979 and one (1) in 1999, that occurred in the County. Therefore, the risk of a dam failure is not non-existent.

According to FEMA, dams can fail for several reasons, including overtopping caused by floods, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. FEMA acknowledges three primary types of risk associated with high hazard potential dams, which include the following:

Incremental Risk: 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 after overtopping, or undergo component malfunction or mis operation, 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: 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: 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.

Figure 13-1: Smithville Lake

Source: https://dnr.maryland.gov/fisheries/pages/hotspots/smithville.aspx

Dam Failure Hazard Risk & History

No high hazard potential dams are located in Caroline County. Furthermore, there are no high hazard potential dams in adjacent jurisdictions with inundation areas impacting Caroline County. Caroline County could be affected by the failure of six dams or levees within the County. Of these dams, two have a hazard potential classification "significant" and four are "low" hazard potential classification. These dams are identified in Table 13-1. In Maryland, the MDE Dam Safety Program is responsible for improving dam safety throughout the state and works with local officials and dam owners. According to the Division, hazard potential classifications are based on the negative impacts should the dam fail, and are described as follows:

- **High Hazard** (107 dams in the State): Probable loss of life; major increases in existing flood levels at houses, buildings, major interstates, and state roads.
- **Significant Hazard** (136 dams in the State): Possible loss of life, significant increased flood risks to roads and buildings with no more than two houses.
- **Low Hazard** (315 dams in the State): Unlikely loss of life; minor increases to existing flood levels at road and buildings.

Table 13-1: Dams Located in Caroline County

Dams Located in Caroline County					
Dam Name	**Dam Type**	**Primary Purpose**	**Emergency Action Plan**	**Owner Name**	**Hazard Potential Classification**
Nagel's Mill Pond	Earth	Recreation	Yes	Nagel Farm Service Inc.	Significant
Chambers Lake	Gravity, Other	Water Supply	Yes	Town of Federalsburg	Significant
Scull Farm Pond	Earth	Recreation	Not Required	Farm Company Inc.	Low
Williston Mill Dam	Earth	Recreation	Not Required	Girl Scouts of the Chesapeake Bay	Low
Lake Bonnie	Earth	Recreation	Not Required	Johnathon & Tammy Merson	Low
Smithville Dam	Earth	Recreation	Not Required	MD DNR-Public Lands, Engineering & Construction	Low

Source: USACE National Inventory of Dams – Caroline County

Both dams labeled with a 'significant' hazard potential have an Emergency Action Plan (EAP). EAPs are required to establish procedures that warn the population at risk to reduce the potential for loss of life and property damage in the event that a dam failure is imminent. The Dam Inspectors and Operator, Department of Emergency Services, and Maryland Dam Safety Program maintain these plans and assist in notification if a dam failure should occur. The locations of these dams are mapped on page 11-4. More information about the significant hazard potential dams listed above is included on Table 13-2 below.

Table 13-2: Significant Hazard Potential Dams in Caroline County

Significant Hazard Potential Dams – Condition and Potential Impact Area		
Dam name	**Condition**	**Nearest City/Town**
Nagel's Mill Pond	Fair	Harmony (Population ~100)
Chambers Lake	Poor	Federalsburg (Population 2,842)

Source: MDE Dam Safety Program Database & National Inventory of Dams, https://nid.sec.usace.army.mil/#/ Satisfactory - No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the minimum applicable state or federal regulatory criteria or tolerable risk guidelines. Fair - No existing dam safety deficiencies are recognized for normal operating conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action. Note: Rare or extreme events are defined by the regulatory agency based on their minimum. Poor - A dam safety deficiency is recognized for normal operating conditions which may realistically occur. Remedial action is necessary. Poor may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Investigations and studies are necessary.*

There are various risks and vulnerabilities to dams that are in poor condition. These include:

- Potential cascading impacts of storms, seismic events, landslides, wildfires, etc. on dams that might affect upstream and downstream flooding potential.
- Potential significant economic, environmental, or social impacts, as well as multi-jurisdictional impacts, from a dam incident.
- Location and size of populations at risk from dam failure, as well as potential impacts to institutions and critical infrastructure/facilities/lifelines.
- Methodology and/or assumptions for risk data and inundation modeling.

According to the Association of State Dam Safety Officials (ASDSO), the following actions can be taken to address high hazard potential dams, or dams in poor condition, and increase overall dam safety:

- Support the improvement of state dam safety programs.
- Increase collaboration.
- Advance and expand the technical expertise of dam and levee safety practitioners through training and education programs.
- Reduce the potential for dam failure by promoting innovative approaches to fund dam rehabilitation.
- Reduce the consequences of dam failure by increasing public awareness, planning, and preparedness.
- Advocate for laws, policies and government programs that serve to improve the safety of dams and reduce the risk to the public.
- Support and strengthen a coordinated effort to improve the safety of levees.

The ASDSO's Strategic Plan 2022-2027 is available online, here.

** Maryland Dam Safety Division Contact Information is available here, or residents can contact the local Department of Emergency Services, here.*

The National Performance of Dams Program has documented two (2) instances of dam failures within Caroline County all of which resulted in an inflow flood. An inflow flood is described as the incremental increase in downstream water surface elevation due to the failure of a dam. Table 13-3 below lists these failures along with the incident type and date of occurrence.

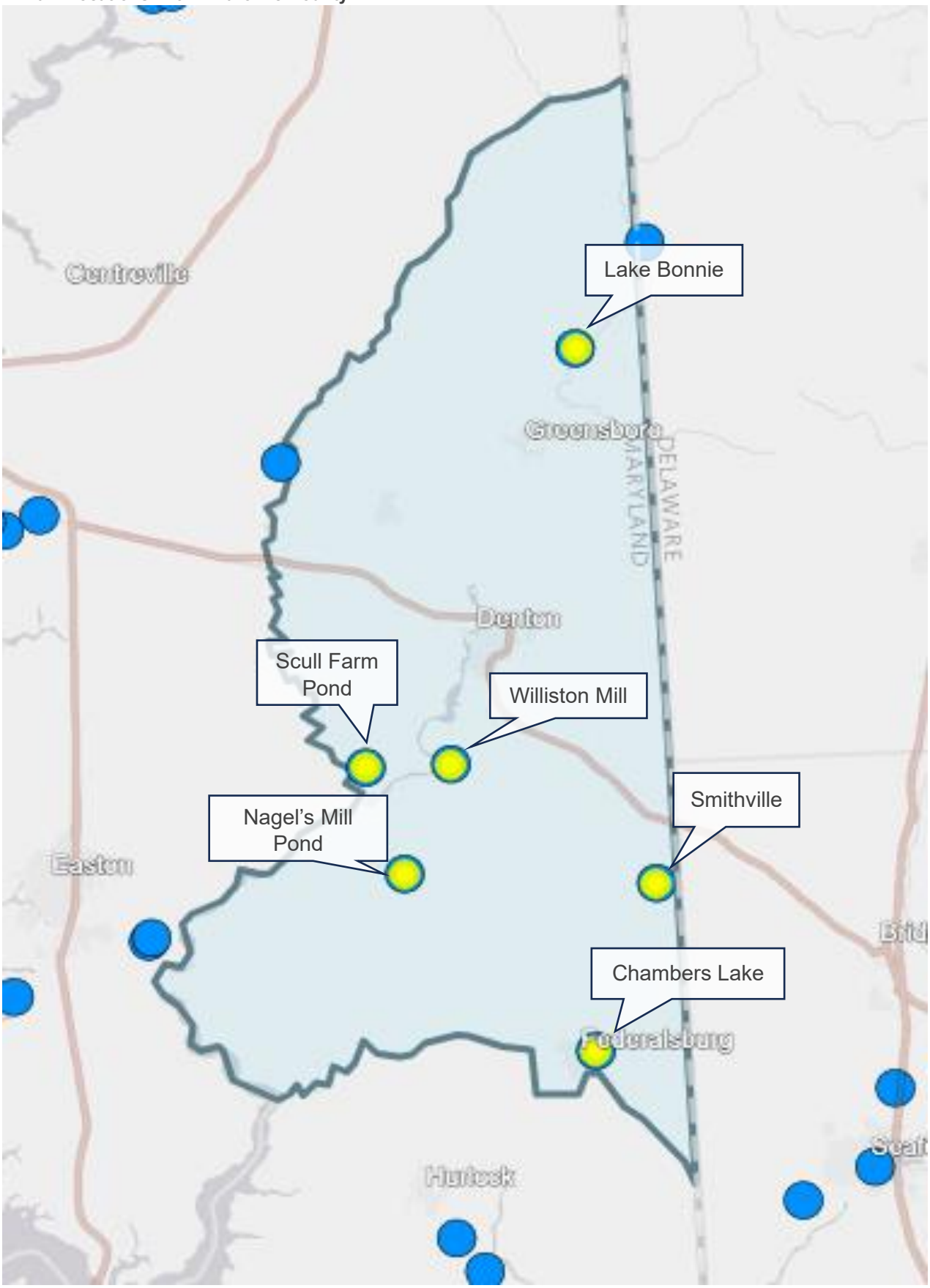
Table 13-3: Dam Failure Incidents in Caroline County 1999-2023

Dam Failure Incidents in Caroline County 1999-2023			
Dam Name	**Incident Date**	**Incident Type**	**Dam Type**
Lake Bonnie	09/16/1999	Inflow Flood – Hydrologic Event	Earth
Scull Farm	09/16/1999	Inflow Flood – Hydrologic Event	Earth
Nagel's Mill Pond	09/15/1999	Piping	Earth

Source: https://npdp.stanford.edu/dam_incidents

The Town of Federalsburg is the only municipality subject to dam failure from the Chambers Lake, which is a significant hazard potential dam. The other significant hazard potential dam is Nagel's Mill Pond, which is located in north of the Town of Preston. The Town of Preston is not within the Nagel's Mill Pond inundation area. The remaining municipalities are not subject to dam failure due to the other dams' locations.

Map 13-1: Dam Locations Within Caroline County



Source: National Inventory of Dams, Caroline County

Dam Failure Vulnerability

The primary hazard surrounding dam failure is the swift, unpredictable flooding of those areas immediately downstream. While general inundation areas can be determined, it is often impossible to know exactly how and where water held back by a dam will flow during a rapid failure of the dam. Generally, there are three (3) types of dam failures: hydraulic, seepage, and structural.

- **Hydraulic Failure:** Hydraulic failures result from the uncontrolled flow of water over the dam, around and adjacent to the dam, and the erosive action of water on the dam and its foundation. Earthen dams are particularly vulnerable to hydraulic failure since earth erodes at relatively small velocities.
- **Seepage Failure:** All dams exhibit some seepage that must be controlled in velocity and amount. Seepage occurs both through the dam and the foundation. If uncontrolled, seepage can erode material from the foundation of an earthen dam to form a conduit through which water can pass. This passing of water often leads to a complete failure of the structure, known as piping.
- **Structural Failure:** Structural failures involve the rupture of the dam and/or its foundation. This is particularly a hazard for large dams and for dams built of low strength materials.

Dam failures generally result from a complex interrelationship of several failure modes. Uncontrolled seepage may weaken the soil and lead to a structural failure. Structural failure may shorten the seepage path and lead to a piping failure. Surface erosion may lead to structural or piping failures.

Maryland Dam Safety Program requires that each dam be evaluated for its hazard potential downstream. Hazard potential is not related to the structural integrity of a dam, but strictly to the potential or loss of life due to flooding. While the probability of a dam failure occurrence is generally low, the potential hazard is significant for the Nagel's Mill Pond and Chambers Lake dams.

Vulnerability and Impacts to People, Systems, and Resources from Dam Failures

To describe the impacts of dam failure within Caroline County and its municipalities, a hazard vulnerability and impacts table has been developed as part of this Plan update; Table 13-4.

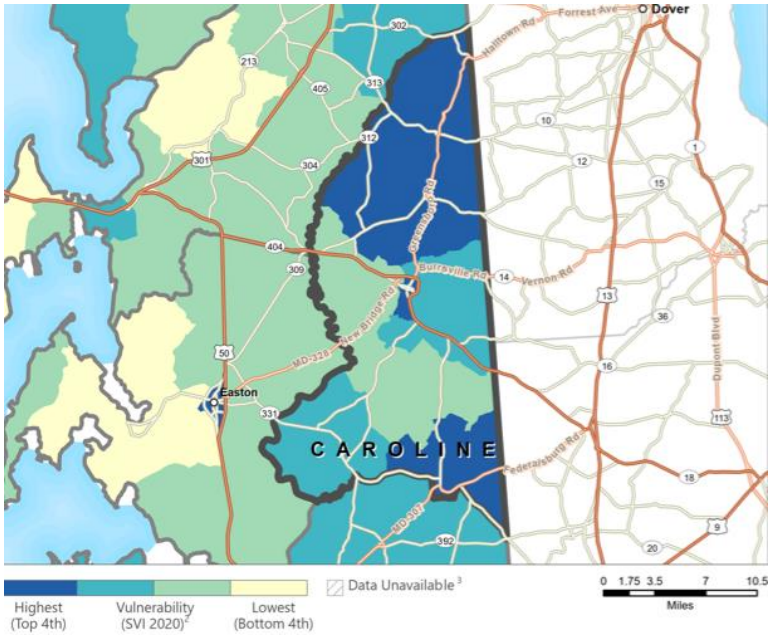
Table 13-4: Dam Inundation Vulnerability and Impacts to People, Systems, and Resources

People	• Dam Failure leading to flooding downstream can cause death, injury, and illnesses relating to water-borne diseases and standing water. • As a result of flooding people may have to evacuate and be displaced from their homes.
Systems (including networks and capabilities)	• Many systems including power, sewer, water, communications, and road access can be impacted by dam failure. • Flooding can create problems with utility services, such as power outage due to stress on power systems. • Outages impact the availability of emergency and government services. • Road closures, as a result of a dam failure could have significant impacts on the County and communities.
Natural, Historic, and Cultural Resources	• Flooding can cause stress to local wildlife habitats. • Disruption of soil structure. • Increased rates of deterioration in buildings exposed to flooding. • Surface cracking, flaking, and sugaring building stone and spalling of brick due to a structure's overexposure to moisture.

Social Vulnerability

As shown in Table 13-3, there have been three dam incidents that did not result in uncontrolled release of the reservoir in the County. These incidents involve Lake Bonnie, Chamber's Lake, and the Scull Farm Pond. Figure 13-2 maps the areas within Caroline County with the highest socially vulnerable populations. As displayed in Map 13-1, two of the six dams located within Caroline County lie within areas that contain the highest degree of socially vulnerable populations. These dams are Lake Bonnie, closest to the town of Greensboro, and Chamber's Lake, closest to the town of Federalsburg. Lake Bonnie in particular has been involved in one recorded dam failure dating back to 09/16/1999 due to a hydraulic event caused by Hurricane Floyd.

Figure 13-2: Overall Social Vulnerability in Caroline County



Source: CDC/ATSDR Social Vulnerability Index 2020

Future Vulnerability

Provided that adequate engineering and maintenance measures are in place, dam failures are generally low in Caroline County. The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur.

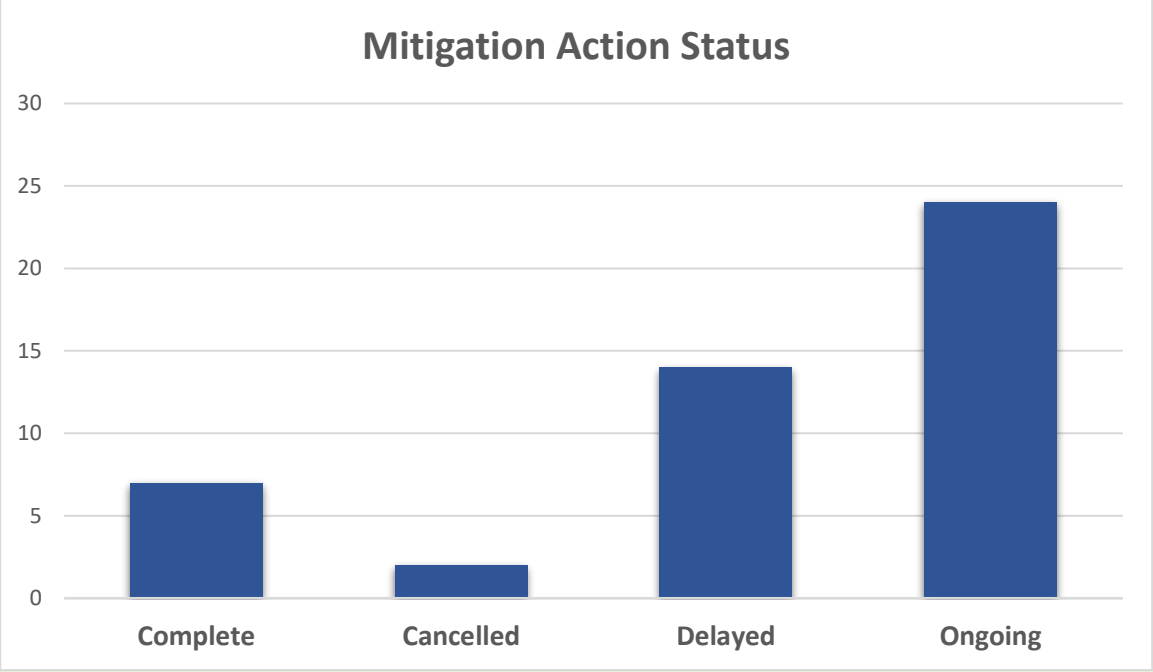
The construction, operation, maintenance, modification, and abandonment of dams is be regulated and monitored by the Maryland Department of Environment Dam Safety Program. Ultimately the safe operation, inspection, and maintenance of the dams is the responsibility of the owner. Dams are evaluated based on categories such as slope stability, undermining seepage, and spillway adequacy. The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur.

Dam Emergency Action Plans drafted in accordance with the Federal Guidelines for Dam Safety identify the risk related information include the inundation area and the time lapse between failure and flooding reaching specific destinations downstream. These plans are also reviewed and approved by local Emergency Management Agencies. Caroline County has the potential to be affected by dam failure, and therefore it is essential to have emergency planning procedures.

Chapter 14
2019 Mitigation Action Status

Chapter Updates

- This chapter was updated to reflect the statuses for the 2019 mitigation actions.
- An overview of the chapter and results were provided at the beginning of the chapter.
- An overall table containing all 2019 mitigation action items provides the mitigation action item, action status (Complete, Cancelled, Delayed, Ongoing) as well as the responsible organization and associated hazard. In addition, a status update details were provided in the "2023 Status Update" section.
- Status updates were provided for municipal actions as well in a separate table.



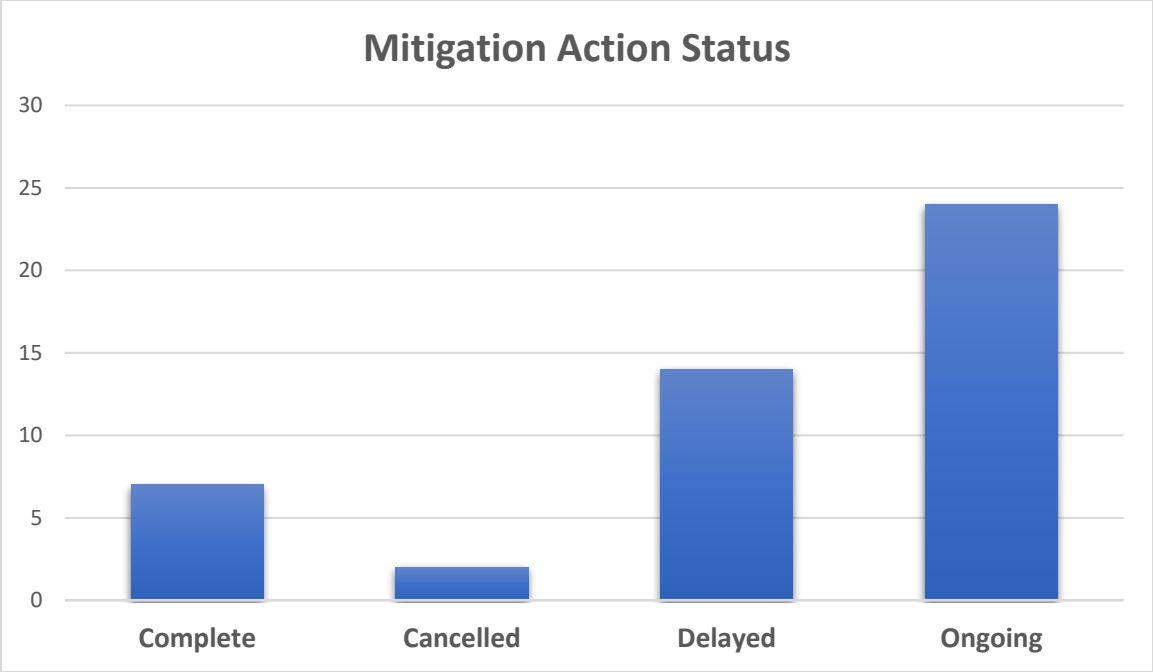
Mitigation Status Report

Mitigation which is action taken to reduce or eliminate long-term risk to hazards.

The purpose of hazard mitigation action items and associated projects is to reduce or eliminate long-term risk to people and property from hazards and their effects. During this plan update process, 2019 mitigation action items were reviewed by the Hazard Mitigation Planning Committee (HMPC) and representatives from each of the ten municipalities. As a result, this mitigation status report was developed for this plan update. A progress status and additional details have been provided for each of the 2019 action items.

Table 14-1 lists the mitigation action items that were set forth in the 2019 Caroline County Hazard Mitigation Plan. The table provides the mitigation action item, action status (Complete, Cancelled, Delayed, Ongoing) as well as the responsible organization and associated hazard. In addition, status update details were provided in the "2023 Status Update" section. Action items ranked as a "High" priority by the 2019 Hazard Mitigation Planning Committee are denoted with "High Priority."

A total of forty-seven (47) action items were evaluated as part of the plan update process; nine (9) of these action items were ranked as "high priority" in the previous plan. Members of the Hazard Mitigation Planning Committee (HMPC) provided important feedback regarding the progress of these action items/strategies. Based on this feedback, the following was determined: seven (7) mitigation actions are "completed," two (2) mitigation action item was "cancelled," fourteen (14) mitigation actions are "delayed," and twenty-four (24) action items are "ongoing." The graph below further illustrates the present status of the 2019 mitigation actions based upon stakeholder feedback.



The mitigation actions identified as "completed" in Table 14-1 are listed below. Four (4) of the high priority mitigation actions was designated as "completed"; these mitigation actions are identified in red.

- **Action Item #4** – LEPC Link on Department of Emergency Services.
- **Action Item #23** – Install Three Fixed Weather Monitoring Stations.
- **Action Item #24** – Install Generator at DES.
- **Action Item #25** – Install Generator Transfer Switch.
- **Action Item #26** – Replace generator at County Corrections/Sheriff's Department located on 101 Gay Street, Denton.
    - The Sheriff's Office relocated.
- **Action Item #28** – Develop Agreement between DES and Public Works for Shelter Signage.

The HMPC determined which mitigation actions/strategies identified as being "delayed" will be carried forward into the current plan update. The HMPC determined a total of four (4) mitigations actions would be carried forward into the Hazard Mitigation Plan Update.

The table on the following pages provides full status details for each mitigation action identified in the 2019 Hazard Mitigation Plan.

Table 14-1: 2019 Mitigation Actions Status Updates

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
Prevention			
1	The NFIP requires structures built within the floodplain to have first floor elevations determined. The County's GIS department could partner with building inspectors/permit administrators to maintain a database of new structures with their first-floor elevations. These elevations can be used with forecasting software such as HAZUS to predict vulnerable structures during a specific hazard event. Currently, Caroline County uses the State's open-source data and HAZUS data has not been utilized.	Planning & Codes	Flood
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DPC-Floodplain Coordinator:** Elevation certificates are a requirement for determining whether a structure is built in accordance with the elevation requirements; however, we have not incorporated this elevation information into our GIS data.		
2	Utilizing FEMA's Flood Mitigation Assistance Program create a Flood Mitigation Plan for the County. This plan will assist the county in obtaining Floodplain Management planning points for the NFIP Community Rating System, thereby lowering flood insurance premiums for homeowners.	Emergency Services, Planning & Codes	Flood
	Complete **Cancelled** **◉ Delayed** **Ongoing**		
	2023 Status Update: **DES:** Nuisance Flood Plan was created in July 2020. The NFIP Rating System was not created due to COVID and personnel changes within the county. We will address additional updates and changes that need to be made. **DPC-Floodplain Coordinator:** A Flood Mitigation Plan has not been established; however, this would still be an action we would like to use for future CRS credits.		
3	Consider working with utility companies to identify problem areas and the possibility of changing to underground lines in those areas. ***High Priority.**	Public Works, Planning & Codes, Delmarva Power, Choptank Electric	Winter Storms, Severe Weather & Power Outages
	Complete **Cancelled** **◉ Delayed** **Ongoing**		
	2023 Status Update: **DPC**-Floodplain Coordinator: The Planning and Codes Department has not contacted any public utilities regarding overhead utility lines. **DPW** - Ongoing		
4	Create a LEPC link from the Emergency Services website. The Emergency Services entire department website is undergoing redesign in the near future. Proposed updates include live feeds, widgets, and a wealth of new information from Emergency Management partners at all levels. ***High Priority.**	Emergency Services, Office of IT	All
	◉ Complete **Cancelled** **Delayed** **Ongoing**		
	2023 Status Update: **DES:** LEPC web link was created on the Department of Emergency Services website.		

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
5	Conduct a Hazardous Materials Survey to identify all hazardous materials that are either stored or traveling through the county.	Emergency Services, LEPC	HazMat
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DES:** We will work with the LEPC to conduct a Commodity Flow Survey for Caroline County identifying the specific routes. **Town of Denton:** 1. Methanol (500 Gallon Storage Tank). Used as a carbon source for the Wastewater Treatment Plant on 650 Legion Road. 2. Aluminum Chloride (7,000 Gallon Storage Tank). Used as a coagulant source for the Wastewater Treatment Plant on 650 Legion Road. 3. Sodium Hypochlorite 12.5%: Used as a disinfectant for the water system. Each Well (1000 Camp Road, 511 Kerr Ave, 5 Engerman Avenue) has 165-gallon storage tanks onsite.		
6	Using Hazardous Materials Survey results, develop a plan to mitigate any identified risks.	Emergency Services, LEPC	HazMat
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DES:** Using the Commodity Flow Study, Caroline County will develop with the LEPC any mitigation for the identified risks. **Town of Denton:** 1. Methanol: Stored in a Convault Tank with Primary internal steel lining, and secondary internal steel lining. Additionally, a flame arrestor is installed on the tank. Firefighting measures are close by (hydrant, fire blanket, eye wash, shower).		
7	Integrate elements of the Hazard Mitigation Plan into the 10-year Comprehensive Plan update. • 2010 Caroline County Master Plan • 2009 Federalsburg, Goldsboro, Henderson, Ridgely, and Templeville Comprehensive Plans • 2010 Greensboro and Hillsboro Comprehensive Plans • 2005 Preston Comprehensive Plan & 2012 Municipal Growth Element	Planning & Codes, All Municipalities	All
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **CCHD:** Henderson and Goldsboro are in the process of updating their comp plans. **Town of Ridgely:** We are working with Wallace Montgomery Engineers to update our comprehensive plan. **Town of Henderson and Goldsboro:** Henderson and Goldsboro are in the process of updating their comp plans. **DPC-Floodplain Coordinator:** The Planning and Codes Department is getting ready to start updating the County's Comprehensive Plan and will look to the Hazard Mitigation Plan for elements to incorporate. **Town of Greensboro:** Greensboro's Comp Plan is still being worked on. We will ensure that elements of the Hazard Mitigation Plan are incorporated. **Town of Preston:** Working on our update with Preston Planning and Zoning. **Town of Federalsburg:** The Comprehensive Plan is currently being updated.		

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
Property Protection			
8	About 13 percent of all septic systems in the County are located within the Critical Area. Upgrade these systems using Bay Restoration Funds.	Public Works, UMD Extension Service	Flood & Coastal Storm
	Complete **Cancelled** **Delayed** ◉ **Ongoing**		
2023 Status Update: **DPC-Floodplain Coordinator:** Funding is available through the Environmental Health Department for upgrades to failing septic systems within the Critical Area. **Town of Greensboro:** Greensboro is on track to begin a WWTP expansion and does utilize Bay Restoration Funds.			
9	Perform a detailed analysis of structures in the floodplain for the towns of **Henderson**, **Greensboro**, **Hillsboro**, and **Federalsburg** to determine first floor elevation for mitigation project purposes. Develop a Flood Mitigation Plan for Caroline County.	Planning & Codes, Identifiable Municipalities	Flood
	Complete **Cancelled** **Delayed** ◉ **Ongoing**		
2023 Status Update: **CCHD:** Unsure of status in Henderson. **Town of Henderson and Goldsboro:** Unsure of status in Henderson. **DPC-Floodplain Coordinator:** The County has not established a Flood Mitigation Plan. A majority of the structures in the floodplain are pre-FIRM, meaning constructed prior to the creation and adoption of the Flood Insurance Rate Maps. Since most houses are pre-FIRM, elevation data is not readily available. **Town of Greensboro:** Greensboro is currently evaluating its hazard mitigation and emergency management policies. **Town of Federalsburg**: Carry forward into plan update.			
10	Asses existing multilevel structures such as hospitals and apartment complexes for their wind load capacities, specifically in municipalities. A list of 3+ story structures in their town would need to be inventoried.	Health Department, Municipalities, Planning & Codes	Coastal Storm, Tornado, & High Wind
	Complete **Cancelled** **Delayed** ◉ **Ongoing**		
2023 Status Update: **CCHD:** N/A for Goldsboro and Henderson. Making sure that this refers to our Environmental Health Division for Damage Assessment assistance. CCHD would not have any responsibility for wind or snow loads. Our Environmental Health Division has new leadership - training as to what is expected should be scheduled. **Town of Ridgely:** 10 West Railroad Avenue apartment complex is a three-story building. **Town of Henderson and Goldsboro:** N/A for Goldsboro and Henderson. **DPC-Floodplain Coordinator:** The Planning and Codes Department has not assessed multilevel structures of this nature. Most structures of this use type are located within municipalities due to wastewater requirements. As a side note, the County did not adopt a building code until 2002. Any structure built prior to 2002 would not have any building plan requirements. Any structures that did have building plans from 2002 to the present day, more than likely would not have wind load capacities listed on them unless prepared by an architect or engineer. **Town of Greensboro:** Greensboro Code Enforcement is conducting inspections and evaluations; however, many landlords make the process difficult. In addition, the Town has a new subdivision going in that will include an apartment complex and mixed-use buildings. **Town of Preston:** Town Water Tower, Nagel Silo's, and Grow Mark Facility Silo's. Complete. **Town of Federalsburg**: Carry forward into plan update.			

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
11	Mitigate and upgrade flooded roads and ditches when funding is available, specifically evacuation routes. ***High Priority.**	Public Works	Flood
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DPC-Floodplain Coordinator:** The Planning and Codes Department, in conjunction with the Public Works Department, reviews proposed road upgrades within the floodplain. **Town of Greensboro:** Storm water management is being incorporated, as needed, during the Town's continued I&I and street repairs. **DPW**: Ongoing		
12	Evaluate Garland Road bridge and the Route 404 Bypass Bridge near **Hillsboro** to conclude if the elevation is higher after recent road construction.	Public Works, Hillsboro	Flood & Severe Weather
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DPW**: Ongoing		
13	Complete a detailed flood study of the Forge Branch. The Forge Branch flows through the Priority Funding Area adjacent to the Town of **Greensboro** on the Northwest Side. This area is slated for future development.	Greensboro Public Works, UMD Extension Service, Soil Conservation District	Flood
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **University of Maryland Sea Grant Extension Program:** Status uncertain. **Town of Greensboro Public Works:** Evaluating - the area has potentially been sold for solar fields despite being part of the Town's future growth area. Further research is required.		
14	Identify Pre-FIRM structures that are in the floodplain and need substantial improvements (50% value increase) to be brought to compliance.	Planning & Codes	Flood & Severe Weather
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DPC-Floodplain Coordinator:** As part of a request from FEMA, the Planning and Codes Department has identified structures within the floodplain; however, elevation data associated with the structures has not been verified and/or is not available. Without knowing the elevation associated with a structure, you could not estimate whether bringing the structure into compliance would be considered substantial improvement.		

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
15	Prioritize mitigation of Repetitive Loss Properties discussed in Chapter 4: Riverine Flooding. Look for opportunities to create open space/recreation space in flood hazard areas. Consider current and future flood conditions.	Planning & Codes, Parks & Recreations	Flood
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DPC-Floodplain Coordinator:** Repetitive Loss Properties are required to be identified as part of the County's annual recertification of our CRS program. The County has focused on preservation of open space within the floodplain though enforcement of higher regulatory standards. **Town of Greensboro:** Greensboro is working on all parks, open spaces, and recreational areas. Greensboro's Choptank River Park is in a critical area and flood zone and the intent is for it to become a family park.		
	Public Education and Awareness		
16	Provide information to citizens focusing on fire resistant wildfire zones around structures. Zones should be free of leaves, debris, or flammable materials for at least 30-foot perimeter.	Emergency Services	Wildfire
	Complete **Cancelled** **◉ Delayed** **Ongoing**		
	2023 Status Update: **DES:** This is a low hazard for Caroline County. This awareness has not been sent out to the public.		
17	Continue to promote Caroline County Connect CodeRED system, which allows residents and businesses to subscribe to important notifications including hazard alerts. ***High Priority.**	Emergency Services, Municipalities, Sheriff's Office	All
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **DES:** Caroline County has moved to Everbridge. We have a link on our website, as well as the County website for subscribers to opt into the system. We are also in the process of mailing out brochures to residents in the county with information on Everbridge. We continue to push Everbridge at our Special Events with our staff. **CCHD:** Goldsboro and Henderson both need to complete this task. CCHD should be added to this - We assist with half the funding for the Everbridge System and assist with notifications for health-related partners and staff. Under possible funding sources, the Public Health Emergency Preparedness (PHEP) Grant should be listed. **Town of Ridgely:** We would like to participate in this system. **Town of Henderson and Goldsboro:** Goldsboro and Henderson both need to complete this task. **Town of Greensboro:** Town faces difficulties in encouraging residents to subscribe to mass notification systems but will work on additional promotions. **Town of Preston:** Complete.		

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
Natural Resource Protection			
18	Develop guidelines for County road ditches and for designated priority areas with sensitive environmental conditions. Using GIS to identify potential priority areas including ditches located in these areas and use recommended types of vegetation for buffers, restrictions on scraping or clearing ditches of vegetation, filtration systems, or use of drainage control structures.	Public Works, UMD Extension Service, Soil Conservation District	Flood
Complete	**Cancelled**	**◉ Delayed**	**Ongoing**
2023 Status Update: **University of Maryland Sea Grant Extension Program:** Status uncertain.			
19	According to a 2004 State water resources report, Eastern Shore agricultural water withdraws will likely conflict with increased water demand as a result of future population growth. Working with MDE and MDA find the most efficient crop irrigation methods.	Public Works, UMD Extension Service, Soil Conservation District	Drought
Complete	**Cancelled**	**◉ Delayed**	**Ongoing**
2023 Status Update: **University of Maryland Sea Grant Extension Program:** Status uncertain.			
20	Encourage 100 percent of implementation of nutrient management plans for farming operations through public outreach programs.	Public Works, UMD Extension Service, Soil Conservation District	Flood
Complete	**◉ Cancelled**	**Delayed**	**Ongoing**
2023 Status Update: **University of Maryland Sea Grant Extension Program**: Status uncertain.			
Emergency Services			
21	Assess all shelters and their ability to sustain damage for specific hazard types and identify retrofitting projects based on this assessment. ***High Priority.**	American Red Cross, Emergency Services, Social Services	All
Complete	**Cancelled**	**Delayed**	**◉ Ongoing**
2023 Status Update: **DES:** In general, the buildings are out of the floodplain and are relatively secured from a lot of potential hazards, however, the major hazard that fire departments are susceptible to is wind damage. It is recommended that DES to work with the fire companies to retrofit the buildings to withstand straight line and storm wind damage. **CCHD:** CCHD should be added to this as well. We are in charge of the Health Suites within the Shelters. It would be beneficial for us to also assess the shelters for the ability to handle potential medical equipment and needs.			

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
22	Coordinate with the Department of Emergency Services and the Department of Social Services to upgrade all shelter resources. ***High Priority.**	American Red Cross, Emergency Services, Social Services	All
	Complete **Cancelled** **Delayed** ◉ **Ongoing**		
2023 Status Update: **DES:** Emergency Services would be working with the Volunteer Fire Departments and identify and hazard mitigation within the facilities for specific hazards. **CCHD:** CCHD should also be added to this due to the Health Suites and the ability to utilize our Public Health Emergency Preparedness (PHEP) grant to assist in procurement of shelter and emergency preparedness items.			
23	Install three fixed weather monitoring stations for the entire jurisdiction resulting in real-time data of precipitation amounts, and wind speed/direction that are critical to the decision-making process for DES. Live data would be available to DES and 9-1-1 dispatch center. ***High Priority.**	Emergency Services, Public Schools	All
	◉ **Complete** **Cancelled** **Delayed** **Ongoing**		
2023 Status Update: **DES:** We have installed three Davis Weather stations in the county. Denton (Central Caroline County), Federalsburg (South Caroline County), and Goldsboro (North Caroline County). **Town of Denton**: A weather station was installed at the Wastewater Treatment Plant. Website data is available if necessary. This is a lower end weather station however it tracks precipitation, wind speed, barometric pressure, and temperature.			
24	Purchase and install a new generator in the Caroline County Department of Emergency Services located on 9391 Double Hills Road, **Denton.** ***High Priority.**	Emergency Services	All
	◉ **Complete** **Cancelled** **Delayed** **Ongoing**		
2023 Status Update: **DES:** Generator installed at the DES Headquarters and Paramedic Station 13 facility January 2022.			
25	Install generator transfer switch at Caroline County Courthouse located on 109 Market Street, **Denton.**	Emergency Services, Sheriff's Office, County Admin	All
	◉ **Complete** **Cancelled** **Delayed** **Ongoing**		
2023 Status Update: **DES**: New generator installed with transfer switch.			

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
26	Replace generator at County Corrections/Sheriff's Department located on 101 Gay Street, **Denton.**	Emergency Services, Sheriff's Office, County Admin	All
	Complete **Cancelled** ◉ **Delayed** **Ongoing**		
	2023 Status Update: **DES:** The Caroline County Sheriff's office is now located at 9305 Double Hills Rd. and the facility has a new generator. The generator for the detention center was not replaced.		
27	Install a transfer switch in the 4H buildings for back-up point of dispensing, shelters, or other emergencies.	Emergency Services, Sheriff's Office, County Admin	All
	Complete ◉ **Cancelled** **Delayed** **Ongoing**		
	2023 Status Update: **DES:** No generator has been installed at the 4H Park. This is not in the future plans to provide as a shelter. **CCHD**: Requesting to be placed in loop on this - as the HD handles PODs for Radiation Releases, Anthrax, etc. as well as the Health Suite at opened shelters.		
28	Develop a formal agreement between Department of Emergency Services (DES) and Public Works to establish formal protocols for the placement and removal of signage for shelters and movement of trailers. In addition, develop Standard Operating Procedures between DES and Public Works to identify shared resources and capabilities, as well as gaps. ***High Priority.**	Public Works, Emergency Services, County Admin	All
	◉ **Complete** **Cancelled** **Delayed** **Ongoing**		
	2023 Status Update: **DES:** Established county policy within the EOP. **CCHD:** SOP between DES and CCHD should be considered not just for the Health Suites within the Shelters for medical care, but also for CCHD's emergency response trailer for PODs, mobile vaccination unit and two mobile treatment units for mental health and substance use disorder treatments. **DPW**: Ongoing		
	Structural Projects		
29	Work with the Town of Greensboro to upgrade undersized water lines for fire suppression.	Greensboro	Wildfire & Major Fire
	Complete **Cancelled** **Delayed** ◉ **Ongoing**		
	2023 Status Update: **Town of Greensboro:** The Town will work on upgrading the water lines as it is working on replacing lead/copper lines. In addition, new builds are required to have 1" vs 5/8" meters.		

#	ACTION	RESPONSIBLE AGENCY(S)	HAZARD
30	Update floodplain management ordinance to address sea level change, using a standard of 2050 Sea Level Change projection, 2.11 feet, plus 1% chance flood inundation (previously known as the 100-year flood event).	Planning & Codes, Municipalities with Floodplain	Flood & Sea Level Rise
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update: **Town of Ridgely:** Currently not applicable. Flooding issues in Ridgely occur from stormwater. There are no tidal bodies of water in town limits. **DPC-Floodplain Coordinator:** Current floodplain regulations require a flood protection elevation of 2' above the base flood elevation; meaning you are required to have the finished floor of the structure 2' above the actual flood elevation called out in the flood insurance study and the flood insurance rate maps. Flood studies and maps will more than likely be updated to incorporate projected sea level rise, as the state of Maryland has been at the forefront of higher regulatory standards for flood policies. **Town of Federalsburg**: Town is not familiar with this program.		
31	Develop capital improvement guidelines to assist in the review of Capital Improvement Projects (CIP) at the department and County level, encouraging resilience to future hazards as criteria in siting and design of capital projects.	Finance, Public Works, County Admin	All
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update:		
32	Encourage capital improvement program to include funding for hazard mitigation projects.	Finance, Public Works, County Admin	All
	Complete **Cancelled** **Delayed** **◉ Ongoing**		
	2023 Status Update:		

In addition to the overall mitigation action items identified in the 2019 Caroline County Hazard Mitigation Plan, municipal specific mitigation action items were developed. Municipalities were asked to provide status updates for each mitigation action that was associated with their town. Status updates for municipal specific mitigation action items are listed in the following table.

Table 12-2: 2019 Municipal Mitigation Action Status Updates

ACTION	GOALS	OBJECTIVES	TIMEFRAME	HAZARD
Property Protection				
Consider flood mitigation options for the **Federalsburg** Police Station located in FEMA Flood Zone AE.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Delayed.** This action item should be carried forward in the plan update.				
Consider flood mitigation options for the **Federalsburg** Wastewater Treatment Plant located in FEMA Flood Zone AE.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Delayed.** This action item should be carried forward in the plan update.				
Consider flood mitigation options for the **Greensboro** Wastewater Treatment Plant located in FEMA Flood Zone AE.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Complete.** The new Greensboro WWTP is located outside of FEMA Flood Zone. New action item should be to relocate WWTP pump stations located in Flood Zones.				
Consider flood mitigation options for the **Federalsburg** Town Hall located in FEMA Flood Zone AE.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Delayed.** This action item should be carried forward in the plan update.				
Raise controls at East Lift Station and (3) pump stations for preventative measures for future flooding events in the Town of **Greensboro**.	2 5 6	2.2 5.1; 5.5 6.1; 6.2; 6.4	Long-term	Flood
2023 Status Update: **Ongoing.** The East Lift Station and pump stations have undergone many repairs and are being evaluated on many levels, including the need for upgrades. The Town experienced extensive flooding during Tropical Storm Irene which resulted in significant changes to the area surrounding the East Lift Station. The Town's original WWTP was turned into a pump station after the new WWTP was built.				

ACTION	GOALS	OBJECTIVES	TIMEFRAME	HAZARD
Negotiate the extension of service from the North County Water and Sewer Authority to the Towns of **Marydel**, **Henderson, and Templeville**.	2 6	2.2 6.2; 6.4	Long-term	All
2023 Status Update: **Ongoing.** Funding is being applied for and engineers are working on the PER. This action item will be carried forward into the plan update.				
Research feasibility and cost benefit analysis for the addition of a second water tower or a method to replenish the supply in the existing tower in the Town of **Preston.**	2 5	2.2 5.1	Long-term	All
2023 Status Update: **Delayed.** We have never researched the feasibility or cost analysis of a second water tower in Preston. We currently have a 150,000-gallon tank. To ensure a fresh water supply we need to turn the supply over every 2-3 days. During the month of August, we pumped 1,922,600 gallons of water. This works out to an average of 62,000 gallons per day. This is right where we need to be with the size of our water tower. However, it couldn't hurt to have a second opinion on this. As far as the method we use to replenish the water in the tower, we pump out of two wells from the Columbia aquifer. Each well traditionally runs once per day. I don't think we need a third well, but I could be wrong. I do know we need at least two wells; in case one is down for maintenance.				
Maintain and/or improve culvert on Church Street within the Town of **Hillsboro** which has a sediment issue. The accumulation of sediment at this location leads to regular nuisance flooding. The surrounding area will be modified to accompany a dog park, adjust, and enhance the flow through the culvert, etc.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Delayed.** A team of federal and state experts reviewed the drainage and street conditions. However, there was a lack of funding available at that level to assist the Town.				
Establish a staging area for the Queen Anne-Hillsboro Volunteer Fire Company to stage equipment at **Hillsboro** Town Hall. Construction of an auxiliary building will be necessary. This action will improve the response time of the Hillsboro first responders. They will not have to drive around the bridge via MD-404 due to flooded road conditions in that area.	2 5 6	2.2 5.5 6.1; 6.2	Long-term	Flood
2023 Status Update: **Delayed.** Lack of funding.				
Public Education and Awareness				
Encourage the Town of **Federalsburg** to participate in the FEMA FloodSmart – National Flood Insurance Program (NFIP) Campaign to help raise awareness in reaching new customers in high-risk flood areas and to encouraging existing customers to renew their policies.	2 3 6	2.1 3.3 6.5	Short-term	Flood

ACTION	GOALS	OBJECTIVES	TIMEFRAME	HAZARD
2023 Status Update: **Ongoing.** This action item should be carried forward in the plan update.				
Natural Resource Protection				
Implement a Strategic Plan for the Town of **Denton**, which provides the breakdown for Public Works, e.g., Sewer vs. Water.	2 3 6	2.3 3.1; 3.2 6.2; 6.4	Long-term	Flood
2023 Status Update: **Ongoing.** This action item should be carried forward.				
Emergency Services				
Purchase watercraft for rescue situation in the Town of **Greensboro**.	2	2.2	Short-term	Flood & Severe Weather
2023 Status Update: **Delayed**. Carry forward. Considering the devastating flooding from TS Irene, this will be a priority for discussion with Town Council.				
Develop emergency kits - Meals Ready to Eat (MRE) to hand out in an emergency in the Town of **Greensboro**.	2	2.2	Short-term	All
2023 Status Update: **Delayed.** Carry forward. The Town does not have any MREs, but it is something that I will include in discussions with Town Council as we continue to review our emergency preparedness and hazard mitigation.				
Purchase generators to operate wells in the Town of **Greensboro**.	1 5 6	1.3 5.5 6.1; 6.2	Short-term	All
2023 Status Update: **Complete.** The Town has and has had generators for the wells and Town buildings. They are all under maintenance contracts.				
Purchase generator for the water tower pump house in the Town of **Preston.**	1 5 6	1.3 5.5 6.1; 6.2	Short-term	All
2023 Status Update: **Delayed.** A generator for the water plant is a great idea. We had an ice storm in the early 1990's that left us without power for 5 days. We naturally couldn't refill the water tower and were without water the entire time. This is obviously a health hazard, and a generator would make it possible to refill the tower.				

Chapter 15 Capability Assessment & New Mitigation Actions

Chapter Updates

- The capability assessment was expanded upon for the plan update.
- The Hazard Mitigation Plan Guidance: Community Capability Assessment Worksheets were used as reference to update Table 15-1. The 2019 version contained only sections of planning and regulatory. As part of the update process, capabilities were expanded to include other planning, technical, fiscal, and administrative capabilities.
- In addition to capabilities assessed in Tables 15-1 to 15-4, capabilities identified in the previous plan have been updated. These capabilities include:
    - Plan Integration
    - Emergency Services
    - Flooding Risk Reduction
    - Multi Hazard Building Codes
    - Protection & Preservation Programs
    - Public Works
    - Public Health
    - Emergency Alert Notifications
    - Current Risk Reduction Projects
    - Caroline County, Maryland NFIP Community Questionnaire
- Goals and objectives were reviewed and updated by the Hazard Mitigation Planning Committee; one (1) new goal and fourteen (14) new objectives were added.
- The 2024-2029 Mitigation Actions section has been rewritten to reflect the process used during this plan update.
    - Discussion on the Mitigation Workshop was provided as well as the results of mitigation actions that are included in plan update.
    - In addition to the selection of mitigation action for inclusion in the plan update, HMPC members prioritized mitigation actions that resonated the most with them and/or had a high likelihood of completion.
    - Table 15-5 provides the action item number, the mitigation action, hazard(s) the action item addresses, the community the action item would help, the lead agency/department for the implementing the action item, the category the action item falls under, potential funding, and the implementation schedule.

Capability Assessment

A review of the community's capabilities, both Caroline County and its municipalities was conducted for this Plan update. Understanding current capabilities and identifying capability gaps that may exist informs mitigation initiatives going forward. In the previous 2019 Plan, capabilities were included and have been updated. However, additional information has been added during this Plan update. The Hazard Mitigation Plan Guidance: Community Capability Assessment Worksheets were used as reference for this assessment. Capabilities have been labeled using the four (4) categories from FEMA's Hazard Mitigation Plan Guidance: Community Capability Assessment Worksheets.

Planning and Regulatory - Planning and regulatory capabilities are plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards.

Administrative and Technical - Administrative and technical capabilities include boards, commissions, departments, staff, and consulting services, along with the related skills and tools, that can be used for mitigation planning and the implementation of specific mitigation actions.

Financial - Financial capabilities include access to or eligibility to use funding resources for hazard mitigation.

Education and Outreach - Education and outreach capabilities include programs and methods already in place that could be used to support implementation of mitigation actions and communicate hazard-related information.

Table 15-1 provides County and municipal details on existing plans, policies, and ordinances. For those municipalities that do not have critical areas, floodplains, slopes, wetland, and forested areas were denoted on the table using "N/A". This information was reviewed and updated during the September 18, 2023, Hazard Mitigation Planning Committee meeting. As part of the update process, capabilities were expanded to include other planning, technical, fiscal, and administrative capabilities.

Table 15-1: Planning & Regulatory

PLANNING & REGULATORY	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
The Maryland Chesapeake Bay Critical Area Program											
The Maryland Chesapeake Bay Critical Area Program, as administered by Caroline County, protects tributary streams located within 1000 feet of tidal waters. The Program establishes appropriate land uses and provides environmental protection measures which establish criteria designed to minimize adverse impacts on water quality, natural resources, wildlife habitats, and spawning grounds, while accommodating growth in the area. Under Caroline County's Critical Area Program, tidal rivers and streams are protected by a 100 foot shoreline buffer, within which no new development is permitted.	✓	✓	N/A	✓	N/A	✓	✓	✓	N/A	N/A	✓
Not Applicable (N/A) Explanations											
The Towns of Goldsboro, Henderson, Ridgely and Templevillle are outside of the designated Chesapeake Bay Critical Area.											
100-Year Floodplain Regulations											
Flood Protection Elevation Base Flood Elevation (BFE) plus freeboard. Freeboard is a factor of safety that compensates for uncertainty in factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, obstructed bridge openings, debris and ice jams, climate change, and the hydrologic effect of urbanization in a watershed.											
The Base Flood Elevation (BFE) plus two (2) feet of freeboard.	✓		N/A		N/A			N/A	N/A	N/A	✓
The Base Flood Elevation (BFE) plus one (1) foot of freeboard.		✓		✓		✓	✓				
Flood Protection Setback A distance measured perpendicular to the top of bank of a watercourse that delineates an area to be left undisturbed to minimize future flood damage and to recognize the potential for bank erosion.											
One hundred feet, if the watercourse has special flood hazard areas shown on the FIRM, except where the setback extends beyond the boundary of the Special Flood Hazard Area (SFHA).	✓	✓	N/A	✓	N/A	✓	✓	N/A	N/A	N/A	✓
Fifty feet, if the watercourse does not have special flood hazard areas shown on the FIRM.	✓	✓		✓		✓	✓				✓

PLANNING & REGULATORY	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
Not Applicable (N/A) Explanations											
Goldsboro: The existing Town of Goldsboro municipal limits are not located within the 100-Year Floodplain. Floodplain protection regulations will be required within the Town's zoning ordinance/subdivision regulations for future annexation areas.											
Henderson: Water Resources in the Henderson region include primarily the Choptank River. Public Drainage Associations provide for land drainage and improved agricultural production but are not classified as "streams" and only carry off rainfall runoff.											
Preston: There are no floodplain areas currently within the Town of Preston's limits that are within any 100 year floodplain. If these areas are annexed, the town will adopt a flood insurance ordinance and ensure that new development is kept behind a 100 foot setback from the edge of the 100 year floodplain.											
Ridgely & **Templeville**: There are no floodplains located within the current corporate boundaries of the Town of Ridgely or Templeville.											
Building Codes											
IBC – International Building Code (IBC) with the Department of Housing and Community Development (DHCD) modifications (Ref: COMAR 05.02.07)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year	2021	2021	2021	2021	2018	2012		2021	2021	2000	2021
Slopes											
Steep slopes are rare in the County with only 1% of soils having been identified as having a slope greater than 15%. Most steep slopes occur along rivers and streams adjacent to or near tidal areas and are protected by the *Caroline County Chesapeake Bay Critical Area Program and Regulations*. A 50-foot setback from the top of steep slopes will provide a no disturbance buffer that will help ensure erosion and siltation do not adversely affect water quality or slope stability.	✓	✓	✓	N/A	N/A	✓	✓	✓	✓	N/A	✓
Not Applicable (N/A) Explanations											
The Towns of Greensboro, Henderson and Templeville are relatively flat and do not contain steep slopes of 15% or greater within municipal limits.											
Water Resources Plan											
The relationship of planned growth to water resources for both wastewater disposal and safe drinking water supply.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PLANNING & REGULATORY	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
National Inventory of Non-Tidal Wetland											
Regulated by the U.S. Army Corps of Engineers and the State of Maryalnd, development impacts are required to fall beyond a 25-foot buffer surrounding mapped non-tidal wetlands.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For consistency and ease of administration (as well as increased protection) Federalsburg intends to adopt a 50-foot buffer for all nontidal wetlands, both within and outside the Critical Area.											
Not Applicable (N/A) Explanations											
Wetlands are not located within the municipal limits for the Towns of Henderson and Templeville.											
Stormwater Management											
Manage stormwater by using environmental site design (ESD) to the maximum extent practicable (MEP) to maintain after development as nearly as possible, the predevelopment runoff characteristics, and to reduce stream channel erosion, pollution, siltation and sedimentation, and local flooding, and use appropriate structural best management practices (BMPs) only when necessary.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
The Town of Preston's stormwater management criteria for any development, beyond the small amount of infill in the village, is regulated by the County.											
The Town of Goldsboro: A permit may not be issued for any parcel or lot unless a stormwater management plan meeting all the requirements of the Caroline County Stormwater Management Ordinance has been approved.											
Forest Conservation / Natural Resources Protection Plan											
• Forest conservation regulations as mandated by the State Forest Conservation Act. These regulations limit clearing for development and in some cases require forested areas to be created in conjunction with new development. Forested areas and regions within Caroline County are subject to the Caroline County Forest Conservation Ordinance. Development must account for forested areas, ensuring that these resources are protected and/or replaced. • Ensures that resources and their functions are protected from the potential adverse impacts of land development or other disturbance.	✓	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓

PLANNING & REGULATORY	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
Forest Conservation / Natural Resources Protection Plan continued											
The Town of Denton's Forest Conservation ordinance requires at least a 50-foot buffer adjacent to intermittent and perennial streams for afforestation and reforestation.											
The Forest and Woodland Protection Section (1-117) of the Town of Federalsburg's Critical Area Ordinance provides implementation of both Critical Area and Forest Conservation Act requirements.											
The Town of Goldsboro: Projects that ultimately require approval of subdivision, sediment control, site plan approval or grading permits must comply with the requirements of the Caroline County Forest Conservation Ordinance.											
Not Applicable (N/A) Explanations											
The Towns of Henderson, Marydel, Preston and Ridgely do not have forested areas within their municipal limits and therefore do not have forest conservation regulations.											
Climate Change Adaptation Plan											
An action plan and vulnerability assessment across a broad range of government services to anticipate, plan for, increase awareness of, and build momentum to address and adapt to a changing climate.	No	No	No	No	No	No	No	No	No	No	No
Emergency Operations Plan											
Organizational procedures and processes to respond to and recover from an emergency.	✓	✓	✓	No	No	No	No	No	No	No	✓
Comments											
The Towns of Hillsboro, Marydel, Preston, Henderson; Ridgely and Templeville do not have an Emergency Operations Plan (EOP) due to lack of staff to develop and implement an EOP. These Towns follow and/or coordinate with the County. The Town of Greensboro is currently in discussion to develop an EOP.											
Continuity of Operations Plan											
The effort within individual agencies to ensure they can continue to perform their mission essential functions during a wide range of emergencies. It's the initiative that ensures that governments, departments, businesses and agencies are able to continue their essential daily functions. COOP requires planning for any event – natural, human-caused, technological threats and national security emergency – causing an agency to relocate its operations to an alternate or other continuity site to assure continuance of its essential functions.	✓	No	No	✓	No	No	No	No	No	No	✓

Comments
The Town of Federalsburg has encountered a high rate of staff turnover and lack of staffing, therefore additional plans such as a COOP is not currently feasible. The Towns of Goldsboro, Henderson, Hillsboro, Marydel, Preston, Ridgely and Templeville are small municipalities and therefore consist of Town Council Members, Town Attorney, Town Manager, and Town Clerk. These Towns follow and/or coordinate with the County.

Table 15-2: Administrative & Technical

ADMINISTRATIVE & TECHNICAL	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
ADMINISTRATIVE											
Land Use Authority											
Authorities to adopt a comprehensive or master plan, to enact a zoning ordinance and to implement subdivision regulations.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Emergency Services (e.g., fire, police)											
Public organizations that respond to and deal with emergencies when they occur, especially those that provide police, ambulance, and firefighting services.	✓	✓	✓	✓	No	✓	✓	✓	✓	No	✓
Engineering Department											
An in-house department providing civil engineering capability.	No	No	No	No	No	No	No	✓	No	No	No
Code Enforcement Department											
An in-house department responsible for evaluating private properties and public grounds against local codes.	✓	✓	✓	✓	No	No	No	✓	✓	No	✓
Public Works Department											
Public works is the combination of physical assets, management practices, policies, and personnel necessary for government to provide and sustain structures and services essential to the welfare and acceptable quality of life for its citizens.	✓	✓	No	✓	No	No	No	✓	✓	No	✓
Finance Department											
An in-house department that is responsible for obtaining and handling any monies on behalf of the jurisdiction.	✓	✓	✓	✓	No	No	No	✓	✓	No	✓

ADMINISTRATIVE & TECHNICAL	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
Planning Commission/Zoning Board											
The local governing body and the planning commission share the responsibility for directing future growth in the jurisdiction.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chief Building Officer											
The in-house or contracted code enforcement staff responsible for evaluating private properties and public grounds against local codes, answering citizen questions about the codes, and issuing citations for code violations.	✓	No	✓	No	No	No	No	No	✓	No	No
Civil Engineer – Construction Project Management											
The in-house or contracted engineering staff responsible for managing construction projects and meeting budget and schedule constraints.	✓	No	No	No	No	No	No	No	Eng. Firm	No	No
Grant Administrator / Writer											
The in-house or contracted staff familiar with and capable of successfully handling FEMA Hazard Mitigation Assistance (HMA) grant program requirements consistent with the Code of Federal Regulations, as well as non-FEMA funding sources.	No	No	No	No	No	No	No	No	No	No	✓
GIS Coordinator											
The in-house or contracted staff responsible for formulating the GIS applications to satisfy requests for products or services, including supervising staff and translating application specifications into programs, user menus and macro-level commands.	✓	No	No	No	No	No	No	No	No	No	✓
Floodplain Manager											
Responsible for administering and enforcing the Floodplain Management Ordinance in accordance with FEMA/NFIP requirements and ensuring compliance with all other local, state, and federal requirements.	✓	No	No	No	No	No	No	No	No	No	✓
Comments											
Municipalities that indicated they do not have certain departments or positions in Table 13-2 is due to minimal staff or part time staff. Towns reference or coordinate with the County, where applicable.											

Table 15-3: Financial

FINANCIAL	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
Capital Improvements Program											
A short-range plan, usually 4 to 10 years, which identifies capital projects and equipment purchases, provides a planning schedule and identifies options for financing the plan.	✓	✓	No	No	No	No	No	No	No	No	✓
Comments											
Municipalities that indicated they do not have a Capital Improvement Program have minimal staff or part time staff.											
Funding Programs – Federal (Non-FEMA)											
Grant programs administered by Federal agencies other than FEMA with potential to fund mitigation actions. For example, the U.S. Department of Housing and Urban Development Community Development Block Grants, U.S. Department of Energy, and the U.S. Department of Transportation, etc.	✓	✓	✓	No	✓	No	No	No	No	No	✓
Utility Fees for Stormwater, Water, Sewer, Gas, Or Electric Services											
Fee levied by the jurisdiction, in addition to cost of service provided, for use in funding related capital programs, such as non-Federal shares for mitigation actions.	✓	✓	No	✓	No	No	No	✓	✓	No	✓
Tax Levies for Specific Purposes											
Special assessments typically are used for the extraordinary expense of a project that benefits the community. For example, a town might levy a special assessment tax to build a public recreation center or a park. The tax is intended to last for a set number of years.	No	No	No	No	No	No	No	✓	No	No	No

Table 15-4: Education & Outreach

EDUCATION & OUTREACH	DENTON	FEDERALSBURG	GOLDSBORO	GREENSBORO	HENDERSON	HILLSBORO	MARYDEL	PRESTON	RIDGELY	TEMPLEVILLE	CAROLINE COUNTY
StormReady Certification											
National Weather Service program that helps arm America's communities with communication and safety skills needed to save lives and property, before, during and after an event.	No	No	No	No	No	No	No	No	No	No	No
Seasonal Emergency Management and Mitigation Outreach											
• Seasonal outreach. For example, in advance of hurricane season or in anticipation of winter weather, including information regarding preparedness and mitigation measures that individuals can undertake for their own risk reduction. • Works with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.	No	No	No	No	No	No	No	✓	No	No	✓
Comments											
Towns rely on the County for seasonal and mitigation outreach.											

Upon review of the assessment worksheets, several recommendations have been identified based on capability gaps. These recommendations have been integrated into the mitigation strategies.

- Participation in the NWS StormReady for both the County and municipalities.
- Develop a countywide Climate Action Plan.
- Host annual emergency services coordination meeting with County and municipal representatives. Review the County's Emergency Operations Plan and Continuity of Operations Plan. Provide technical assistance to the municipalities regarding municipal plans or municipal elements within countywide plans. Review outreach plan and opportunities for collaboration.
- Host annual floodplain management coordination meeting with county and municipal representatives.

Integrating hazard planning into the County's and its municipalities planning framework will lead to development patterns and redevelopment that decreases hazard risk and vulnerability. In order to achieve and facilitate integration, Caroline County and its municipalities should further evaluate planning documents, policies, codes, and programs for hazard mitigation plan integration opportunities. These opportunities for plan integration will result in effective ways to reduce hazard vulnerability and community resilience.

Additional Capabilities

In addition to capabilities assessed in Tables 13-1 to 13-4, capabilities identified in the previous plan have been updated. These capabilities include:

- Plan Integration
- Emergency Services
- Flooding Risk Reduction
- Multi Hazard Building Codes
- Protection & Preservation Programs
- Public Works
- Public Health
- Emergency Alert Notifications
- Current Risk Reduction Projects
- Caroline County, Maryland NFIP Community Questionnaire

Plan Integration

Integrating hazard mitigation planning and implementation actions into existing planning mechanisms, such as comprehensive plans, and vice versa is essential to building a safer and more resilient community. Integration of planning documents results in consistency and collaborative ideas within the local planning structure.

Comprehensive plans, a Maryland requirement for jurisdictions with land use authority, were completed by the County and all 10 municipalities. These comprehensive plans were reviewed to identify planning capabilities that assist in the mitigation of hazard impacts. Comprehensive plans include:

- Town of Denton 2010 Comprehensive Plan
- 2009 Federalsburg Comprehensive Plan
- Goldsboro Comprehensive Plan, 2009
- Greensboro Comprehensive Plan, 2010
- Henderson Comprehensive Plan, 2009
- Town of Hillsboro Comprehensive Plan, 2009
- Marydel Comprehensive Plan, 2009
- Town of Preston Comprehensive Plan, 2005; Municipal Growth Element, 2012; and, Water Resource Element, 2012
- Town of Ridgely 2009 Comprehensive Plan
- Templeville Comprehensive Plan, 2009
- Caroline County Comprehensive Plan, 2010

Caroline County is currently in the process of updating the County's Comprehensive Plan, Caroline 2040. In addition, comprehensive plans for the Towns of Greensboro, Goldsboro, Henderson, Preston, and Ridgely are in the process of being updated as well. The Maryland Department of Planning is requiring all County and municipal comprehensive plans to be updated by 2025. Included in this Plan update is a mitigation action to integrate the hazard mitigation plan update into the County and municipal comprehensive plan updates.

Emergency Services

The Caroline County Emergency Operations Plan (EOP) was recently updated and published in the fall of 2022. The last date of revision was October 2016. The 2019 Hazard Mitigation Plan was integrated into the EOP under the Hazard Analysis Summary section of the plan.

The County has mutual aid agreements with surrounding counties for emergency services. In addition, the 2010 Maryland Code Public Safety Title 14-Subtitle 8-Section 14-803, Maryland Emergency Management Assistance Compact (MEMAC) enables jurisdictions to provide and receive mutual aid in managing emergencies. The compact also provides for mutual cooperation in emergency-related training and exercises.

MEMAC provides the County with access to a network of trained agency and volunteer personnel including State agencies such as the Maryland State Police, Department of Natural Resources, Department of the Environment, Department of Health, State Highway Administration, and the Maryland Department of Emergency Management.

In addition to mutual aid, another capability that has been enhanced over the years is Caroline County's Local Emergency Planning Committee (LEPC). The Caroline County LEPC meets quarterly and is chaired by the Caroline County Department of Emergency Services Emergency Management Division. The committee is comprised of:

- Police, fire, civil defense, and public health professionals
- Environment, transportation, and hospital officials
- Facility representatives
- Representatives from community groups and the media

Several Hazard Mitigation Planning Committee (HMPC) members are also members of the LEPC. The hazard mitigation plan update was discussed at meetings. Best practices and mitigation ideas were shared at these meetings.

Caroline County maintains open communication with private utility companies. The pre-existing lines of communication and collaboration have steadily improved, as evidenced during the hazard mitigation planning process.

Finally, in terms of training and exercise, Caroline County has conducted sheltering and community point of distribution exercises during the previous planning cycle. During this planning cycle, the County will continue to maintain and enhance capabilities through training and exercises. In January of 2019, a damage assessment training was conducted for the Department of Emergency Services and other departments. The training was extended to Public Schools, Planning & Codes Administration, Public Works, and neighboring jurisdictions to build capacity on the Middle Shore.

The Department of Emergency Services provides a webpage for education and training. The webpage contains a calendar displaying training events.

Excerpt for DES Education & Training webpage:

The Department of Emergency Services has implemented a training and continuing education program designed to ensure continuous quality improvement, improved patient outcomes, and provide every EMS Clinician in Caroline County (both career and volunteer) with all education and training required for recertification at both the national and state level. Additionally, the training staff of DES are highly involved in community outreach and education during special events like Summerfest as well as through educational courses such as CPR, AED, and Stop the Bleed. If you are interested in training opportunities conducted by DES, send us an email.

Flooding Risk Reduction

Caroline County's capabilities are similar to other counties that deal with flooding. Usually, local roads are blocked to some extent and when warranted, residents are asked to evacuate from the area.

The Department of Emergency Services has a plan which coordinates evacuation activities with the Public Works Department and State Highway Administration and with local police, fire and rescue units, the Health Department, and the Red Cross. While Caroline County makes a great effort to mitigate flood events, the character of the natural environment lends itself to further mitigation efforts, particularly that of moving people and structures from harm's way since there are large portions of the County that is not impacted by flood.

The County also has the capability to mitigate future flood losses through its Subdivision Regulations, Floodplain Management Ordinance and Building Code.

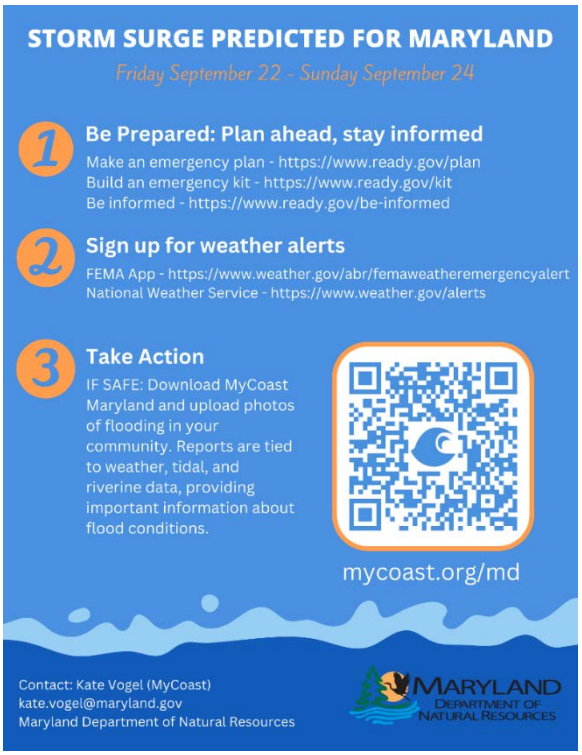
In October 1980, Caroline County adopted regulations, which require any new development to have sufficient area outside the floodplain to accommodate all construction, including wells and septic systems. All development located in the 100-year floodplain is subject to strict flood protection measures. Since 1995, Caroline County has participated in the Community Rating System (CRS) program and currently has a CRS rating of a Class 7. The CRS program is a voluntary program administered by the Federal Emergency Management Agency (FEMA) and provides discounts for flood insurance policy holders within participating communities. The most recent version of the Floodplain Ordinance became effective on November 25, 2014.

- **Flood Protection Elevation** – The base flood elevation plus two feet freeboard. "Freeboard" is a factor of safety that compensates for uncertainty in factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, obstructed bridge openings, debris and ice jams, climate change, and hydraulic effect of urbanization in a watershed.
- **Flood Protection Setback A –** Along nontidal waters of the state, the flood protection setback is:
    A. One hundred feet, if the watercourse has special flood hazard area shown on the Flood Insurance Rate Maps (FIRM), except where the setback extends beyond the boundary of the special hazard area; or
    B. Fifty feet, if the watercourse does not have special flood hazard areas shown on the FIRM.

Planning & Codes answers all questions regarding floodplain determinizations using the effective Digital Flood Insurance Rate Maps (DFIRMs) and Flood Insurance Study (FIS). The Caroline County Floodplain Ordinance follows the Maryland State Model Floodplain Ordinance, which has many higher regulatory standards that exceed minimum NFIP requirements. The most current DFIRM/FIRM and Flood Insurance Study was adopted January 16, 2015.

To further assist citizens in understanding their flood risk, the Caroline County website, under Floodplain Management, contains a link to the Maryland DFIRM Outreach tool. The State of Maryland in conjunction with the Federal Emergency Management Agency (FEMA) has been systematically updating Flood Insurance Rate Maps (FIRMs) for communities over the past several years. This site is designed to guide homeowners/renters as well as communities through the process of determining their current flood risk as well as future flood risk based on the preliminary Digital Flood Insurance Rate Maps (DFIRMs).

In 2019, the Maryland Department of Natural Resources (DNR) and Chesapeake & Coastal Service developed the MyCoast: Maryland application. This platform was designed to allow citizens to share photos in order to document the ground impacts of flooding and damage that are attributed to rain, storms, or high tides. The data assists DNR and Chesapeake & Coastal Service in determining flood prone areas, frequency of flooding, and helps identify and prioritize climate change resilience and restoration opportunities.



Caroline County Department of Emergency Services has been promoting the MyCoast app not only on the Hazard Mitigation webpage, but also on social media. Caroline County residents have been submitting reports since 2020. Reports have been provided from:

- Denton,
- Greensboro,
- Hillsboro; and,
- Preston.

These reports assist the County with identifying flood risk areas and determining which are high priority for potential mitigation measures.

Multi Hazard Building Codes

The International Building Code as published by the International Code Council, Inc., and as modified by the Maryland Building Performance Standards, COMAR 05.02.07, was adopted as the Building Code for Caroline County, Maryland. The code includes the following climatic and geographic design criteria:

- Flat-Roof Design Snow Load: 25 pounds/square foot;
- Wind Speed: 100 mph;
- Seismic Design Category: C;
- Subject to Damage from Weathering: Severe;
- Subject to Damage from Frost Line Depth: 24 inches;
- Subject to Damage from Termite: Heavy;
- Subject to Damage from Decay: Moderate;
- Winter Design Temp: 10 degrees Fahrenheit, and
- Flood Hazards: See FEMA Flood Insurance Rate Maps (FIRMs) and Flood Boundary and Floodway Map (FBFM).

Protection & Preservation Programs

Caroline County's Transferable Development Rights Program was amended, adopted, and made effective on April 1, 2006, allowing for the identification, sale, purchase, and utilization of development rights as necessary and desirable to promote essential countywide growth planning and to preserve Caroline County's farmland, woodland, rural landscape, and rural way of life. The program provides for the assignment of Receiving Areas for rural-residential development in the R-Rural zoning district (maximum 50 lots) in areas of the County that are most suited for residential growth. All other areas of the County in the R-Rural zoning district are rural/ farming areas and are considered Sending Areas whereby development rights may be transferred off the

property. Since the adoption of the new regulations in April 2006, 181 development rights have been approved for transfer according to the County website.

The Chesapeake Bay Critical Area Act, passed in 1984, was significant and far-reaching, and marked the first time that the State and local governments jointly addressed the impacts of land development on habitat and aquatic resources. The law identifies the "Critical Area" as all land within 1,000 feet of the Mean High-Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries. The law created a statewide Critical Area Commission to oversee the development and implementation of local land use programs directed towards the Critical Area that met the following goals:

- Minimize adverse impacts on water quality that result from pollutants that are discharged from structures or conveyances or that have run off from surrounding lands;
- Conserve fish, wildlife, and plant habitat in the Critical Area; and
- Establish land use policies for development in the Critical Area which accommodate growth and address the fact that, even if pollution is controlled, the number, movement, and activities of persons in the Critical Area can create adverse environmental impacts.

In Caroline County, the Chesapeake Bay Critical Area Law affects all properties within 1000 feet of the Choptank River and the Tuckahoe and Marshyhope Creeks and their tributaries.

The Maryland Forest Conservation Act (Natural Resources Article Section 5-1601 through 5-1613) enacted in 1991 to minimize the loss of Maryland's forest resources during land development by making the identification and protection of forests and other sensitive areas an integral part of the site planning process. Although the Maryland DNR Forest Service administers the FCA, it is implemented on a local level. Caroline County amended its Code of Local Public Laws in October 2000 to include Chapter 109, Forest Conservation.

The Chesapeake Bay Critical Area, the Maryland Forest Conservation site planning, and floodplain regulations work in tandem with one another to achieve risk reduction and natural resources preservation.

Public Works

As noted in the Chapter 2 County Profile, Caroline County on average receives 14.2 inches of snow annually. The Public Works Department, the Public Schools, and local municipalities, along with the State Highway Regional Office are equipped to deal with the occasional snowstorm or ice storm during the winter months. The Public Works Department – Roads Division maintains 450 miles of roadway and 39 bridge crossings. The Roads Division has developed a plan for plowing roads.

In addition to the Public Works Department and State Highway Administration, the Department of Emergency Services has close ties with Choptank Electric, Delmarva Power, and Verizon which provide electrical and telephone service to the citizens of the County. These utility companies clear dead or overhanging trees from utility rights-of-way during summer months so that ice and wind damage is minimized during winter storms.

Public Health

As noted in the Drought Hazard Characterization, heat and drought can be a severe problem in Caroline County. When dry conditions disrupt water service in an area of the County, the Department of Emergency Services can request the Maryland Department of Emergency Management through the Maryland National Guard to provide temporary water storage tanks. Additionally, the County Health Department monitors well development through the building permit process and has access to well records through the Department of the Environment to monitor ground water use and replenishment. The Department of Agriculture also monitors soil moisture conditions and provides farmers with information on crop development through the Soil Conservation District during low soil moisture conditions.

As noted in the Emerging Infectious Disease Characterization, the Maryland Department of Health administers the County Health Department. This administrative setup allows the full capabilities of the State to be utilized to mitigate an epidemic or other outbreak of disease in Caroline County.

Caroline County's Health Department informs provides various health services as well as environmental health services. The Health Department also has a Public Health Emergency Preparedness and Response division. This division assists with preparedness for all emergencies, not just health emergencies. The Public Health Emergency Preparedness and Response webpage provides numerous links to preparedness resources, notifications platforms, current health threats, CPR and First Aid classes, and Safety Alerts and Recalls.

A Public Health Emergency Planner can also be requested to speak to community groups, schools, businesses, and nonprofits about the importance of being prepared for an emergency.

The Caroline County Health Department utilizes the Emerging Infectious Disease (EID)/Infectious Disease Response Plan (IDRP) produced by the Maryland Department of Health. This document also focuses on other diseases such as Avian Flu (H5N1), Dengue Fever, West Nile, Hantavirus, Lyme Disease, E. coli, HIV (according to John Hopkins Medicine), Nipah Virus, Yellow Fever, Rift Valley Fever, and Middle East Respiratory Syndrome.

In addition, the Health Department maintains a Continuity of Operations Plans. The plan was updated in January of 2022 and will be updated in 2024. The Health Department's goal is to have this document reviewed annually.

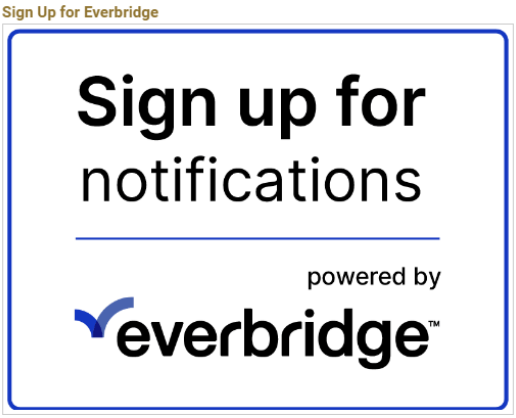
Furthermore, the Health Department conducts annual reviews to ensure all staff has and maintains Incident Command Systems (ICS) training. All Health Department Merit and Contractual Staff are required to have IS 100, 700 & 800 within six (6) months of employment. Once a staff member becomes a supervisor, IS200 must be completed. A staff spreadsheet is reviewed and updated by the Deputy Health Officer and Human Resources.

The Health Department also conducts training and exercise based on different response incidents. Training and exercises are conducted with the Regional Healthcare Coalition, as well as in-house training as needed. Upcoming exercises are Pediatric Surge TTX, Chemical Surge TTX, MCM Throughput Drill, Regional MRSE Exercise; In-House CPR/AED/1st Aid and TtT.

Emergency Alert Notification

The Caroline Connect notification system allows residents and businesses to subscribe to important notifications regarding Caroline County. There are over 20,700 active subscribers to emergency alerts throughout the County.

The Caroline County website emergency service page contains a citizen sign-up link: https://member.everbridge.net/311440963535079/new.



Current Risk Reduction Projects

During the planning cycle, various County departments and agencies applied for and were awarded grant funding to complete several projects for essential facilities or projects containing a mitigation component. These projects and their associated details are provided below.

Project Title: Federalsburg Health Center Construction for Choptank Community Health System

Requested By: Senator Ben Cardin

Recipient Name: Choptank Community Health System

Project Purpose: I request $800,000 to support the construction of a new Federalsburg Health Center to better serve the medically underserved residents of Caroline County, Maryland. The proposed building will provide examination rooms for family medicine, behavioral health, medication assisted treatment, women's health, and dentistry. As well as a waiting area, patient services, provider offices, a special purpose training room, restrooms, healthcare support function areas, communications, and mechanical spaces. The facility will also host training and classroom space for Choptank Community Health System's Rural Residency Program and Teaching Health Center Development. The resulting facility will result in a larger and better organized facility, well-suited to deliver services to the community of Federalsburg and surrounding areas. $800,000 in federal funding will allow Choptank Community Health System to complete the site work for the project including tree removal, grading, earthwork, exterior improvements, seeding of disturbed areas and connection to underground utilities.

Project Location: Federalsburg, Maryland

Amount Funded: $2.889 million

Project Title: Prioritization and Implementation Plan for Caroline County Public Schools - Stormwater Management Improvements

Project Purpose: In early 2017, the County partnered with AECOM on a grant-funded, water quality improvement project to develop a Prioritization and Implementation Plan for Caroline County Public Schools for stormwater management improvements. The plan evaluated the feasibility of stormwater management upgrade projects on eight County public school campuses (10 schools total). The plan included a characterization of existing site conditions and site plans, historical site perspectives, maps and photos of proposed and existing stormwater management practices, and spreadsheets with preliminary sizing, cost, and load reduction calculations for new and retrofit stormwater practices at each school. The final report recommended stormwater management upgrades at six County public schools. The first school upgrade was completed at Lockerman Middle School in Denton in early 2020, funded by a grant from the MDE 319(h) Program. MDE 319(h) grant funding has been secured for the second school upgrade, Denton Elementary School, which will begin in 2024.

Project Location: Denton, Maryland

Project Title: Construction Services for North County Regional Park Stream & Wetland Restoration

Requested By: Caroline County Recreation & Parks

Project Purpose: In the spring of 2022, Caroline County released a request for proposals for the Construction Services for North County Regional Park Stream & Wetland Restoration project. The purpose of this project was to restore 2.50 acres of Delmarva Bay wetland and to restore 1,300 feet of agriculture ditch and 1,260 feet of degraded stream tributary channels by constructing a regenerative stormwater conveyances & stream restoration practice at the North County Regional Park along the Upper Choptank River north of Greensboro.

Project Location: North County Regional Park, Maryland

Project Title: Caroline County Detention Center Pump Station

Project Purpose: Upgrade the Detention Center pump station with new pumps, rails, piping, valves, and the addition of an in-line sewage comminutor to macerate all atypical items deposited in the system. Raise existing wetwell out of the floodplain. Replace float with submersible transducer system and fully automated control system.

Project Location: Denton, Maryland

Additional projects and descriptions listed in the Caroline County 2022 Capital Improvement Plan are included below.

- Choptank Marina
  - Maintenance dredging marina basin includes restoration of dredge disposal site restoration.
  - Restoration of perimeter seawall and street-side marina retaining wall
- Choptank Marina Facility Sea-Level Rise Resiliency Mitigation
  - Design/build Floating pier installation for basin boat mooring with power and utility supply.
- Gilpin's Point Sea-Level Rise Resiliency Mitigation
  - Resource management design and shoreline stabilization
- Jonestown Park
  - Land use design and construction to reduce stormwater flooding of park spaces.
- Stoney Point Sea-Level Rise Resiliency Mitigation
  - Entry road improvements and resource stabilization and definition of public access and parking uses; to include easement or acquisition of 3.5-5 acres for watershed management improvements.

Caroline County, Maryland NFIP Community Questionnaire

As part of the Plan update, Region 3 Hazard Mitigation Plan Guidance Checking in on the NFIP – Community Worksheets were completed by Caroline County's Floodplain Manager. These worksheets demonstrate the County's capabilities related to floodplain identification and mapping, floodplain management, and flood insurance.

Floodplain Identification & Mapping

1. Who is your FPA or floodplain manager? Please provide office/agency name, position title, and contact information.	Mr. Matt Kaczynski, Assistant Director of Development Review & FPA Caroline County, Maryland 109 Market Street, Room 123 Denton, Maryland 21629 410-479-8100 mkaczynski@carolinemd.org
2. Where do you keep your FIRM and FIS report?	Hard copies of the FIRM, FIS, & LOMCs are available in the Caroline County Office of Planning & Codes. Digital versions are available for review at www.mdfloodmaps.net
3. Has your community adopted the most recent FIRM? When was the adoption? Where is that information stored? Has your community updated the floodplain ordinance language to include the current FIRM and FIS?	Caroline County, Maryland has adopted the most recent FEMA FIRM, effective date of January 16, 2015. The Caroline County Floodplain Management Ordinance language is in compliance with the current FIRM and FIS and is available online at the County's website; hard copies are available for review in the County's Department of Planning and Codes.
4. Does your jurisdiction support requests for map updates?	Yes. Caroline County reviews and may provide support for LOMC applications.
5. Is there a specific agency/department responsible for compiling these updates and tracking LOMCs?	Yes, Caroline County tracks and compiles updates for LOMC's. Approved LOMC's can also be found on the FEMA Map Service Center Website.
6. Do you collect updated technical or scientific data and modeling? How do you share this with FEMA?	Yes. Caroline County collects and reviews technical and/or scientific modeling data when applicable. Copies are provided to FEMA during the LOMC process.
7. Does your jurisdiction provide assistance with local floodplain determinations? If yes, specify how.	Yes. Caroline County may assist homeowners and potential applicants in determining if their property is located within or near the SFHA by providing mapping resources and information, both lateral and vertical determination information.
8. Do the people/agencies responsible for using these tools in your community have the access they need? Which tools does your community rely on?	Yes. Caroline County utilizes multiple tools for NFIP information dissemination and education, including the County website, floodplain management personnel, and other tools such as www.mdfloodmaps.com and www.floodsmart.gov.
Floodplain management requires that you understand the mapping and data side when working with the public.	

Floodplain Management

1. Does your jurisdiction issue permits for all proposed development in the SFHA? What office/position is responsible?	Yes. The Caroline County Department of Planning and Codes and the FPA are responsible for permit issuance within the SFHA.
2. Does your jurisdiction require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres? If so, what department or office is responsible?	Yes. Any new development/subdivision lots within the SFHA is prohibited, unless it is demonstrated that new structures cannot be located out of the floodplain and shall be designed in accordance with the Caroline County Floodplain Ordinance. The County is responsible.
3. How does your community identify substantially improved structures? When do they intervene?	The Caroline County FPA requires documentation to be submitted regarding substantially improved structures, including market value, damage assessments, engineer certifications, etc. for compliance with floodplain management requirements.
4. Does your community have a coordinated process to determine substantial damage and to permit repair and improvement? Does the jurisdiction conduct substantial damage assessments in the SFHA? Does your community have a plan for who will conduct substantial damage assessments and a procedure for assessment?	Yes. The Caroline County Floodplain Management Ordinance specifies that the FPA shall administer the requirements related to work on existing structures that are located within the SFHA and have been substantially damaged and/or improved, and to notify owners of substantially damaged structures to obtain permits and prohibit non-compliant repair of damaged buildings. The FPA and/or authorized/designated County Representative conducts damage assessments. Substantial improvement and damage worksheet and definitions provided on Planning and Codes webpage.
5. Does your jurisdiction require Elevation Certificates for new or substantially improved structures? If yes, how is it documented and which office/agency/department is responsible?	Yes. Applicants for construction within the SFHA must submit an Elevation Certificate prepared by a licensed engineer or surveyor. Caroline County reviews the applications and certificates.
6. How does the jurisdiction enforce the floodplain ordinance sections? How does the jurisdiction address SI/SD violations?	The Caroline County FPA makes periodic inspections of properties, structures, and utilities for compliance with the ordinance and can issue violations, stop work orders, and penalties. The Caroline County FPA and the code enforcement officer is responsible for enforcing violations.
7. Has your jurisdiction had a Community Assistance Visit? If so, were any corrective actions required?	Yes, Caroline County had a Community Assistance Visit on March 28, 2017. Minor corrective actions were recommended regarding permit compliance and documentation, such as developing a checklist and as-built elevation certificates.
8. Does your jurisdiction have or is considering higher ordinance standards than the NFIP? Please describe the higher standards and where they are documented.	All new or substantially improved structures shall have the lowest floor elevated to or above the flood protection elevation. The Caroline County Flood Protection Elevation is the base flood elevation plus two (2) feet of freeboard. No additional regulations are planned at this time.
9. Are any local officials/departments in your community interested in additional training? What topics relate most to your community?	Yes, Caroline County personnel are always interested in additional training in reviewing and administering the requirements of the NFIP.

Floodplain management reduces flood risk and protects floodplain health.

Floodplain Insurance

1. How does the jurisdiction educate community members about the availability and value of flood insurance?	Caroline County personnel and/or the FPA educates the community and property owners regarding the value of flood insurance through press releases, public service announcements, and/or direct contact with property owners within the SFHA.
2. Does the jurisdiction inform community property owners about changes to the FIRM that would impact their insurance rates?	Yes, Caroline County and/or the FPA notifies property owners within the SFHA regarding changes to the FIRM through press releases, public service announcements, social media posts, and where applicable, direct correspondence.
3. How does the jurisdiction provide general assistance to community members regarding insurance issues?	The FPA and Caroline County personnel are available to advise, assist and answer any questions of community members regarding the NFIP program and/or floodplain regulations.
4. Does the jurisdiction keep track of the number of residential and non-residential structures in the SFHA? How many structures are in the SFHA in your community?	Yes. A database of the number of residential and non-residential structures is maintained by the County. According to the FEMA CIS NFIP Insurance Report, there are 68 NFIP policies within the County.
5. Does the jurisdiction have any levees or levee systems in its jurisdiction?	No. Caroline County has no (0) levee systems within its jurisdiction according to the USACE national levee database.
6. Is the levee or levee system certified and accredited?	N/A
7. Is the levee or levee system a Provisionally Accredited Levee (PAL)?	N/A
8. Is the levee or levee system part of the USACE Rehabilitation and Inspection Program?	N/A
9. Does your community have any Major Dams or High Hazard Dams, and if so, have you applied for FEMA's High Hazard Potential Dam grant?	No. Caroline County has no high hazard dams within its jurisdiction according to the USACE National Inventory of Dams. The County has not applied for FEMA's High Hazard Potential Dam grant.

Flood risk communication to the public is vital for a community to be truly resilient.

NEXT STEPS

- What are your short- and long-term pertaining to floodplain management and the community rating system?
    - Our goals include maintaining our Class 7 CRS Rating, and to focus on improving overall scoring in accordance with the strategies outlined in the most current version of the CRS Coordinator's Manual.

Potential Mitigation Action Item

- Add additional floodplain management and permitting information to the County website, i.e., permit application, links to state and federal floodplain mapping and insurance programs.
- Add additional substantial damage and improvement information to Planning & Codes webpage such as, FEMA SD Quick Guide, graphic, and fact sheet.

Goals and Objectives

The 2023 Caroline County Hazard Mitigation Planning Committee reviewed and modified the 2019 mitigation strategies, which includes a set of goals and objectives that serve as the basis for new mitigation projects. During the update process, one (1) new goal and fourteen (14) new objectives were added. The new goal and objectives and modifications to previous objectives are denoted in green.

Goals as identified in this Plan are broad-based and long-term. The following goals identify what the community expects to accomplish through mitigation actions during the next five years. Objectives as identified in this Plan are more specific and narrower in scope than goals. They expand upon goals and provide more details on how to accomplish them.

Note: *These goals, objectives, and mitigation action items apply to municipal participants as well as the unincorporated parts of the County.*

Goal 1 Maintain and enhance Caroline County's Department of Emergency Service's capacity to continuously make Caroline County less vulnerable to hazards.

Objective 1.1 Institutionalize hazard mitigation.

Objective 1.2 Improve organizational efficiency.

Objective 1.3 Maximize utilization of best technology.

Objective 1.4 Maximize utilization of GIS software.

Objective 1.5 Reduce vulnerability to environmental hazards by providing enhanced trainings, equipment, and plans for emergency response and mitigation.

Objective 1.6 Keep current with changing science related to climate change threats.

Goal 2 Build and support municipal capacity and commitment to become continuously less vulnerable to hazards.

Objective 2.1 Increase awareness and knowledge of hazard mitigation principles and practice among local and municipal public officials.

Objective 2.2 Aid municipal officials and help municipalities obtain funding for mitigation planning and project activities.

Objective 2.3 Prepare technical reports for critical facilities as necessary.

Objective 2.4 Coordinate hazard mitigation efforts with goals identified in municipal plans as they relate to hazards.

Goal 3 Improve coordination and communication with other relevant organizations.

Objective 3.1 Establish and maintain lasting partnerships.

Objective 3.2 Streamline policies to eliminate conflicts and duplication of effort.

Objective 3.3 Incorporate hazard mitigation into activities of other organizations.

Goal 4 Increase public understanding, support, and demand for hazard mitigation.

Objective 4.1 Identify hazard specific issues and needs.

Objective 4.2 Heighten public awareness of natural hazards.

Objective 4.3 Publicize and encourage the adoption of appropriate hazard mitigation actions.

Objective 4.4 Increase the number of businesses that have developed a business risk reduction plan.

Objective 4.5 Increase the proportion of businesses and residences that have flood insurance.

Objective 4.6 Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.

Objective 4.7 Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.

Objective 4.8 Increase public awareness and preparedness specific to emerging infectious diseases, always utilizing data and information from verified and trustworthy public health sources.

Goal 5 Protect existing and future properties (residential, commercial, public, and critical facilities).

Objective 5.1 Utilize the most effective approaches to protect buildings from hazards, including acquisition and elevation.

Objective 5.2 Enact and enforce regulatory measures to ensure that new development will not increase hazard threats from riverine flooding, storm surge, sea level rise, stormwater flooding or the threat of wildfire at the urban/forest interface.

Objective 5.3 Review and update Building Codes to ensure that manufactured housing, including mobile homes, are constructed, and installed in a manner to minimize wind and storm surge damage.

Objective 5.4 Reduce the number of houses in the floodplain that are subject to flooding.

Objective 5.5 Increase the number of critical facilities that have carried out mitigation measures to ensure their functionality in a 100-year flood event.

Objective 5.6 Ensure continuous power supply to critical and public facilities.

Objective 5.7 Ensure adequate public safety infrastructure.

Objective 5.8 Minimize the impact of winter weather on life, property, buildings, critical facilities, and infrastructure.

Objective 5.9 Seek opportunities to protect critical communications infrastructure, such as by upgrading or burying powerlines where feasible.

Goal 6 Ensure that public funds are used in the most efficient manner.

Objective 6.1 Prioritize new mitigation projects, starting with sites facing the greatest threat to life, health, and property.

Objective 6.2 Use public funding to protect public services, and critical and public facilities.

Objective 6.3 Use public funding on private property where benefits exceed costs.

Objective 6.4 Maximize the use of outside funding sources.

Objective 6.5 Encourage property-owner self-protection measures.

Goal 7 Promote sustainable development to improve the quality of life.

Objective 7.1 Establish open space parks and recreational areas in flood hazard areas.

Objective 7.2 Provide for the conservation and preservation of natural resources.

Objective 7.3 Limit additional housing (especially elderly and high density) in areas of high hazard risk.

Objective 7.4 Prioritize forest conservation and tree planting to mitigate extreme temperatures and to provide stormwater benefits. Consider potential for carbon offset program.

Goal 8 Prevent destruction of forests and structures in the Urban Wildland Interface.

Objective 8.1 Improve communications capability between municipal and County emergency services and law enforcement personnel.

Objective 8.2 Identify specific high hazard areas in the Urban Wildland Interface and notify residents of means to protect their property from wildfire damage.

Objective 8.3 Develop evacuation procedures to enable residents near forested areas to evacuate safely.

Goal 9 Protect public infrastructure, especially evacuation routes.

Objective 9.1 Upgrade or replace public roads and storm water management features to include mitigation into the project design and construction.

Objective 9.2 Improve evacuation routes utilized in flood hazard events to mitigate life-threatening road conditions and road closures.

Objective 9.3 Mitigate problem road sections within the County and municipalities.

Objective 9.4 Ensure evacuation information is readily available throughout the County.

Objective 9.5 Review 2050 sea level rise projections to identify additional public infrastructure and evacuation routes that may be at risk or in need of improvement.

Goal 10 Integrate plan and policies across disciplines and agencies within the County through the consideration of potential hazards and future development.

Objective 10.1 Integrate hazard mitigation into areas such as land use, transportation, climate change, natural and cultural resource protection, water resources, and economic development.

Objective 10.2 Solicit participation and offer opportunities for various departments to work together on a regular basis.

Objective 10.3 Clearly define roles of, and improve intergovernmental coordination between planners, emergency managers, engineers, and other staff, and municipal and regional partners in improving disaster resiliency.

Objective 10.4 Integrate the new 2023 Hazard Mitigation Plan into existing plans, policies, codes, and programs that guide development.

Goal 11 Promote the development of policies, programs, initiatives, and projects that prioritize diversity, equity, and environmental justice.

Objective 11.1 Identify and reduce the health and safety impacts of hazards on vulnerable populations.

Objective 11.2 Improve community engagement and outreach by organizations and agencies that provide services to vulnerable populations.

Objective 11.3 Provide hazard related public awareness materials and notifications in both Spanish and Haitian Creole.

2024-2029 Mitigation & Community Resilience Actions

This section of the Plan provides mitigation and community resilience actions for Caroline County and participating municipalities to undertake over the next five years. These actions were developed on the consensus of the Caroline County Hazard Mitigation Planning Committee (HMPC) and participating municipalities along with the findings of the Hazard Identification and Risk Assessment (HIRA). The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation and assigned target completion deadlines. Funding sources have been identified that can be used to assist in project implementation.

On January 25th, a virtual Mitigation Workshop was held to identify mitigation and community resilience actions for inclusion in the 2024 Hazard Mitigation Plan (HMP). During the Workshop, HMPC members were divided into small groups based on four (4) mitigation action categories, below. Each of the four (4) groups reviewed actions carried over from the 2019 HMP and new action ideas developed for this update. Each group was relatively small, which enabled members to have discussions on various topics during this virtual setting. An excel spreadsheet was utilized to review 2019 action items and introduce potential 2024 action ideas. Each group's answers and modifications were captured on the spreadsheet during the workshop. Thereafter, each group's results were combined and distributed for review to the entire HMPC, including the municipalities.

A comprehensive range of specific techniques or actions were identified and analyzed during this Plan update. Four categories of hazard mitigation techniques and actions were utilized and include:

- **Local plans and regulations**: Government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include, but are not limited to comprehensive plans, subdivision regulations, building codes and enforcement, and NFIP and CRS.
- **Structure and infrastructure**: Modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. Examples include but are not limited to acquisition and elevation of structures in flood prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, and culverts.
- **Natural systems protection**: Actions that minimize damage and losses and preserve or restore the functions of natural systems. Examples include but are not limited to sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.
- **Public Education and Emergency Services**: Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate the hazards and may also include participation in national programs. Examples include but are not limited to radio or television spots, websites with maps and information, provide information and training, NFIP outreach, StormReady, and Firewise Communities. Emergency services measures protect people during and after a flood. Most counties and many cities have emergency management offices to coordinate warning, response, and recovery during a disaster.

The Mitigation workshop virtual meetings schedule on January 25, 2024, was:

- Local Planning and Regulations
  - 8:30 AM – 10:00 AM
- Structure and Infrastructure Projects
  - 10:30 AM - Noon
- Natural Systems Protection
  - 12:30 PM – 2:00 PM
- Public Education and Emergency Services
  - 2:30 PM – 4:00 PM

Results of the workshop were distributed to HMPC members for review and have been included in this section of the 2024 HMP, Table 15-5. Participants reviewed almost one hundred (100) mitigation actions for potential inclusion in the Plan update. Participants reviewed each action and indicated if the proposed action item under review should or should not be included in the Plan update. The review resulted in a total of thirty-three (33) new actions. While thirty (30) actions were carried over from the previous Plan. A total sixty-three (63) mitigation and community resilience actions were selected for inclusion in the Plan and were categorized as follows:

- Local Planning and Regulations- 15 Action Items (9 new)
- Structure and Infrastructure Projects- 17 Action Items (3 new)
- Natural Systems Protection- 7 Action Items (7 new)
- Public Education and Emergency Services - 25 Action Items (14 new)

Table 15-5 was provided to all Hazard Mitigation Planning Committee (HMPC) members for final review. During the review process, direct coordination with several departments/agencies/municipalities was necessary to ensure mitigation and community resilience actions were accurate. The following departments and agencies were contacted via email.

- Department of Planning and Codes – Action Items #1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 14, 15
- Town of Hillsboro – Action Items #4, 24, 25
- Town of Federalsburg – Actions Items #4, 22, 26, 27, 44, 49
- Town of Greensboro – Actions Items #4, 20, 23, 29, 41, 42
- Town of Templeville – Action Item #4
- Town of Preston – Action Items #4, 43

Representatives from these departments/agencies provided review comments and modifications were made according to the respective mitigation and community resilience action items listed above.

In addition to the selection of mitigation and community resilience action for inclusion in the Plan update, Mitigation Workshop participants were asked to identify mitigation and community resilience actions that resonated the most with them and/or had a high likelihood of completion. While there were sixty-three (63) total mitigation and community resilience actions chosen for inclusion in the Plan update, twelve (12) of those were identified for further prioritization.

To further prioritize the twelve (12) selected mitigation and community resilience actions, an online survey was provided to all HMPC members and municipal representatives. The basis for this survey is the STAPLEE evaluation method, which uses standard criteria for evaluation: Social, Technical, Administrative, Political, Legal, Economic, and Environmental, however this evaluation was modified to a user-friendly online survey facilitating participation. The survey consisted of six (6) questions, which corresponded to a point system for prioritization purposes. Participants answered Yes/No/or Null to each question.

These six (6) questions included the following:

1. Do you think there would be community acceptance/general support for this mitigation project?
2. Do you think implementation of this mitigation project will enhance the health and safety of the community?
3. Do you think the community will be able to sufficiently staff and/or provide technical support to implement this mitigation project?
4. Do you think the benefits of this mitigation project will exceed the likely costs?
5. Do you think the maintenance requirements for this option will be affordable and not provide an undue burden on the County?
6. Is this project consistent with environmental goals?

Caroline County Mitigation Action Prioritization Survey

Thank you for participating in this survey. While 65 mitigation actions are included in the 2024 Caroline County Hazard Mitigation Plan Update, 12 were identified for further prioritization during the mitigation workshops. These action items were selected during the workshop as resonating with participants and having a high likelihood of completion during the next planning cycle.

Mitigation actions are divided into the four (4) categories used during the workshops:

- Local Planning and Regulations
- Structure and Infrastructure Projects
- Natural Systems Protection
- Public Education and Emergency Services

Completion of this survey will assist in the final prioritization of the 12 mitigation actions. Please complete this survey to the best of your ability.

As a result of the prioritization survey, five (5) mitigation and community resilience action items were rated as "high" priority, five (5) action items were rated "medium," while the remaining two (2) mitigation action items were rated "low." As discussed in Chapter 2, community lifelines are lifelines that enable the continuous operation of critical government and business functions and is essential to human health and safety or economic security. Community lifelines associated with prioritized action items have been identified. Ratings for the mitigation action items and associated community lifelines are as follows:

- **High Mitigation Action Item #15** - Limited future annexation areas and the expansion of public utilities in high hazard areas, floodplains, see Chapter 2, Figures 2-4 through 2-7, areas circled in red.
  - Community Lifeline(s): Energy & Water Systems
- **High Mitigation Action Item #18** - Mitigate and upgrade flooded roads and ditches when funding is available, specifically evacuation routes.
  - Community Lifeline(s): Transportation & Safety and Security
- **High Mitigation Action Item #31** - Develop concept designs and apply for grant funding to address nuisance and urban flood issues identified and prioritized in the Nuisance Flood Plan.
  - Community Lifeline(s): Transportation & Safety and Security

- **High Mitigation Action Item #58** - Ensure that all hazards related announcements, information, and materials are accessible to all socially vulnerable groups, including but not limited to those: over the age of 65, under the age of 5, limited English-speaking proficiency, disabilities, and those at or below the poverty line. Coordinate with municipalities on distribution.
    - Community Lifeline(s): Communications
- **High Mitigation Action Item #59** - Continue shelter operations training program. Hold shelter operations table tabletops followed by functional drill. The planning team include Emergency Services, Social Services, and the Health Department.
    - Community Lifeline(s): Food, Hydration, Shelter
- **Medium Mitigation Action Item #5** - Develop capital improvement guidelines to assist in the review of Capital Improvement Projects (CIP) at the department and County level, encouraging resilience to future hazards as criteria in siting and design of capital projects.
    - Community Lifeline(s): Safety and Security
- **Medium Mitigation Action Item #34** - Develop guidelines for County road ditches and for designated priority areas with sensitive environmental conditions. Using GIS to identify potential priority areas including ditches located in these areas and use recommended types of vegetation for buffers, restrictions on scraping or clearing ditches of vegetation, filtration systems, or use of drainage control structures.
    - Community Lifeline(s): Transportation & Safety and Security
- **Medium Mitigation Action Item #38** - Identify funding opportunities in order to dredge the Choptank River near the Town of Denton. As discussed in the Town of Denton Nuisance Flooding Plan, nuisance flooding has increased dramatically over the past 50 years (2-4 feet), which is likely due to siltation of the Choptank River. The Choptank River has needed dredging for many years and the Town has tried unsuccessfully to obtain the necessary funds to dredge the river.
    - Community Lifeline(s): Transportation
- **Medium Mitigation Action Item #47** - Coordinate with the Department of Emergency Services and the Department of Social Services to upgrade all shelter resources.
    - Community Lifeline(s): Food, Hydration, Shelter
- **Medium Mitigation Action Item #63** - Work with municipalities to develop their own Emergency Operations Plans.
    - Community Lifeline(s): Safety and Security
- **Low Mitigation Action Item #45** - Conduct a Hazardous Materials Survey to identify all hazardous materials that are either stored or traveling through the County.
    - Community Lifeline(s): Transportation
- **Low Mitigation Action Item #8** – Develop a countywide Climate Action Plan.
    - Community Lifeline(s): Safety and Security

As previously discussed, Table 15-5, 2024-2029 Mitigation Actions provides the sixty-three (63) action items identified for inclusion in this Plan update. A total of thirty-three (33) mitigation and community resilience actions are new, while thirty (30) actions have been carried over from the previous Plan. Mitigation numbers in the first column that are highlighted in green are the new action items for the 2024 HMP Update. Mitigation and community resilience actions denoted with an asterisk (*) are the twelve (12) action items that resonated the most with the HMPC.

Hazard mitigation and **community resilience** action items are included in table. Caroline County and their participating municipalities seeks to mitigate the negative effects of natural hazards and improve resiliency in their community by undertaking various actions. Please note, while the table includes sixty-three (63) action items, including both mitigation and community resilience actions, for each hazard identified in this plan update, there is a minimum of one mitigation specific action per hazard for both Caroline County and each participating municipality.

HAZARD MITIGATION AND COMMUNITY RESILIENCE

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. **Resilience** is the capacity of individuals, communities, businesses, institutions, and governments to adapt to changing conditions and to prepare for, withstand, and rapidly recover from disruptions to everyday life, such as hazard events. Hazard mitigation planning is the foundation of community resilience because it encourages the development of a long-term mitigation strategy. By going through the planning process, communities think about their risks and develop mitigation actions and projects before a disaster even has a chance of occurring, making it easier to recover from future events.

Source: FEMA Planning for Resilient Communities Fact Sheet

Table 15-5 provides the action item number, the mitigation action, hazard(s) the action item addresses, the community the action item would help, the lead agency/department for the implementing the action item, the category the action item falls under, potential funding, and the implementation schedule. Note the implementation schedule is based on: Short Term (1 - 2 years to complete) and Long Term (3 – 5 years to complete).

Table 15-5: 2024-2029 Mitigation Actions

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
1	Utilizing FEMA's Flood Mitigation Assistance Program create a Flood Mitigation Plan for the County. This Plan will assist the County in obtaining Floodplain Management planning points for the NFIP Community Rating System, thereby lowering flood insurance premiums for homeowners.	Flood	Caroline County	Emergency Services, Planning & Codes	**Local Planning and Regulations**	FEMA – Flood Mitigation Assistance (FMA)	Short Term
2	The NFIP requires structures built within the floodplain to have first floor elevations determined. The County's GIS department should partner with building inspectors/permit administrators to maintain a database of new structures with their first-floor elevations. These elevations can be used with forecasting software such as HAZUS to predict vulnerable structures during a specific hazard event. Currently, Caroline County uses the State's open-source data and HAZUS data has not been utilized.	Flood	Caroline County	Planning & Codes	**Local Planning and Regulations**	FEMA – Hazard Mitigation Grant Program (HMGP)	Short Term
3	Integrate elements of the Hazard Mitigation Plan into the 10-year Comprehensive Plan update. • 2010 Caroline County Comprehensive Plan • 2009 Federalsburg, Goldsboro, Henderson, Ridgely, and Templeville Comprehensive Plans • 2010 Greensboro and Hillsboro Comprehensive Plans • 2005 Preston Comprehensive Plan & 2012 Municipal Growth Element	All	Caroline County, All Municipalities except Denton	Planning & Codes, All Municipalities	**Local Planning and Regulations, Structure and Infrastructure Projects**	Annual Operating Budget	Short Term
4	Perform a detailed analysis of structures in the floodplain for the towns of Greensboro, Hillsboro, and Federalsburg to determine first floor elevation for mitigation project purposes.	Flood	Greensboro, Hillsboro, and Federalsburg	Planning & Codes, Identified Municipalities	**Local Planning and Regulations**	FEMA – Hazard Mitigation Grant Program (HMGP)	Short Term
*5	Develop capital improvement guidelines to assist in the review of Capital Improvement Projects (CIP) at the department and County level, encouraging resilience to future hazards as criteria in site and design of capital projects.	All	Caroline County	Finance, Public Works, County Administrator	**Local Planning and Regulations**	Annual Operating Budget	Short Term
6	Encourage capital improvement program to include funding for hazard mitigation projects. Generally, FEMA may provide up to 75% of the cost of eligible mitigation activities under BRIC. FEMA may provide up to 90% of the cost of eligible mitigation activities for small, impoverished communities.	All	Caroline County	Finance, Public Works, County Administrator	**Local Planning and Regulations**	Annual Operating Budget	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
7	Implement a Strategic Plan for the Town of Denton, which provides the breakdown for Public Works, e.g., Sewer vs. Water.	Flood	Denton	Town of Denton	**Local Planning and Regulations**	Annual Operating Budget	Short Term
*8	Develop a countywide Climate Action Plan.	Flood, Hurricane, SLR & Erosion, Drought & Excessive Heat, Thunder-storm, Tornado	Caroline County, All Municipalities	Planning & Codes	**Local Planning and Regulations**	FEMA – Building Resilient Infrastructure and Communities DNR – Grants Gateway	Short Term
9	Encouraging all municipalities that lack FEMA regulated floodplains to participate in the NFIP. This enables property owners to purchase flood insurance under the NFIP, federally backed insurance. Due to changing conditions and flooding in areas outside of the FEMA regulated floodplains, encouraging the purchase of flood insurance is a new mitigation action item within this Plan update.	Flood	Henderson, Marydel, Templeville	Planning & Codes, Municipalities not within Floodplain	**Local Planning and Regulations**	Annual Operating Budget	Short Term
10	Host annual floodplain management coordination meeting with County and municipal representatives.	Flood	Caroline County, All Municipalities	Planning & Codes, Municipalities	**Local Planning and Regulations**	Annual Operating Budget	Long Term
11	Evaluate the repetitive loss areas for mitigation measures such as acquire, elevate or floodproofing. One repetitive loss property is located in the Town of Greensboro, while the other is within the Town of Preston.	Flood	Caroline County, Greensboro, Preston	Planning & Codes, DES	**Local Planning and Regulations**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG)	Long Term
12	Increase awareness of homes that lie in the flood zone for prospective home buyers and residents by posting a link to the County's website that provides property-specific flood zone information. Provided targeted mailers to homeowners in socially vulnerable areas.	Flood	Caroline County	Planning & Codes, Floodplain Administrator	**Local Planning and Regulations**	Annual Operating Budget	Long Term
13	Promote FEMA Risk Rating 2.0 to the Public. Understand the community impact of Risk Rating 2.0 and share information with the public to encourage the purchase and/or retention of flood insurance.	Flood	Caroline County, All Municipalities	Planning & Codes, Floodplain Administrator	**Local Planning and Regulations**	FEMA - CERC MDE - Comprehensive Flood Management Grant Program	Long Term
14	Add additional floodplain management and permitting information to the County website, i.e., permit application, links to state and federal floodplain mapping and insurance programs.	Flood	Caroline County	Planning & Codes	**Local Planning and Regulations**	Annual Operating Budget	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
*15	Limited future annexation areas and the expansion of public utilities in high hazard areas, floodplains, see Chapter 2, Figures 2-4 through 2-7, areas circled in red.	Flood	Caroline County, All Municipalities	Planning & Codes	**Local Planning and Regulations**	Annual Operating Budget	Long Term
16	Work with utility companies to identify problem areas and the possibility of changing to underground lines in those areas.	Winter Storms, Thunder-storm, Tornado, Mass Power Outages, Drought & Excessive Heat	Caroline County, All Municipalities	Public Works, Planning & Codes, Delmarva Power, Choptank Electric	**Structure and Infrastructure Projects**	Annual Operating Budget	Long Term
17	Research feasibility and cost benefit analysis for the addition of a second water tower or a method to replenish the supply in the existing tower in the Town of Preston.	Flood, Hurricane, Winter Storms, SLR, Drought & Excessive Heat, Thunder-storm, Tornado	Preston	Town of Preston	**Structure and Infrastructure Projects**	US EPA - Drinking Water State Revolving Fund (DWSRF) Program	Short Term
*18	Mitigate and upgrade flooded roads and ditches when funding is available, specifically evacuation routes. River Road is considered high importance and is an evacuation route, therefore this roadway should be prioritized for mitigation measures. Refer to Chapter 6, Section Nuisance Flooding for prioritized roadways.	Flood	Caroline County	Public Works	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Long Term
19	Prioritize mitigation of Repetitive Loss Properties discussed in Chapter 4: Riverine Flooding. Look for opportunities to create open space/ recreation space in flood hazard areas. Consider current and future flood conditions.	Flood	Caroline County	Planning & Codes, Parks & Recreations	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) MDE - Comprehensive Flood Management Grant Program	Long Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
20	Work with the Town of Greensboro to upgrade undersized water lines for fire suppression.	Thunder-storm, Tornado, Drought & Excessive Heat	Greensboro	Town of Greensboro	**Structure and Infrastructure Projects**	MDE – Maryland Water Infrastructure Financing, Water Supply Assistance Grant Program (WSG) FEMA – Hazard Mitigation Assistance Annual Operating Budget	Long Term
21	About 13 percent of all septic systems in the unincorporated areas of the County are located within the Critical Area. Upgrade these systems using Bay Restoration Funds.	Flood & Hurricane, Emerging Infectious Disease	Caroline County,	Public Works, Environmental Health	**Structure and Infrastructure Projects**	MDE - Bay Restoration Fund Septic System Grant Program	Long Term
22	Consider flood mitigation options for the Federalsburg Police Station located in FEMA Flood Zone AE.	Flood	Federalsburg	Town of Federalsburg	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) USACE - Planning Assistance to States MDE - Comprehensive Flood Management Grant Program	Short Term
23	Raise controls at East Lift Station and (3) pump stations for preventative measures for future flooding events in the Town of Greensboro.	Flood	Greensboro	Town of Greensboro	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) USACE - Planning Assistance to States MDE - Comprehensive Flood Management Grant Program	Short Term
24	Maintain and/or improve culvert on Church Street within the Town of Hillsboro, which has a sediment issue. The accumulation of sediment at this location leads to regular nuisance flooding. The surrounding area will be modified to accompany a dog park. There are no critical facilities near this location.	Flood	Hillsboro	Town of Hillsboro	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
25	Establish a staging area for the Queen Anne-Hillsboro Volunteer Fire Company to stage equipment at Hillsboro Town Hall. Construction of an auxiliary building will be necessary. This action will improve the response time of the Hillsboro first responders. They will not have to drive around the bridge via MD-404 due to flooded road conditions in that area.	Flood	Hillsboro	Town of Hillsboro	**Structure and Infrastructure Projects**	FEMA - Assistance to Firefighters Fire Station Construction Grants (FSC)	Short Term
26	Consider flood mitigation options for the Federalsburg Wastewater Treatment Plant located in the 1% annual chance flood hazard area.	Flood	Federalsburg	Town of Federalsburg	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) USACE - Planning Assistance to States MDE - Comprehensive Flood Management Grant Program	Short Term
27	Consider flood mitigation options for the Federalsburg Town Hall located in 1% annual chance flood hazard area.	Flood	Federalsburg	Town of Federalsburg	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) USACE - Planning Assistance to States MDE - Comprehensive Flood Management Grant Program	Short Term
28	Negotiate the extension of service from the North County Water and Sewer Authority to the Towns of Marydel, Henderson, and Templeville.	Flood, Hurricane, Sea Level Rise Severe Storms & Power Outages	Marydel, Henderson, Templeville	Towns of Marydel, Henderson, and Templeville	**Structure and Infrastructure Projects**	Annual Operating Budget	Long Term
29	Relocate WWTP pump stations in Greensboro that are vulnerable to flooding.	Flood	Greensboro	Town of Greensboro	**Structure and Infrastructure Projects**	HUD - Community Block Development Grant (CDBG) USACE - Planning Assistance to States MDE - Comprehensive Flood Management Grant Program	Long Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
30	Ensure all WTP and WWTP plants have continuous operation during storm events by installing generators.	Severe Storms & Power Outages	All Municipalities	DES, Municipalities	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance FEMA - Homeland Security Grants USACE - Continuing Authorities Program	Short Term
*31	Develop concept designs and apply for grant funding to address nuisance and urban flood issues identified and prioritized in the Nuisance Flood section of the Plan Update.	Flood	Caroline County	DES, Sea Grant Extension, Public Works	**Structure and Infrastructure Projects**	FEMA – Hazard Mitigation Assistance HUD - Community Block Development Grant (CDBG) MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Short Term
32	Reduce the potential for dam failure by promoting innovative approaches to fund dam rehabilitation. As noted in Chapter 11 Dam Failure, Chambers Lake is in poor condition and the potential impact area is Federalsburg.	Dam Failure	Caroline County, Federalsburg	Public Works, DES, Town of Federalsburg	**Natural Systems Protection**	FEMA HH Dams MDE – Dams	Long Term
33	Identify mitigation measures for the two (2) nuisance flooding locations noted in the Town of Denton Nuisance Flood Plan. These locations include Town of Denton: Crouse Park Boat Ramp and Visitor and Heritage Center, and Caroline County: River Landing Road.	Flood, Hurricane, Sea Level Rise	Caroline County, Denton	Sea Grant Extension, Public Works, DES, Town of Denton	**Natural Systems Protection**	HUD - Community Block Development Grant (CDBG) MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Short Term
*34	Develop guidelines for county road ditches and for designated priority areas with sensitive environmental conditions. Using GIS to identify potential priority areas including ditches located in these areas and use recommended types of vegetation for buffers, restrictions on scraping or clearing ditches of vegetation, filtration systems, or use of drainage control structures.	Flood	Caroline County	Public Works, Sea Grant Extension, Soil Conservation District	**Natural Systems Protection**	Annual Operating Budget	Short Term
35	Conduct watershed assessments to include new Atlas 14 precipitation table- rainfall intensity.	Flood, Hurricane	Caroline County	Planning & Codes, UMD Extension Service, Sea Grant Extension	**Natural Systems Protection**	FEMA – Hazard Mitigation Assistance MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
36	Create new and restore existing wetlands as a best management practice to increase resiliency by providing storm buffers, drought buffers and sea level rise buffers. Consider projects to create wetlands to increase floodplain holding capacity. Possibly target Ganeys Wharf Road (6–7-foot section away from Choptank River) or target Choptank River side.	Flood, Sea Level Rise	Caroline County, Denton, Federalsburg Greensboro	Planning & Codes, Public Works, UMD Extension Service, Soil Conservation District	**Natural Systems Protection**	FEMA – Hazard Mitigation Assistance MDE - Comprehensive Flood Management Grant Program DNR – Grants Gateway	Long Term
37	Well head elevations should be inventoried and where feasible raised above the Federal Emergency Management Agency (FEMA) base flood elevation or higher. Consider sea level rise in terms of well head elevation. Well head covers may also be utilized as a preventative measure to mitigate flood contamination.	Flood, Hurricane, Sea Level Rise, Emerging Infectious Disease	Caroline County, All Municipalities	Health Department, Planning & Codes, MDE	**Natural Systems Protection**	US EPA- Drinking Water System Infrastructure Resilience and Sustainability Program	Long Term
*38	Identify funding opportunities to dredge the Choptank River near the Town of Denton. As discussed in the Town of Denton Nuisance Flooding Plan, nuisance flooding has increased dramatically over the past 50 years (2-4 feet), which is likely due to siltation of the Choptank River. The Choptank River has needed dredging for many years and the Town has tried unsuccessfully to obtain the necessary funds to dredge the river.	Flood, Hurricane, Sea Level Rise	Denton	Town of Denton, DNR, DES	**Natural Systems Protection**	DNR - State Waterway Improvement Fund Grants	Short Term
39	Provide information to citizens focusing on fire resistant fire zones around structures. Zones should be free of leaves, debris, or flammable materials for at least 30-foot perimeter. According to the US Fire Administration, fire hazards during severe weather include lightning, portable generators not often used or maintained, leaking gas lines, damaged gas propane containers and leaking vehicle gas tanks, appliances and vehicles exposed to water, debris near severed electrical wires and transformers, damaged or downed utility lines, and exposed electrical outlets and wiring.	Thunder-storm, Tornado, Mass Power Outages	Caroline County, All Municipalities	Emergency Services	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
40	Replace generator and/or transfer switch at County Corrections located on 101 Gay Street, Denton.	All	Caroline County, Denton	Emergency Services, Sheriff's Office, County Admin	**Public Education & Emergency Services**	FEMA – Hazard Mitigation Assistance FEMA - Homeland Security Grants USACE - Continuing Authorities Program	Short Term
41	Purchase watercraft for rescue situation in the Town of Greensboro.	Flood & Thunder-	Greensboro	Town of Greensboro	**Public Education &**	DNR - State Waterway Improvement Fund Grants	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
		storm, Tornado			**Emergency Services**		
42	Develop emergency kits - Meals Ready to Eat (MRE) to hand out in an emergency in the Town of Greensboro.	All	Greensboro	Town of Greensboro	**Public Education & Emergency Services**	FEMA - Emergency Food and Shelter Program (EFSP)	Short Term
43	Purchase generator for the water tower pump house in the Town of Preston.	Flood, Hurricane, Thunder-storm, Tornado, Power Outage Drought & Excessive Heat, Winter Weather	Preston	Town of Preston	**Public Education & Emergency Services**	FEMA – Hazard Mitigation Assistance FEMA - Homeland Security Grants USACE - Continuing Authorities Program	Short Term
44	Continue to promote the Caroline County Everbridge system, which allows residents and businesses to subscribe to important notifications including hazard alerts. Work in partnership with the Health Department and other allied agencies.	All	Caroline County, All Municipalities	Emergency Services, Municipalities, Sheriff's Office, Health Department	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
*45	Conduct a Hazardous Materials Survey to identify all hazardous materials that are either stored or traveling through the County.	All	Caroline County	Emergency Services, LEPC	**Public Education & Emergency Services**	FEMA - Homeland Security Grants DOT - Hazardous Materials Emergency Planning (HMEP) Grant Program	Short Term
46	Using Hazardous Materials Survey results, develop a plan to mitigate any identified risks.	All	Caroline County	Emergency Services, LEPC	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
*47	Coordinate with the Department of Emergency Services and the Department of Social Services to upgrade all shelter resources.	All	Caroline County	Emergency Services, Social Services, Health Department	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
48	Assess all shelters and their ability to sustain damage for specific hazard types and identify retrofitting projects based on this assessment. In addition, assess the shelters for the ability to handle potential medical equipment and needs.	Hurricane, Thunder-storm, Tornado,	Caroline County	Emergency Services, Social Services, Health Department, Public Schools	**Public Education & Emergency Services**	Annual Operating Budget	Short Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
		Power Outage, Winter Storms					
49	Encourage the Town of Federalsburg to participate in the FEMA FloodSmart – National Flood Insurance Program (NFIP) Campaign to help raise awareness in reaching new customers in high-risk flood areas and to encouraging existing customers to renew their policies.	Flood	Federalsburg	Town of Federalsburg	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
50	Participation in the NWS StormReady for both the County and municipalities.	Flood, Hurricane, Winter Storm, Thunder-storm, Tornado	Caroline County, All Municipalities	DES, Municipalities	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
51	Work with the Community Collaborative Rain, Hail & Snow Network to encourage Caroline County citizens to sign-up as a volunteer observer and become part of the CoCoRaHS network. Currently there are two (2) stations located in Caroline County; Station MD-CL-10 located in Denton and Station MD-CL-9 located in Greensboro.	Winter Storm	Caroline County, All Municipalities	DES, Municipalities	**Public Education & Emergency Services**	Annual Operating Budget	Long Term
52	Train citizens to be storm spotters to increase reporting on events to the NWS NCEI database. The trend for thunderstorm activity is increasing, however not all events have been reported to NCEI. NWS offers free training.	Thunder-storm, Tornado, Mass Power Outage	Caroline County, All Municipalities	DES, Municipalities	**Public Education & Emergency Services**	NWS - SKYWARN	Short Term
53	Standard Operating Procedure between DES and CCHD should be considered not just for the Health Suites within the Shelters for medical care, but also for CCHD's emergency response trailer for Points of Dispensing (PODs), mobile vaccination unit and two mobile treatment units for mental health and substance use disorder treatments.	All	Caroline County	DES, Health Department	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
54	Host annual emergency services coordination meeting with County and municipal representatives. Review the County's Emergency Operations Plan and Continuity of Operations Plan. Provide technical assistance to the municipalities regarding municipal plans or municipal	All	Caroline County, All Municipalities	DES, Municipalities	**Public Education & Emergency Services**	Annual Operating Budget	Long Term

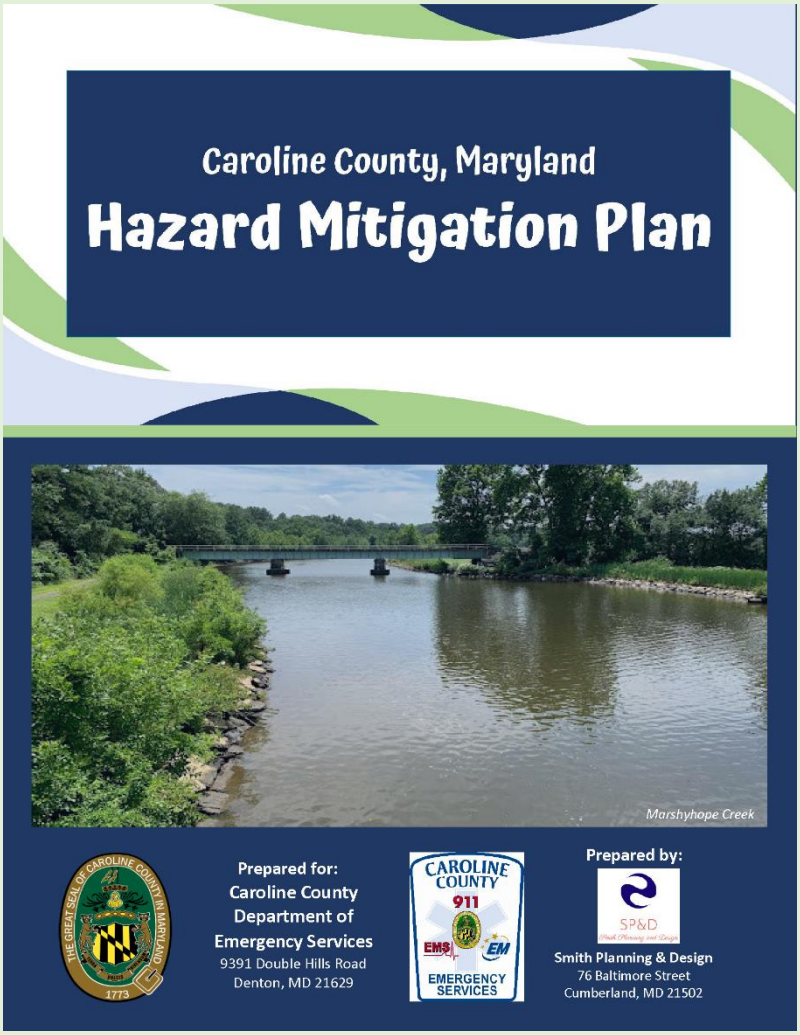
2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
	elements within countywide plans. Review outreach plan and opportunities for collaboration.						
55	Review Situational Awareness and Reporting tools for All-Hazards used for incident operations that lend themselves to the integration of community lifelines construct. Incorporating the lifelines primarily impacts how incident information is organized and reported during response. The lifelines help characterize an incident, i.e., what is happening and why it is important. • Safety and Security • Food, Water, and Shelter • Health and Medical • Energy • Communications • Transportation • Hazardous Materials	All	Caroline County	DES	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
56	Target the homes that are within the significant hazard dam inundation areas, Nagels Mill Pond, and Chambers Lake, to advise homeowners of risks to life, health, and safety. According to Nagel Mill Pond EAP, 7 properties are at risk, while Chambers Lake identifies 18 properties within its inundation area. The Chambers Lake is located within an area that contains the highest degree of socially vulnerable populations.	Dam Failure	Caroline County, Federalsburg	DES, Dam Owners	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
57	Targeted future outreach efforts should be attempted to "bridge the gap" in access to information and services as it relates to natural hazards. Refer to results of the Social Vulnerability Index (SVI) mapping intersected with hazard vulnerability to identify vulnerable populations (potentially under-served and/or underrepresented communities).	All	Caroline County, All Municipalities	Health Department, DSS & DES	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
*58	Ensure that all hazards related announcements, information, and materials are accessible to all socially vulnerable groups, including but not limited to those: over the age of 65, under the age of 5, limited English-speaking proficiency, disabilities, and those at or below the poverty line. Coordinate with municipalities on distribution.	All	Caroline County, All Municipalities	Health Department, DSS & DES	**Public Education & Emergency Services**	Annual Operating Budget	Long Term
*59	Continue shelter operations training program. Hold shelter operations table tabletops followed by functional drill. The planning team include Emergency Services, Social Services, and the Health Department.	All	Caroline County	Health Department, DSS & DES	**Public Education & Emergency Services**	Annual Operating Budget	Long Term

2024-2029 MITIGATION ACTIONS							
Number	**Action**	**Hazard(s) Addressed**	**Community**	**Lead Agency/ Department**	**Category**	**Potential Funding**	**Implementation Schedule**
60	Conduct a series of meetings to identify best practices and develop standard operating procedures to be used before, during, and after a hazard event specific to vulnerable populations. Include who and how vulnerable populations will be contacted, how outstanding needs will be relayed to the Emergency Operations Center, and how follow-up contacts will be made during the recovery phase of a hazard incident.	All	Caroline County	DES, Health Department, DSS	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
61	Establish a meeting with Delmarva Community Services, Inc. to explore opportunities to work together during a hazard event. As stated in Chapter 2 - Transportation section, the Department of Emergency Services has worked in the past with Delmarva Community Services, Inc. to provide transport to vulnerable populations during hazard events.	All	Caroline County	DES, Delmarva Community Services, Inc.	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
62	DES to work with the fire companies to retrofit the buildings to withstand straight line and storm wind damage. See Chapter 2 Critical Facilities, Fire Station and Paramedic Unit locations, pages 2-22 and 2-23. Example of the types of recommendations that can be made: https://www.fema.gov/sites/default/files/2020-07/retrofitting-buildings-wind-resistance_hurricane-michael_florida.pdf.	Thunder-storm, Tornado, Mass Power Outage	Caroline County	DES, Fire Departments	**Public Education & Emergency Services**	FEMA - Assistance to Firefighters Fire Station Construction Grants (FSC)	Short Term
*63	Work with municipalities to develop their own Emergency Operations Plans.	All	Caroline County, All Municipalities	DES, Municipalities	**Public Education & Emergency Services**	Annual Operating Budget	Short Term
Actions highlighted in green are new for the 2024 HMP Update. Actions with an asterisk (*) denote groups top action items.							

Chapter 16 Plan Maintenance & Implementation

Chapter Updates

- This chapter was updated to discuss how to keep the plan accurate, current, and relevant over the five-year approval period. It also includes monitoring, evaluating, updating the plan, and keeping the planning process active. Discussion on public involvement in the next five years was included.



Plan Adoption

The Disaster Mitigation Act of 2000 requires that local Hazard Mitigation Plans and any updates be formally adopted by the Caroline County Commissioners following review by the Maryland Department of Emergency Management and Federal Emergency Management Agency. The Plan and any updates will be subject to a public hearing prior to adoption by the County and municipalities. County held a public session to discuss the Plan and provide an opportunity for public comment on ?? 2024. The Plan was formally adopted by the Caroline County Commissioners on ?? 2024. Each municipality followed their local procedures for Plan adoption. All municipal resolutions of adoption have been included in the final official version of the Plan.

Plan Update & Continued Public Involvement

The Disaster Mitigation Act of 2000 requires Local Hazard Mitigation Plans to be monitored, evaluated, and updated during a five-year cycle. The County's Department of Emergency Management, which was instrumental in developing this Hazard Mitigation Plan, will continue to meet on a regular basis during the five-year cycle to monitor and evaluate mitigation projects and to keep the Plan current. Annual status reports will be completed on the progress of various mitigation activities. Copies of these status reports will be made available to the public via the Department of Emergency Services' Hazard Mitigation webpage. In addition, the review of the Hazard Mitigation Plan will be conducted following disaster events.

The annual status report will detail mitigation activities undertaken over the course of the year and will highlight completed activities. The report will also address the following points:

- Evaluate the goals and objectives to ensure they address current and expected conditions.
- Determine if the nature or magnitude of risk as changed.
- Evaluate whether current resources are adequate for implementing the Plan.
- Document any technical, legal, or coordination issues.
- Document agency and partner participation along with public involvement.
- Document accomplishments to date.
- Evaluate hazard mitigation priorities and identify any new priorities.
- Identify any challenges and need for technical or other assistance.

Copies of the annual report will be made available to Hazard Mitigation Planning Committee (HMPC), Local Emergency Planning Committee (LEPC), local governments, participating agencies and partners, and citizens.

The Hazard Mitigation Plan is to be updated and readopted at the end of each five-year cycle. In the event of a significant disaster or any substantial changes in land use or regulations that impact mitigation efforts, more frequent updates may be required.

The Department of Emergency Management will be responsible for overseeing the update to the Hazard Mitigation Plan. The process used to update the Plan would follow the procedure used to prepare the original Plan. This would include participation by the Hazard Mitigation Planning Committee and would also include municipal and citizen involvement. Public comments will be reviewed and discussed by HMPC and Department of Emergency Services. These comments will be recorded and where applicable incorporated into the Plan. Public meetings will be advertised in the local newspaper and on the County website. The Plan will be available for public review through the Department of Emergency Services' Hazard Mitigation webpage. Copies of the Plan may also be obtained directly through the Caroline County Department of Emergency Services office.

Planning Requirements

The Disaster Mitigation Act of 2000 also requires that the County implement the Plan through existing programs. This can be accomplished through inclusion of mitigation measures in the Comprehensive Plan, the Land Use and Building Codes, the Floodplain Ordinance and through Federal grant programs which are identified in the previous section. As these documents are updated, reference to the mitigation measures included in the Hazard Mitigation Plan can be amended into various plans and regulations.

Integrating hazard mitigation planning and resiliency into local planning frameworks will lead to development patterns and redevelopment that decreases hazard risk and vulnerability. Local planning documents would benefit from integrating/continuing to integrate components from this hazard mitigation plan within future updates of respective plans.

Caroline County and its municipalities will begin the plan integration process by reviewing their local planning mechanisms and first determining if hazard mitigation planning exists within each. Reviewing Chapter 13 Capability Assessment & New Mitigation Actions provides an excellent starting point to review local planning capabilities and identified gaps.

For municipalities working with planning mechanisms that currently include hazard mitigation actions, the goal will be to update or expand what currently exists. For those planning mechanisms where hazard mitigation actions do not currently exist, the goal is to determine where hazard mitigation fits within the document and then integrate that information during the local plan update process.

Integrating hazard mitigation into local comprehensive planning is one important step a local jurisdiction can take towards plan integration and hazard vulnerability reduction. Including hazard mitigation into comprehensive planning demonstrates that municipalities are taking steps to discourage future development in natural hazard areas.

For example, both the County and several of its municipalities are due for an update to their comprehensive plans within the next five years. The update process provides a great opportunity to review these documents for hazard mitigation principles and identify areas for integration. Reviewing Chapter 13 is a good place to review the current Comprehensive Plans and identify gaps in hazard mitigation integration.

Municipalities that develop their own comprehensive plans can integrate elements from this hazard mitigation plan into their respective comprehensive plan updates. Hazard mitigation information from this plan that is relevant to each municipality can be added into the body of an existing element, as a new element, or as an appendix. Chapters 4 through 11 of this Plan include natural and man-made hazard profiles and vulnerability and risk analysis that would be useful for comprehensive planning and future land use planning.

The mitigation actions located in Chapter 3 of this Plan clearly denote the intended location, and responsible agency for each project. Projects where a municipality is listed as “responsible agency” can be integrated into the goals and objectives of updated comprehensive plans. Additionally, Chapter 13 includes summarized municipal-level information, data, capabilities, and ongoing mitigation projects that can be utilized for integration purposes.

For a complete guide to plan integration, FEMA has created a step-by-step guidebook to aid local communities. The guide is called “Plan Integration: Linking Local Planning Efforts” and was published in July 2015. The guide is available at fema.gov.

Appendix A
Critical Facilities

Appendix A Critical Facilities

As part of the plan update process, critical facilities identified in the 2019 Plan were reviewed and additional facilities were added to ensure all facilities identified as critical by FEMA and MDEM have been included. As a result, a total of 142 critical facilities were identified and analyzed for vulnerability to hazards identified in the plan. Critical facilities are listed under each associated community lifeline, where applicable.

Critical Facilities			
Facility Type	**Facility Name**	**Address**	**Hazard Risk**
Communications			
EOC	Emergency Services and 911 Communications	9391 Double Hills Road, Denton, MD 21629	
Communication Tower	American Tower, Inc	Barclay Rd, Marydel, MD 21649	
	American Tower, Inc	Benedictine Ln, Ridgely, MD 21660	
	Subcarrier Communications Inc	Bloomery Rd, Federalsburg, MD 21632	
	American Tower, Inc	Burrsville Rd, Denton, MD 21629	
	Tri Gas & Oil	Federalsburg Hwy, Federalsburg, MD 21632	
	C&P Bell Tel Co	Grove Rd, Preston, MD 21655	
	TARA Communication	Hog Neck Rd, Preston, MD 21655	
	Muhammad	Idlewild Rd, Federalsburg, MD 21632	
	TELECOM Cell Tower	Langrell Rd, Preston, MD 21655	
	TELECOM Cell Tower	Laurel Grove Road, Federalsburg, MD 21632	
	TELECOM Cell Tower	Laurel Grove Road, Denton, MD 21629	
	MD State Highway Administration	Legates Dr, Denton, MD 21629	
	Caroline County Soil Conservation District	Legion Rd, Denton, MD 21629	
	Tower Co Assets LLC	Main St, Marydel, MD 21649	
	Telecommunications Tower	Marsh Creek Rd, Preston, MD 21655	
	State of MD MIEMSS	N University Ave, Federalsburg, MD 21632	
	Board of Education	Noble Ave, Preston, MD 21655	
	American Towers Inc.	Old Line Rd, Goldsboro, MD 21636	
	Board of Education	Richardson Rd, Federalsburg, MD 21632	
	C&P Bell Tel Co.	Ridgely Rd, Ridgely, MD 21660	
	Choptank Electric	River Road, Denton, MD 21629	
	TELECOM Cell Tower	Shore Hwy, Ridgely, MD 21660	
	TELECOM Cell Tower	Shore Hwy, Denton, MD 21629	
	TELECOM Cell Tower	Shore Hwy, Federalsburg, MD 21632	
	American Tower	Smithville Rd, Federalsburg, MD 21632	
	TELECOM Cell Tower	Sunset Blvd, Ridgely, MD 21660	
	TELECOM Cell Tower	Tanyard Rd, Preston, MD 21655	
	TELECOM Cell Tower	Tuckahoe Rd, Denton, MD 21629	

Facility Type	Facility Name	Address	Hazard Risk
Fire Stations	Station 100	208 North University Avenue, Federalsburg, MD 21632	Winter Storm
	Station 200	3680 Choptank Rd, Preston, MD 21655	
	Station 300	400 S 5th Ave, Denton, MD 21629	
	Station 400	101 Sunset Blvd, Ridgely, MD 21660	Winter Storm
	Station 56	110 Firehouse Ln, Marydel, DE 19964	
	Station 600	13781 Greensboro Road, Greensboro, MD 21639	Winter Storm
	Station 700	700 Old Line Rd, Goldsboro, MD 21636	
	Station 800	13512 1st St, Queen Anne, MD 21657	
Paramedic Units	Paramedic 11	405 University Ave N, Federalsburg, MD 21632	Winter Storm
	Paramedic 12	3681 Choptank Rd, Preston, MD 21655	
	Paramedic 13	9391 Double Hills Rd, Denton, MD 21629	
	Paramedic 14	101 Sunset Blvd, Ridgely, MD 21660	Winter Storm
	Paramedic 16	116 N Main St, Greensboro, MD 21639	Winter Storm
	Paramedic 17	700 Old Line Road, Goldsboro, MD 21636	
Police Department	Caroline County Sheriff's Office	9305 Double Hills Road, Denton, MD 21629	
	Denton Police Department	13 N. Third Street, Denton, MD 21629	
	Federalsburg Police Department	104 Morris Avenue, Federalsburg, MD 21632	Winter Storm
	Greensboro Police Department	104 East Sunset Avenue, Greensboro, MD 21639	Winter Storm
	Ridgely Police Department	2 Central Avenue, Ridgely, MD 21660	Winter Storm
Medical	Diagnostics Center	838 S. 5th Avenue, Denton, MD 21629	
	Family Medicine	836 S. 5th Avenue, Denton, MD 21629	
	Laboratory Services	836 S. 5th Avenue, Denton, MD 21629	
	Rehabilitation Center	920 B Market Street Denton, MD 21629	
	University of Maryland Urgent Care	8 Denton Plaza, Denton, MD 21629	
	Family Practice, Jensen, Christian, Md	9307 Corkell Road, Denton, MD 21629	
	UM Shore Regional Health Diagnostics At Denton	1140 Blades Farm Road, Suite 102, Denton, MD 21629	
	Family Practice, University Of Maryland Shore Health System	1140 Blades Farm Road, Suite 101, Denton, MD 21629	
	Choptank Community Health System Inc Denton	808 S Fifth Avenue, Denton, MD 21629	
	Choptank Community Health System Administration	301 Randolph Street, Denton, MD 21629	
	Korah Pulimood, Md	912 Market Street, Denton, MD 21629	

Facility Type	Facility Name	Address	Hazard Risk
Medical Cont.	Preston Family Physician Care	3683 Choptank Road, Preston 21655	
	Tidal Health Primary Care Federalsburg	3304 Hayman Drive, Federalsburg, MD 21632	
	Choptank Community Health Systems Federalsburg, Federalsburg Medical Center	215 Bloomingdale Avenue, Federalsburg, MD 21632	
	Choptank Community Health Systems Goldsboro, Goldsboro Medical Center	316 Railroad Avenue, Goldsboro, MD 21636	
	Heath And Public Services Building	403 South 7th St., Denton, MD 21629	
	DaVita Kidneycare Dialysis Center	842 South 5th Ave., Denton, MD 21629	
Food, Hydration, Shelter			
Schools (Shelters)	Caroline County Public Schools BOE	204 Franklin Street, Denton, MD 21629	
	Denton Elementary School	303 Sharp Road, Denton, MD 21629	
	Federalsburg Elementary School	302 S University Avenue, Federalsburg, MD 21632	Winter Storm
	Greensboro Elementary School	627 N Main Street, Greensboro, MD 21639	
	Preston Elementary School	225 Main Street, Preston, MD 21655	
	Ridgely Elementary School	118 N Central Avenue, Ridgely, MD 21660	
	Colonel Richardson Middle School	25390 Richardson Road, Federalsburg, MD 21632	
	Lockerman Middle School	410 Lockerman Street, Denton, MD 21629	
	Caroline Career & Technology Center	10855 Central Avenue, Ridgely, MD 21660	Winter Storm
	Colonel Richardson High School	25320 Richardson Road, Federalsburg, MD 21632	
	North Caroline High School	10990 River Road, Ridgely, MD 21660	Winter Storm
	Benedictine School (Private)	14299 Benedictine Lane, Ridgely, MD 21660	Winter Storm
	Caroline County Early Head Start	100 N 6th St, Denton, MD 21629	
Government (Not a Community Lifeline)			
County Owned	Board Of Education	323 University Ave, Federalsburg, MD 21632	
	Federalsburg Branch Library	123 Morris Ave, Federalsburg, MD 21632	Storm Surge Inundation Areas
	County Historical Society	3395 Linchester Road, Preston, MD 21655	Storm Surge Inundation Areas
	County Commissioners- Historic - Webb Cabin	23459 Grove Road, Preston, MD 21655	
	Caroline County 4-H Park	8230 Detour Road, Denton, MD 21629	
	Caroline County Community Center	107 S 4th St, Denton, MD 21629	
	Board Of Education	204 Franklin St, Denton, MD 21629	
	County School Maintenance & Transportation	414 Gay St, Denton, MD 21629	
	Caroline County Public Library	100 Market St, Denton, MD 21629	
	Caroline County Department Of Corrections	101 Gay St, Denton, MD 21629	

Facility Type	Facility Name	Address	Hazard Risk
County Owned Cont.	Department Of Public Works Building	520 Wilmuth St, Denton, MD 21629	
	Caroline County Courthouse	109 Market St, Denton, MD 21629	
	Delmarva Community Transit	10502 Greensboro Road, Denton, MD 21629	
	Dayspring Townhomes	12050 School St, Ridgely, MD 21660	
	The Caroline Center	12061 School St, Ridgely, MD 21660	
	Dayspring Townhomes	School St, Ridgely, MD 21660	
	Caroline County Humane Society	407 W Belle Road, Ridgely, MD 21660	
	Caroline County District Court	207 S 3rd St, Denton, MD 21629	
	Caroline County Office Building	411 Franklin St, Denton, MD 21629	
Municipal Owned	Denton Town Hall	4 N 2nd St, Denton, MD 21629	
	Goldsboro Town Hall	505 Oldtown Road, Goldsboro, MD 21636	
	Preston Town Hall	105 Back Landing Road, Preston, MD 21655	
	Town Of Federalsburg Community Center	223 Kinder St, Federalsburg, MD 21632	
	Mayor And Council Of Federalsburg	704 Morris Ave, Federalsburg, MD 21632	1% Annual Chance Flood Event Storm Surge Inundation Areas
	Federalsburg Town Hall	118 N Main St, Federalsburg, MD 21632	1% Annual Chance Flood Event Storm Surge Inundation Areas
	Town Of Preston	3690 Choptank Road, Preston, MD 21655	
	Denton Self Storage	24 Engerman Ave, Denton, MD 21629	
	Town Of Denton - Chesapeake Culinary Center	512 Franklin St, Denton, MD 21629	
	Town Of Denton - Fiber Arts Center	7 N 4th St, Denton, MD 21629	
	Denton - Museum Of Rural Life	16 N 2nd St, Denton, MD 21629	
	Town Of Denton	414 High St, Denton, MD 21629	
	Old Denton Town Hall	13 N Third St, Denton, MD 21629	
	Hillsboro Town Hall	22043 Church St, Denton, MD 21629	
	Town Of Hillsboro	22004 Main St, Denton, MD 21629	
	Ridgely Rec Field/Park	W Forth St, Ridgely, MD 21660	
	Ridgely Town Hall	2 Central Ave, Ridgely, MD 21660	
	Greensboro Town Hall	111 Main St, Greensboro, MD 21639	
	Marydel Town Hall	319 Main St, Marydel, MD 21649	
Energy			
Power Stations	Choptank Electric Cooperation	6905 Reliance Road, Federalsburg, MD 21632	
		Cemetery Road, Denton, MD 21629	
		24820 Meeting House Road, Denton, MD 21629	
		24820 Meeting House Road, Denton, MD 21629	
		Conrail Road, Federalsburg, MD 21632	
		10384 River Road, Denton, MD 21629	
		River Road, Denton, MD 21629	Storm Surge Inundation Areas
		25245 Beauchamp Branch Rd, Denton, MD 21629	

Facility Type	Facility Name	Address	Hazard Risk
Power Stations Cont.	Choptank Electric Cooperation Cont.	10675 Greensboro Road, Denton, MD 21629	
		1227 Market St, Denton, MD 21629	
		4307 Bethlehem Road, Preston, MD 21655	
	Delmarva Power & Light Company	821 Camp Road, Denton, MD 21629	
		Pennsylvania Ave, Federalsburg, MD 21632	0.2% Annual Chance Flood Event Storm Surge Inundation Areas
		Cemetery Road, Denton, MD 21629	
		11711 Eveland Road, Ridgely, MD 21660	
Water Systems			
Water Treatment Plant (WTP)	Jonestown WTP	109 Market St, Denton, MD 21629	
Water Towers	Denton	Engerman Ave, Denton, MD 21629	
		Old Camp Rd, Denton, MD 21629	
		N 5th Street, Denton, MD 21629	
	Greensboro	Watertower Aly, Greensboro, MD 21639	
		Hobbs St, Greensboro, MD 21639	
	Federalsburg	Caroline Dr, Federalsburg, MD 21632	
		Industrial Park Rd, Federalsburg, MD 21632	
	Henderson	Henderson Rd, Henderson, MD 21640	
	Preston	Wright St, Preston, MD 21655	
Wastewater Treatment Plant (WWTP)	Denton WWTP	650 Legion Rd, Denton, MD 21629	
	Federalsburg WWTP	125 Kerney St, Federalsburg, MD 21632	
	Greensboro WWTP Pump Stations	13514 Greensboro Rd, Greensboro, MD 21639	1% Annual Chance Flood Event
	Greensboro WWTP	13875 Greensboro Road, Greensboro, MD 21639	
	Ridgely WWTP	23236 W Belle Rd, Ridgely, MD 21660	

Appendix B
HMPC Meeting Notes & Municipal Participation Documentation

Caroline County Hazard Mitigation Planning, Training, and Outreach Initiatives				
Date	**Meeting, Training, or Outreach Activity**	**Target Audience**	**Materials Provided**	**Comments/Input**
6-Jun-23	Project Kick-Off Mtg.	Project Manager	Project SOW & Timeline	Discussed outreach strategy and project website. HMPC members listing review and update will be completed.
13-Jun-23	Kickoff Meeting Save the Date	Hazard Mitigation Planning Committee	Meeting Details	The importance and purpose of hazard mitigation planning .
5-Jul-23	Website Content	HMPC & Public	Hazard Mitigation Specific Content	Hazard miitgaiton plan information, public survey link, social media links, and contact information provided.
19-Jul-23	HMPC Kickoff Metting	Hazard Mitigation Planning Committee	Webex Meeting- Agenda	HMPC Role, HMPC, Municipal & Public Surveys & Project Website
24-Jul-23	Kickoff Meeting Notes & PowerPoint	Hazard Mitigation Planning Committee	Notes, PowerPoint, HMPC and Municipal Surveys	Notes discussing the kickoff meeting, surveys and social media posts.
24-Jul-23	HMPC & Municipal Surveys	Hazard Mitigation Planning Committee	HMPC and Municipal Surveys	Surveys for the HMPC and municipalities were provdied for completion.
27-Jul-23	Website Content	HMPC & Public	Kickoff Meeting Notes	Notes discussing the kickoff meeting, surveys and social media posts.
31-Jul-23 & 15-Aug-23	Utility Outage Data	Choptank Electric	CAIDI Average Restoration Time & SADI Average Outage Duration by Year	Email and phone converstions regarding power outage information for inclusion in the plan update.
14-Aug-23	GIS Data Coordination	GIS Speicalist	Data Layer Requests	Specific GIS data layer request.
14-Aug-23	Draft Chapters Review	Hazard Mitigation Planning Committee	Chapter 8 Drought & Excessive Heat; Chapter 9 Severe Weather	Chapters 8 & 9 were provided for review and comment.
18-Aug-23	NFIP Data Requested	FEMA Flood Insurance Outreach Specialist	FEMA NFIP Data Request	NFIP data was requested from FEMA.
21-Aug-23	2019 Mitigation Action Status Update	Hazard Mitigation Planning Committee	Mitigation Action Status Update Form	Members were asked to provide status updates for the previous mitigation actions identified in the 2019 plan.
1-Sep-23	Draft Chapter Review	Hazard Mitigation Planning Committee	Chapter 2 County Profile	Chapter 2 was provided for review and comment.
8-Sep-23	Draft Chapter Review	Hazard Mitigation Planning Committee	Chapter 7 Winter Storms	Chapter 7 was provided for review and comment.
13-Sep-23	Draft Chapter Review	Hazard Mitigation Planning Committee	Chapter 3 Hazard Identification & Risk Assessment	Chapter 3 was provided for review and comment.
18-Sep-23	Midpoint Meeting	Hazard Mitigation Planning Committee	Capability Assessment	Members review the Mitigation Status Update, HIRA Results, and Public Survey Result. Members then participated in the Capability Assessment Work Session.
20-Sep-23	Draft FEMA NFIP Questionnaire	Floodplain Manager	NFIP Questionnaire	Draft questionnaire was provided to the Floodplain Manager for review and comment.
21-Sep-23	Midpoint Meeting Notes & PowerPoint	Hazard Mitigation Planning Committee	Notes and PowerPoint	Notes discussing the midpoint meeting.
23-Sep-23	Website Content	HMPC & Public	Midpoint Meeting Notes	Notes discussing the midpoint meeting.
26-Sep-23	Draft Chapters Review	Hazard Mitigation Planning Committee	Chapter 12 2019 Mitigation Status Report & Chapter 13 Capability Assessment	Chapters 12 & 13 were provided for review and comment.
3-Oct-23	NFIP Data and ISAA for Carolina County	DES, FEMA	FEMA NFIP Data Request	Data exchange
25-Oct-23	FEMA NFIP Questionnaire	Floodplain Manager	NFIP Questionnaire	NFIP questionnaire follow-up with Floodplain Manager about mitigation action items developed as result of the questionnarie.
27-Nov-23	Draft Chapter Review	Hazard Mitigation Planning Committee	Chapter 11 Dam Failure	Chapter 11 was provided for review and comment.
27-Nov-23	Draft Chapter Review	Health Department, Department of Social Services	Chapter 10 Emerging Infectious Disease	Chapter 10 was provided to the Health Department for review and comment. In addition, a questionnaire was provided assist with documenting public health capabilities and/or new mitigation actions.
30-Nov-23	Draft Goals and Objectives	Hazard Mitigation Planning Committee	Goals and Objectives	Goals and objectove were provided for review. Members were asked to provide modifications and/ or new goals and objectives.

16-Jan-24	Draft Chapter Review	Hazard Mitigation Planning Committee	Chapter 10 Emerging Infectious Disease	Chapter 10 was provided for review and comment.
18-Jan-24	Small Group Social Equity Meeting	DES, Health Department, Department of Social Services	Questionnaire	Discussion for integration of social equity into the hazard mitigation plan update.
25-Jan-24	Mitigation Workshop	Hazard Mitigation Planning Committee	Mitigation Action Items	Members review mitigation action items to determine if they should be included and/ or modified for inclusion in the plan.
26-Jan-24	Municipal Coordination	Municipalities	Municipal Specific Mitigation Action Items	Emails sent to the Towns of Federalsburg, Greensboro, Hillsboro, and Preston regarding town specific mitigation action items.
14-Feb-24	Mitigation Action Prioritization Survey	HMPC	Online Survey	Online prioritization survey distributed to HMPC for completion.
5-Mar-23	Mitigation Workshop Notes	Hazard Mitigation Planning Committee	Notes	Notes discussing the Mitigation Workshop.

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Kick-off Meeting
July 19, 2023, 10:00 – 11:00 AM

All members of Caroline County's Hazard Mitigation Planning Committee (HMPC) were invited to the Plan Update Kick-off Meeting. A full list of the HMPC will be made available as an appendix. All HMPC members will receive a copy of these notes. The following members were in attendance:

Name	Organization/Department	Position/Title
Samuel Grant	CC Department of Emergency Services	Emergency Management Division Chief
Leslie Grunden	CC Department of Planning & Codes	Assistant Director
Ryan White	CC Department of Public Works	Director
Kelli Schanken	CC Department of Emergency Services	Office Manager
Tammy Kelledes	Town of Greensboro	Town Manager
Mark Chandler	Town of Denton Department of Public Works	Director
Amber Korell	Town of Preston	Town Manager
Jeannette DeLude	Town of Henderson, Marydel & Goldsboro	Circuit Rider
Kristin A. Dietz	Caroline County Health Department	Deputy Health Officer
Eric Helm Buehl	University of Maryland Extension	Regional Watershed Restoration Specialist
Jeffrey Baggett	American Red Cross	Disaster Program Manager
Michele King	SP&D	Planner
Virginia Smith	SP&D	Principal

Agenda

- Introductions
- Hazard Mitigation Overview
- Project Timeline
- HMPC, Municipal & Public Participation
- Hazard Identification Risk Assessment (HIRA)
- Hazard Surveys
- Survey Results Utilization
- Development of Mitigation Action Items
- Next Steps

Hazard Mitigation Overview

- The 2019 Caroline County Hazard Mitigation Plan (HMP) is in the plan update process. The 2019 HMP is available for review on the Caroline County Department of Emergency Services-Emergency Management website: https://www.carolinemd.org/659/Hazard-Mitigation.

- FEMA Requirements:
  - FEMA requires hazard mitigation plans to be updated every five (5) years.
  - Jurisdictions are required to develop and maintain a FEMA approved and locally adopted Hazard Mitigation Plan.
  - Stakeholder, public, and regional collaboration and engagement is vital throughout all stages of the plan development process to be approved by MDEM & FEMA.
  - **New** State and Local Mitigation Planning Policy Guide (effective April 19, 2023)
  - For municipalities to be covered under the Caroline County HMP, they must participate throughout the planning process and formally adopt the plan.
  - Note: it is recommended that municipalities complete the Municipal Survey (online) and provide recommendations for mitigation projects.
- Mitigation is Cost Effective
  - More federal funding is available more than ever to fund local hazard mitigation projects. Federal grants offer a return of $6 for every $1 spent (*National Institute of Building Sciences, 2020*).

Hazard Mitigation is any action taken to permanently reduce or eliminate long-term risk to people and their property from the effects of hazards.

The purpose of the **Hazard Mitigation Plan** is to prevent or reduce loss of life and injury as well as limit damage costs from various hazards through the development of mitigation methods which lessen or eliminate future damage.

Project Timeline

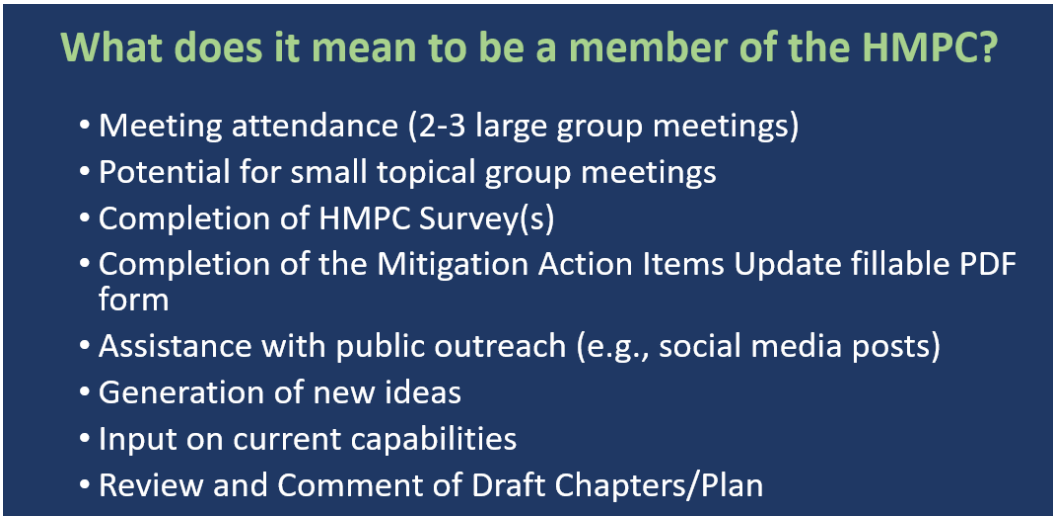
- The kick-off meeting for this Plan Update was held on July 19, 2023.
- The HMPC will meet throughout the planning process in addition to small group meetings that will be scheduled as needed, including:
  - Floodplain Management/Checking In on the NFIP Worksheets
  - Public Health & Social Equity
- Draft chapters will be sent to HMPC members and placed on the project's website for public review as they are completed. A full draft plan for stakeholder review will be made available prior to MDEM and FEMA review.
- The 2019 HMP expires on June 10, 2024.
- The project calendar has been included as an attachment to the meeting notes.

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Kick-off Meeting
July 19, 2023, 10:00 – 11:00 AM

HMPC, Municipal & Public Participation

Hazard Mitigation Planning Committee (HMPC)

- HMPC members from a broad cross-section of the community were identified and invited to participate.
    - HMPC members may have public outreach initiatives that pair well with hazard mitigation, resilience, and preparedness. SP&D requests that members provide details of these public outreach initiatives for collaboration and documentation (e.g., agenda, brief description of the meeting and how the Hazard Mitigation Plan Update process was discussed).



    - SP&D is requesting photos, data, and ideas from HMPC members as they relate to hazard mitigation and/or natural hazard events in Caroline County and its municipalities.
- A webpage on DES Emergency Management website has been created to provide updates, post links, and share new information relating to the HMP Update. This webpage will be updated throughout the plan development process.
    - **Link:** https://www.carolinemd.org/659/Hazard-Mitigation.

Hazard Identification & Risk Assessment (HIRA)

- Hazards identified within the HMP:
    - **Natural Hazards**: Riverine Flooding, Coastal Flooding, Coastal Storms (Hurricanes), Winter Storm, Drought & Excessive Heat, Thunderstorm, Power Outages, and Tornado
    - **New Hazards added:** Emerging Infectious Diseases and Dam Failure.

- To assess the hazard risk for the natural hazards identified in this Plan Update, a composite scoring method will be utilized. The composite score method is based on a blend of quantitative and qualitative factors extracted from the National Centers for Environmental Information (NCEI) database, and other available data sources. These included:
    - Historic impacts, in terms of human lives and property
    - Geographic extent (size and magnitude of hazard area)
    - Historical occurrence
    - Probability of Future Occurrence
    - Community Risk Perspective

> **Hazard:** incidents that result from acts of nature such as flood or tornado. Also, technological hazards that results from failure of man-made systems such as dam failure or transportation accidents.
>
> **Risk:** possibility of loss injury.

- The aforementioned risk factors are weighted and used in the following formula to determine the composite risk ratings for each hazard:
    - Equation: Composite Score = Injuries + Deaths + Property Damage + Crop Damage + (Geographic Extent*1.5) + Events Annualized + Future Probability + (Community Perspective*1.5)

Hazard Surveys

HMPC Survey

- HMPC members were requested at the Kick-off Meeting to complete the **HMPC Survey** to provide the above "community risk perspective."
- HMPC members are asked to complete the survey online by COB August 7, 2023.
    - **Link to HMPC Survey:** https://www.surveymonkey.com/r/HYNMHWM and **QR Code:**
- Results of the HIRA will be provided to HMPC members and posted on the project website.

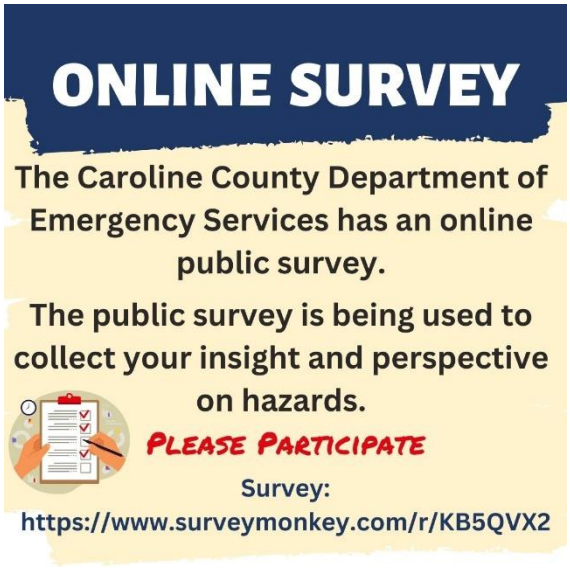
Municipal Survey

- A separate **Municipal Survey** has been developed to obtain municipal perspective on the identified hazards and to determine current capabilities. The Municipal Survey will be provided to municipal representatives for completion. We request the survey be completed by COB August 7, 2023.
    - **Link:** https://www.surveymonkey.com/r/RNPDFDD and QR Code

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Kick-off Meeting
July 19, 2023, 10:00 – 11:00 AM

Public Survey

- The **Public Survey** has been launched on the County's Emergency Management webpages and is currently available for members of the public to complete. The link to this survey will remain active on the website for the length of the project.
    - **Link:** https://www.surveymonkey.com/r/KB5QVX2
    - SP&D provides ready-made outreach imagery for social media and requests that HMPC members to post/share the public survey on their department/agency/ organization's approved social media, below.
    - Below is the ready-made social media post and QR Code. As mentioned during the meeting, if you post the survey on your social media, please let me know via email (mking@smitp-d.com).



Survey Results Utilization

- HMPC and Municipal Hazard Risk Surveys:
    - Results used for Hazard Identification and Risk Assessment.
    - Looking for new mitigation project ideas.
    - Current, planned, or proposed regional collaboration ideas and projects.
- Public Survey:
    - Open throughout the planning process, with final results integrated into the plan towards the end of the planning process.
    - Public survey results are reviewed throughout the planning process, for:
        - Areas of agreement and disagreement regarding hazard perspectives.
        - Identification of new or preferred styles of mitigation projects.
        - Insight into overall perception of hazards.

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Kick-off Meeting
July 19, 2023, 10:00 – 11:00 AM

Development of Mitigation Action Items

- SP&D reviewed the steps for the development of actions items and projects for the plan update.
    - Step 1: HMPC members provide new ideas for inclusion in the Plan Update. Results are integrated into the Plan Update.
    - Step 2: Continue to collect new mitigation ideas throughout the plan development process via stakeholder discussion and public comments received via the project website and surveys. In addition, the Mitigation Workshop provides an opportunity for HMPC members to work together to further develop ideas into projects.
    - Step 3: Mitigation Action Items are developed based on HMPC input, public input, and results of risk and vulnerability analysis. Then a Mitigation Action Item Prioritization process is conducted to determine "high priority" projects.

Note: FEMA requires that two (2) action items are developed for each identified hazard, at a minimum.

Next Steps

- HMPC Meeting #1 Notes
    - Distributed to HMPC members and uploaded to project website.
- **HMPC and Municipal Survey – please complete by COB August 7, 2023.**
    - HMPC Link: https://www.surveymonkey.com/r/HYNMHWM
    - Municipal Link: https://www.surveymonkey.com/r/RNPDFDD
- New Hazard Identification Risk Assessment (HIRA)
    - Will be provided to HMPC members and placed on project website for review.
- Targeted Small Group Meetings: September/October
- HMPC Meeting #2
    - **September 2023**

Project Website:
https://www.carolinemd.org/659/Hazard-Mitigation
Contact: mking@smithp-d.com
Phone: (301) 724-7611

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Midpoint Meeting
September 18, 2023, 1:00 – 2:00 PM

All members of Caroline County's Hazard Mitigation Planning Committee (HMPC) were invited to the Plan Update Midpoint Meeting. A full list of the HMPC will be made available as an appendix. All HMPC members will receive a copy of these notes. The following members were in attendance:

Name	Organization/Department	Position/Title
Mark Sheridan	CC Department of Emergency Services	Director
Doug Jones	CC Department of Emergency Services	Emergency Management Division Chief
Leslie Grunden	CC Department of Planning & Codes	Assistant Director
Megan Gallagher	CC Department of Planning & Codes	GIS & Data Coordinator
Ryan White	CC Department of Public Works	Director
Donald Baker	CC Sheriff's Office	Sheriff
Mark Chandler	Town of Denton Department of Public Works	Director
Michele King	SP&D	Planner
Eric Messick	SP&D	Planner

Agenda

- Introductions
- Hazard Mitigation Overview
- Plan Update Progress Report
- Review Mitigation Status Update
- Review Hazard Identification Risk Assessment (HIRA) Results
- Review Public Surveys Results
- Capability Assessment Work Session
- Next Steps

Hazard Mitigation Overview

- The 2019 Caroline County Hazard Mitigation Plan (HMP) is in the plan update process. The 2019 HMP is available for review on the Caroline County Department of Emergency Services-Emergency Management website: https://www.carolinemd.org/659/Hazard-Mitigation.
- FEMA Requirements:
    - FEMA requires hazard mitigation plans to be updated every five (5) years.
    - Jurisdictions are required to develop and maintain a FEMA approved and locally adopted Hazard Mitigation Plan.
    - Stakeholder, public, and regional collaboration, and engagement is vital throughout all stages of the plan development process to be approved by MDEM & FEMA.

- **New** State and Local Mitigation Planning Policy Guide (effective April 19, 2023)
- For municipalities to be covered under the Caroline County HMP, they must participate throughout the planning process and formally adopt the plan.

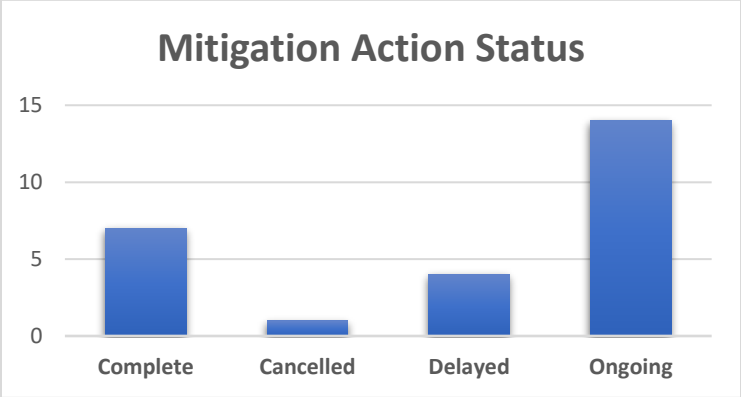
Plan Update Progress Report

- A webpage has been added under the Department of Emergency Services website: https://www.carolinemd.org/659/Hazard-Mitigation. Content has been uploaded to the webpage.
- The press release is located on the DES Hazard Mitigation webpage. The press release was also featured in The Star Democrat newspaper on July 12, 2023.
- Hazard Mitigation Planning Committee members participated in the HMPC survey. Results were integrated into Chapter 3 Hazard Identification & Risk Assessment.
- Six (6) out of ten (10) municipalities completed the Municipal Survey. Efforts to have the following municipalities participate will continue.
  - Greensboro, Federalsburg, Hillsboro, Templeville
- The public survey was made available in July and has been promoted on social media. The survey will remain open throughout the planning process.
- The following draft chapters have been provided to committee members for review.
  - Chapters 2 County Profile
  - Chapter 3 Hazard Identification & Risk Assessment
  - Chapter 7 Winter Storms
  - Chapter 8 Drought and Excessive Heat
  - Chapter 9 Severe Weather
- The NFIP Questionnaire was completed for Caroline County and provided to the Floodplain Manager for review.
- Chapter 12 Mitigation Status Report and Chapter 13 Capability Assessment are the next chapters to be distributed.

Review Mitigation Status Update

- A total of thirty-two (32) action items were evaluated as part of the plan update process.
  - Nine (9) of the thirty-two (32) action items were ranked as “High Priority” by the 2019 HMPC members.
- Six (6) were identified as complete by committee members during the review. Four (4) of the completed action items were “High Priority” actions.
- Four (4) action items were delayed and will be carried forward into the plan update.
- Status updates are needed for six (6) mitigation actions.
  - SP&D will continue its efforts to obtain status updates.

- The graph below further illustrates the present status of the 2019 mitigation actions based upon stakeholder feedback.



Hazard Identification & Risk Assessment (HIRA)

- Hazards identified within the HMP:
  - **Natural Hazards**: Riverine Flooding, Coastal Flooding, Coastal Storms (Hurricanes), Winter Storm, Drought & Excessive Heat, Thunderstorm, Power Outages, and Tornado
  - **New Hazards added:** Emerging Infectious Diseases and Dam Failure.
- As part of the HMPC Survey, members were asked to indicate their level of concern for each identified hazard. Results gathered from the this were used for the "Community Risk Perspective" factor in the composite score method. HMPC members' level of concern results are below.

HMPC PERSPECTIVE			
Hazard	**Types of Events**	**2019 Level of Concern**	**2023 Level of Concern**
Riverine Flooding	Heavy Rain, Flood, & Flash Flood	Concerned	Concerned
Coastal Flood (Tidal)	Coastal Flooding	Very Concerned	Somewhat Concerned
Coastal Storms	Hurricanes, & Tropical Storms	Very Concerned	Concerned
Shoreline Erosion & Sea Level Rise	Shoreline Erosion & Sea Level Rise	Somewhat Concerned	Concerned
Winter Storms	Cold/Wind Chill, Extreme Cold/Wind Chill, Blizzard, Frost/Freeze, Heavy Snow, Sleet, Winter Storm, & Winter Weather	Concerned	Concerned
Drought & Excessive Heat	Drought, Excessive Heat, & Heat	Concerned	Concerned
Thunderstorms	Thunderstorm Wind, High Wind, Lightning, & Hail	Concerned	Concerned
Tornado	Funnel Cloud & Tornado	Somewhat Concerned	Somewhat Concerned
Power Outages	Power Outages	Somewhat Concerned	Concerned
New - Emerging Infectious Disease	Emerging Infectious Disease	N/A	Somewhat Concerned
New - Dam Failure	Dam Failure	N/A	Somewhat Concerned

Source: 2023 Hazard Mitigation Planning Committee

  - The survey also asked the HMPC members about their perspective on social vulnerability in the county. Results indicated that the top three (3) groups particularly at risk include: Age (65 and older), Language Barriers (limited English), and Socioeconomic Status (poverty). Top hazards affecting these groups include Drought & Extreme Heat, Power Outages, and Emerging Infectious Disease.

- To assess the hazard risk for the natural hazards identified in this Plan Update, a composite scoring method was utilized. The composite score method is based on a blend of quantitative and qualitative factors extracted from the National Centers for Environmental Information (NCEI) database, and other available data sources. These included:
  - Historic impacts, in terms of human lives and property
  - Geographic extent (size and magnitude of hazard area)
  - Historical occurrence
  - Probability of Future Occurrence
  - Community Risk Perspective
- The aforementioned risk factors were weighted and used in the following formula to determine the composite risk ratings for each hazard:
  - Equation: Composite Score = Injuries + Deaths + Property Damage + Crop Damage + (Geographic Extent*1.5) + Events Annualized + Future Probability + (Community Perspective*1.5)
- Results from the composite score are below.

Hazard Risk Ranking Results	
Hazard	**2023 Hazard Ranking**
Riverine Flooding	High
Coastal Flood (Tidal)	Medium
Coastal Storms	Medium
Shoreline Erosion & Sea Level Rise	Medium-Low
Winter Storms	Medium-High
Drought & Excessive Heat	High
Thunderstorms	High
Tornado	Medium-Low
Power Outages	Medium
Dam Failure	Medium-Low
Emerging Infectious Disease	Medium

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Midpoint Meeting
September 18, 2023, 1:00 – 2:00 PM

Review Public Survey Results

- The **Public Survey** has been launched on the County's Emergency Management webpages and is currently available for members of the public to complete. HMPC members have assisted with distributing the link on various social media platforms as well.
- Preliminary results were reviewed with committee members and are attached for those unable to attend the meeting.
    - The public survey currently has 112 responses.
        - Municipal response breakdown: Denton (61), Federalsburg (3), Goldsboro (5), Greensboro (11), Henderson (1), Hillsboro (0), Marydel (2), Preston (15), Ridgely (0), and Templeville (7).
        - Preliminary results indicate the public is most concerned with Thunderstorm and Mass Power Outage.
- The Public Survey will remain open throughout the duration of the plan update, with results integrated into the plan document towards the end of the planning process.
    - Public survey results will continue to be reviewed throughout the planning process with HMPC members.
    - This survey assists with the identification of new or preferred types of mitigation projects and insight into overall perception of hazards.

Capabilities Assessment Work Session

- During this session, committee members were asked to review the capability assessment, which is part of Chapter 13.
- A roundtable discussion took place in order to review the accuracy of the information provided on the capability tables. Members also provide missing information or a point of contact for the missing information.
    - Capability tables reviewed:
        - Planning Capabilities & Integration
        - Administrative & Technical
        - Financial
        - Education & Outreach
- Members reviewed the community overview and capabilities provided in narrative form at the beginning of the chapter.
- Members were asked to add information on their organization's hazard mitigation or preparedness capabilities, as applicable.
- Discussion indicated that both education and outreach capabilities are limited.

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Midpoint Meeting
September 18, 2023, 1:00 – 2:00 PM

Next Steps

- Meeting #2 Notes will be provided to all stakeholders and uploaded to the project website.
- Coordinate information follow-ups to complete capabilities chapter.
- Chapter 12: Mitigation Status Report will be distributed once additional information is obtained.
- Chapter 13: Capabilities Assessment distributed to HMPC following this meeting. Note – new mitigation strategies are also included in the chapter. Only the Capabilities Assessment section will be distributed.
- Continue outreach to municipalities for participation.
- Targeted Small Group Meetings – September and October
- Continue drafting chapters.
- Next Meeting – Mitigation Workshop - November 2023.

Project Website:
https://www.carolinemd.org/659/Hazard-Mitigation
Contact: mking@smithp-d.com
Phone: (301) 724-7611

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Mitigation Workshop
January 25, 2024

All members of Caroline County's Hazard Mitigation Planning Committee (HMPC) were invited to the Mitigation Workshop, including municipal representatives. Meeting notes are distributed to the HMPC and are included in the Appendix. The following members were in attendance:

Name	Organization/Department	Position/Title
Mark Sheridan	CC Department of Emergency Services	Director
Doug Jones	CC Department of Emergency Services	Emergency Management Division Chief
Leslie Grunden	CC Department of Planning & Codes	Assistant Director
Matt Kaczynski	CC Department of Planning & Codes	Floodplain Manager
Bryan North	CC Department of Public Works	Roads Superintendent
Eric Helm Buehl	University of Maryland – Sea Grant Extension	Regional Watershed Restoration Specialist
Heather Grove	CC Health Department	Public Health Emergency Planner
Kristin A. Dietz	CC Health Department, LEPC	Deputy Health Officer
Joshua L. Parker	Maryland Department of Health	Director of Environmental Health
Matthew Teffeau	Choptank Electric Cooperative	
Scott Getchell	Town of Denton	Town Manager
Mark Chandler	Town of Denton Department of Public Works	Director
Virginia Smith	SP&D	Principal
Eric Messick	SP&D	Planner

Agenda

- Welcome and Introductions
- Where are we?
- 2024 Hazard Mitigation Actions – Group Activity
- Next Steps

Hazard Mitigation Overview

- The 2019 Caroline County Hazard Mitigation Plan (HMP) is in the plan update process. The 2019 HMP is available for review on the Caroline County Department of Emergency Services-Emergency Management website: https://www.carolinemd.org/659/Hazard-Mitigation.
- FEMA Requirements:
  - FEMA requires hazard mitigation plans to be updated every five (5) years.
  - Jurisdictions are required to develop and maintain a FEMA approved and locally adopted Hazard Mitigation Plan.
  - Stakeholder, public, and regional collaboration, and engagement is vital throughout all stages of the plan development process to be approved by MDEM & FEMA.
  - **New** State and Local Mitigation Planning Policy Guide (effective April 19, 2023)
  - For municipalities to be covered under the Caroline County HMP, they must participate throughout the planning process and formally adopt the plan.

Caroline County Hazard Mitigation Plan Update
Hazard Mitigation Planning Committee
Mitigation Workshop
January 25, 2024

Plan Update Progress Report

- A webpage has been added under the Department of Emergency Services website: https://www.carolinemd.org/659/Hazard-Mitigation. Content has been uploaded to the webpage.
- The press release is located on the DES Hazard Mitigation webpage. The press release was also featured in The Star Democrat newspaper on July 12, 2023.
- Eight (8) out of ten (10) municipalities completed the Municipal Survey. Efforts to have the following municipalities participate will continue.
    - Federalsburg, Hillsboro Needed
- The public survey was made available in July and has been promoted on social media. The survey will remain open throughout the planning process (209 participants as 1/24/2024)
- The NFIP Questionnaire was completed for Caroline County and provided to the Floodplain Manager for review.
- Draft Chapters Provided for Review
- Social Equity Meeting – January 18, 2023

Mitigation Workshop

The mitigation workshop was conducted using four topical sessions. Mitigation actions carried over from the previous plan as well as new mitigation actions were reviewed and modified as needed. Participants were given an opportunity to choose which mitigation items to include in the 2024 HMP. Also, those mitigation actions that resonated with workshop participants the most were identified.

The four topical sessions included:

(1) Local Planning and Regulations
This group will discuss preventive measures that are designed to keep the problem(s) associated with various hazards from occurring or getting worse. This includes mitigation actions that ensure that future development does not increase damage. Typically, mitigation actions under this group are administered by building, zoning, planning and/or code enforcement offices. Nine (9) of the thirty-two (32) action items were ranked as "High Priority" by the 2019 HMPC members.

Twenty (20) proposed Mitigation Action Items were reviewed by this group. Upon review, fifteen (15) Mitigation Action Items were identified for inclusion in the 2024 HMP. Of these nine (9) Mitigation Action Items were new, developed during this plan update, while the remainder were carried over from the previous 2018 HMP.

(2) Structure and Infrastructure Projects
This group will discuss protection measures that are used to modify buildings and infrastructure or structural flood control projects. Your community may find some of these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Whereas mitigation actions associated with structural, or infrastructure projects may prove very expensive, however, hazard mitigation grant opportunities are available.

Twenty-two (22) proposed Mitigation Action Items were reviewed by this group. Upon review, seventeen (17) Mitigation Action Items were identified for inclusion in the 2024 HMP. Of these three (3) Mitigation Action Items were new, developed during this plan update, while the remainder were carried over from the previous 2018 HMP.

(3) Natural Systems Protection.
Water quality and natural habitats may be improved, and flood losses reduced, by preserving or restoring natural areas or the natural functions of floodplain and watershed areas.

Eight (8) proposed Mitigation Action Items were reviewed by this group. Upon review, seven (7) Mitigation Action Items were identified for inclusion in the 2024 HMP. All seven (7) Mitigation Action Items were new and developed during this plan update.

(4) Public Education and Emergency Services.
Public information activities advise property owners, potential property owners and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of floodplains. Emergency services measures protect people during and after a flood. Most counties and many cities have emergency management offices to coordinate warning, response, and recovery during a disaster.

Twenty-seven (27) proposed Mitigation Action Items were reviewed by this group. Upon review, twenty-five (25) Mitigation Action Items were identified for inclusion in the 2024 HMP. Of these fourteen (14) Mitigation Action Items were new, developed during this plan update, while the remainder were carried over from the previous 2018 HMP.

Note: The Town of Denton had two representatives attend this meeting. For all other municipalities, a municipal specific mitigation actions questionnaire was distributed for their completion.

Next Steps

- Meeting #3 Notes along with the Mitigation Action Item Table that resulted from the Mitigation Workshop will be provided to all stakeholders for final review and comment.
- Continue outreach to municipalities for participation.
- Mitigation Action Online Prioritization Survey – will be provided to all HMPC members for completion.
- Integration of final public survey results.

- Completion of cohesive draft *2024 Hazard Mitigation Plan* for HMPC review and comment.
- Upload of draft *2024 Hazard Mitigation Plan* to DES webpage for public review and comment.
- Submittal of draft *2024 Hazard Mitigation Plan* for State and Federal Review.
- Local Adoption – both County and Municipal.

Project Website:
https://www.carolinemd.org/659/Hazard-Mitigation
Contact: mking@smithp-d.com
Phone: (301) 724-7611

Maryland
DEPARTMENT OF
EMERGENCY MANAGEMENT

MDEM/Regional Report

March, 2023

MDEM NEWS

New at MDEM- Jon Hart is the MDIMT Coordinator and Albert Sun is the new WebEOC Administrator.

Cybersecurity- The Maryland State and Local Cybersecurity Grant Program Planning Committee is developing a Cybersecurity Plan and will disseminate to the local jurisdictions for feedback. There is work being done on a cybersecurity database. The local cyber fund will be available in July.

Preparedness Branch- They are working on:

A. MDEM is working on a COOP template and guide for local jurisdictions. They do have the template done for state agencies and it is available upon request, as it should be very similar to what the local jurisdiction template will be.
B. MDEM CMOP(Consequence Management Operations Plan) Revision
C. Finalizing the development of the Special Events Dashboard.
D. Also the POCs For specific inquiries of the Branch are:

Planning-Harrison Brown
Continuity (COOP/COG) - Ken Maloney
Cyber Preparedness - Jon Caudle
Training & Exercise-Jerry Immler
Special Events-Todd Tracy
Radiological (REPP)-Marci Catlett

Mesonet Project- This is "a state-of-the-art network of approximately 75 weather-observing towers across the state that will provide real-time community-level monitoring and improve situational awareness during rapidly changing weather conditions." Tim Tharp is the MDEM lead on this project. The towers will be strategically located throughout the state to gather data on the weather conditions to provide information to the weather service for the development of tools to better predict weather. This project is a partnership with the University of Maryland. The goal in the first year is to get 24 towers up, one in each county. The Mesonet Team in in the process of conducting the initial tower siting meeting with local directors.

Grants Branch-Please reach out to the Grants team with any issues or questions about grants: grants.mdem@maryland.gov .

Regional Catastrophic Preparedness Grant (RCPGP) - This grant is to go to the Delmarva Planning and exercise project.

Public Assistance/Individual Assistance- Nora Lagola is the Public Assistance officer and Branch Manager. She and Jessica Nusbaum, the Individual Assistance Officer, are available to answer your inquiries. Also, they are available to conduct damage assessment training for anyone who is interested. Please let them know or contact me and I will get it arranged for you.

Remember that the Covid Public Health Emergency ends May 11, 2023. When ready, toward the end of April, there will be webinars on how and what to do to close everything out.

Mitigation-"The Center of the Universe" – There has been restructuring of the Mitigation Branch, direct all inquiries to the mitigation.mdem@maryland.gov email address. The State Hazard Mitigation Officer (SHMO) is Caitlin Whiteleather. There are two Senior Project Officers (SPO) and the one covering

the Shore, except for Cecil County, is Shafraz Zain. The counties are split between two Project Officers, Nevin Stambaugh and Crystal Zhao. The other SPO is Jesse Delph and Cecil is one of his assigned counties with Aliyah Russell as your Project Officer.

Grants for School Emergency Management (GSEM)-This is a "federally funded initiative jointly administered by the Maryland State Department of Education (MSDE) and the Maryland Department of Emergency Management (MDEM)." They offer a Core Course which introduces school administration and staff to the concepts of Emergency Management, National Incident Management System (NIMS), Incident Command System (ICS), Planning, EOP Development, Training and Exercise, and concludes with a capstone exercise. They have developed brochures for client services. They are reviewing school EOPs; and meeting with non-public school representatives. Currently the POC is Carlton Phillander.

WebEOC –Remember the new platform for WebEOC is MDEM WebEOC Version 9.4 . The representatives of the WebEOC working group from the Shore are Geneva Harrison from Talbot County and Lori Morris from Queen Anne's County. I am also on the workgroup. Reach out to us with any issues or improvements you would like to see in WebEOC.

There is virtual Training 3/15/23 and 6/14/23 starting at 1pm each day.

MDEM Webpage- Please visit MDEM's webpage to get the latest information on Emergency Management and programs at the Department. It has been completely redone since we have been named a Department and has a lot of good information on programs at MDEM and Emergency Management throughout the state. There are links to the following programs: Safe Schools MD; OIT Before it is Too Late; MD Ready web app https://mdready.maryland.gov/Pages/default.aspx ; and KnowYouZoneMD .

MIEMAC- During the 2020 legislative session the Maryland Intrastate Emergency Management Assistance Compact (MIEMAC) was amended, simplifying the process. The result of these changes was a system that allows for rapid resource sharing during local emergencies and disasters. We have begun to identify specialty assets throughout the state, FEMA typing them and putting together Mission Ready Packages. The Mission Ready Spreadsheet is now available to compile intrastate and interstate deployable assets. Please let me know if you need the worksheet. I will be glad to assist you as well as Brett Boyce, the Resource Management Officer at MDEM.

Maryland Incident Management Team (MDIMT) – "MD-IMT has previously and continues to support jurisdictions on the Eastern Shore and throughout the state with both incidents and pre-planned events. MD-IMT provides capabilities to support incident management and EOC support. MD-IMT support the MDEM – State Special Events Program to provide incident management planning for pre-planned events."

With the new coordinator in place they are working on the initial draft of goals for the IMT are written. The IMT advisory committee identified their primary goal as to complete the program and policy manual. Weekly meetings with deputies will begin, with a planner assigned to finish by June. Starting in April we will reach out to each local emergency manager to identify concerns, and offer assistance.

Exercise and Training

A. **MDEM Learning Management System** - Training and exercise events will be posted on the MDEM LMS Events Calendar, similar to the current training and exercise calendar. To register for an upcoming event, you will need to be registered with the LMS; registration requires a Federal Emergency Management Agency (FEMA) Student Identification (SID) Number.

a. FEMA SID Number: https://cdp.dhs.gov/femasid/
b. MEMA LMS: https://memamaryland.csod.com

B. **Crisis Leadership (MGT-340)** - Includes a case study of the Mandalay Bay (Las Vegas shooting), April 20, 2023 at Maryland State Police Commercial Vehicle Enforcement Division located at 6855 Deerpath Rd., Suite G Elkridge, MD 21075. https://my.teex.org/TeexPortal/Default.aspx?MO=mCourseCatalog&D=FP&C=MGT340&S=165

C. **MEDM Training & Exercise Newsletter** for March will be included in this email.

D. **DEMA Course offerings:** Information and registration for classes being offered by DEMA can be found at, http://www.dema.delaware.gov/services/calendar/Trng_Cal.shtml .

Regional Updates

Personnel updates-Since my last bulletin the following personnel changes have occurred on the Shore. We welcome: Alex Yetkins, part-time Planner for Cecil County; Brian Pearsall, Emergency Planner for Kent County; Chris Hopkins, Deputy Director for Wicomico. Jimmy Windsor is now the primary contact for Dorchester Emergency Management. We want to wish the best to Wayne Darrell and Bob Rhode, both of whom will be retiring at the end of April.

In Southern Maryland we congratulate Amy Bledsoe who was promoted to Emergency Manager of St. Mary's County and Kara Buckmaster as Acting Emergency Manager of Calvert County.

Caroline County- They have finished their EOP update. One annex of the EOP is their newly developed Cyber Security Plan and which they hope to exercise

next year. They are working to develop a more robust LEPC in the county and just held their first meeting. Have been approved for HMP Grant and are starting their Hazard Mitigation Update.

Cecil County- Their Hazard Mitigation Plan update is complete and has been adopted. They are updating the DES website; revising their EOP and organizing their ESF's and hope to have training for them; developing a TTX for the town of Perryville involving a train derailment; and are switching to Everbidge for notifications.

Dorchester-Their Multi-Hazard Mitigation Plan and Flood Mitigation Plan are complete and have been adopted by the county. Still need local jurisdictional adoption. Working through the transitional period for county emergency management.

Kent County- Brian, the new Planner, is working on updating their EOP and other plans.

Ocean City- Their COOP plans are complete. They have finished their Hazard Mitigation Plan and it is at FEMA for review. They will be updating their EOP. Getting ready for the many special events for the summer.

Queen Anne's County- They have renewed their efforts in developing their Active Assailant Plan. They are revitalizing their LEPC and conducting CERT Training in the middle school as well as one community. Have several Hazard mitigation projects.

Somerset- They have formed a CERT team. Their Hazard Mitigation Plan has been adopted at the county level.

Talbot County- Their Hazard Mitigation Plan is finished and adopted. The AAR for the county's Covid response has been completed. Will be doing a

complete rewrite of their EOP; are conducting CERT training; and revamping their volunteer program.

Worcester- They are preparing for hurricane season. Will be hosting a NWS Skywarn Class on April 21, 2023.

Wicomico- They have completed their EOP update; took part in the annual VOAD Conference this year; working on their RAD Ingestion Zone Plan update; have met with the ARC; have updated their Emergency Preparedness packets for county schools, and will be hosting a virtual Skywarn Class on April 19, 2023.

Maryland
DEPARTMENT OF
EMERGENCY MANAGEMENT

MDEM/Regional Report

November, 2023

MDEM News

New at MDEM- The Local Support Branch, formerly the Local Liaison Officers Program, has been formed and is part of the Consequence Management Directorate. The new Branch Manager is Harrison Brown, and we are in the process of hiring two new Liaison Officers. Once the new Liaison Officers are on board there will be one assigned to the Eastern Shore, Bill Hildebrand, one assigned to the Central Region, John Dulina, one assigned to Southern Maryland to include Prince Georges and Montgomery Counties, and one to Western Maryland to include Frederick County. The Special Events Branch will also be a part of this new Local Support Branch.

Cybersecurity Unit- Currently working on:

A. Conducting a Local Jurisdiction Operation Resilience Pilot Program
B. Supporting and implementing the state and local Cybersecurity Grant Program (SLCGP)
C. In Partnership with DoIT-Office of Security Management and MDNG
D. Updating State cyber plans
E. Conducting cyber risk management and NIST/CIS control assessments

This unit is ready to get out and assist with the local Cyber Security programs, from helping with assignments, planning, and exercises. They have their own email address where you can send inquiries, cyberpreparedness.mdem@maryland.gov . Jon Caudle manages the Unit and the

local contact who will interact with the local jurisdictions is Taylor Munir. She is the Cyber Planning & Tech Assistance Program Coordinator.

State Continuity Unit- Currently working on:

A. Finalized new MDEM COOP Plan
B. Completing draft of the new Executive Branch COG Plan
C. Providing technical assistance to State agencies COOP Exercises
D. Developing continuity communications initiatives
E. Conducting a Local Jurisdiction Operational Resilience Pilot Program

Planning and Assessment Unit

A. Will be posting for the Planning unit Supervisor and Planning Specialist Positions.
B. MDEM-CMOP, Consequence Management Operations Base Plan, update was finalized this year and can be found in the WebEOC File Library
C. Annual Stakeholder Preparedness Review (SPR), linked to THIRA, is underway.
D. Annual Integrated Preparedness Plan (IPP) update is underway.

Training and Exercise Unit

A. Hosting two Basic Academies (Fall 2023/Spring 2024 and Fall 2024)
B. Hosting Advanced Professional Series G-Courses
C. Beginning multi-year Statewide exercises, with heavy emphasis on the DelMarVa in initial years
D. Hosting and/or supporting ICS-300/400 courses.
E. Developing an MYTEP (Multi-Year Training & Exercise Plan) for the IMT to be integrated into the State IPP

F. Refer to LMS for all course offering for the rest of the year. In Qt1 and Qt2 of 2024 MDEM plans to host 40 new courses, which will be in LMS once the logistics have been worked out.

Preparedness Branch Unit POCs

A. Planning and Assessment- Open
B. State Continuity (COOP/COG)- Ken Maloney
C. Cyber Preparedness- Jon Caudle
D. Training & Exercise- Matthew Moynihan
E. Radiological (REPP)- Marci Catlett

Grants Administration Branch-Please reach out to the Grants team with any issues or questions about grants: grants.mdem@maryland.gov . Stacey Stone is the new Grants Administration Branch Manager. Currently the following people are the POC for the grants shown:

Stacey Stone- EOCGP, NSGP, HSGP
Wilson Low- HMEP, RCPGP, NSGP
Ashley Majette- EMPG

Mesonet Project- The first of approximately 75 weather-observing towers across the state has been completed at the University of Maryland Research and Education Center in Clarksville (Howard County). Other towers will be strategically located throughout the state to gather data on current weather conditions to provide information to the weather service With data for the development of tools to better predict weather, as well as giving the state and local authorities a better picture of changing conditions. This project is a partnership with the University of Maryland. The goal in the first year is to get 24 towers up, one in each county.

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Regional Catastrophic Preparedness Grant (RCPGP) - This grant is to go to the Delmarva Planning and exercise project.

Public Assistance/Individual Assistance- Nora Lagola is the Public Assistance officer and Branch Manager. She and Jessica Nusbaum, the Individual Assistance Officer, are available to answer your inquiries.

Mitigation-"The Center of the Universe" – Direct all mitigation inquiries to the mitigation.mdem@maryland.gov email address and either a Senior Project Officer or Project Officer will get back to you. The State Hazard Mitigation Officer (SHMO) is Caitlin Whiteleather. There are two Senior Project Officers (SPO) and the one covering the Shore and Southern Maryland, except for Cecil County, is Shafraz Zain. The counties are split between two Project Officers, Nevin Stambaugh and Crystal Zhao. The other SPO is Jesse Delph and Cecil is one of his assigned counties with Aliyah Russell as your Project Officer.

Grants for School Emergency Management (GSEM)-This is a "federally funded initiative jointly administered by the Maryland State Department of Education (MSDE) and the Maryland Department of Emergency Management (MDEM)." This is in the final year for the grant, and they are working on legacy documents.

WebEOC – There has been a major update to the boards, and I urge everyone to take part in the WebEOC Wednesday trainings. This helps you stay familiar with the new board structures and to keep your account active,

MDEM Webpage- Please visit MDEM's webpage to get the latest information on Emergency Management and programs at the Department.

Maryland Incident Management Team (MDIMT)- The MDIMT leadership has completed the IMT Policy Manual, and some revisions will need to be made since MDEM is initiating qualification/certification/credentialing. They will be hosting two position specific courses in winter/spring: Situation Unit Leader Feb. 5-9 and Resource Unit leader April 22-25. They are developing a Multi-year Training Plan (MYTEP) with the assistance of MDEM.

Exercise and Training

A. **MDEM Learning Management System** - Training and exercise events will be posted on the MDEM LMS Events Calendar, similar to the current training and exercise calendar. To register for an upcoming event, you will need to be registered with the LMS; registration requires a Federal Emergency Management Agency (FEMA) Student Identification (SID) Number.
    a. FEMA SID Number: https://cdp.dhs.gov/femasid/
    b. MEMA LMS: https://memamaryland.csod.com
B. **DEMA Course offerings:** Information and registration for classes being offered by DEMA can be found at, http://www.dema.delaware.gov/services/calendar/Trng_Cal.shtml .

FEMA News

FEMA Integration Team- Theses teams are FEMA personnel who are in place in regions to interact with the local jurisdictions and be the local's conduit to FEMA. There is a FIT member in VA Hampton Roads area and there will be one soon on

the Eastern Shore. Once the person has been hired, they will be working out of Cambridge. I plan to work closely with this person making sure they get oriented with the jurisdictions on the shore.

MDH News

Emergency Response Managers- This is a new program with the Maryland Department of Human Services office of Emergency Operations. These Emergency response Managers will be located throughout the state "to serve as liaisons to the local emergency management Teams for operations response coordination in State Disaster Mass Care Services. The person on the shore is Thomas Esham and is in Denton. His email is thomas.esham@maryland.gov .

Regional Updates

Personnel updates-Since my last bulletin the following personnel changes have occurred on the Shore. Wayne Darrell retired as Director of Emergency Services in Kent County and Pete Landon is now the new Director. Sam Grant, EM Division Chief at Caroline County Department of Emergency services left and is now the Director of Emergency Services in Garrett County and Doug Jones has taken the position in Caroline. Laraine Buck is now the planner in Somerset County.

Caroline County- They are in the mist of updating their Hazard Mitigation Plan. They trying to get their LEPC back up and meeting.

Cecil County- They completed and train derailment TTX for the town of Perryville and the Perryville Volunteer Fire Co and Police. Have been getting their EOC Representative lists updated and conducting WebEOC Training.

Dorchester- They are working through the transitional period for county emergency management. Currently working on the County COOP Plan,

Kent County- Their EOP has been signed off on by County Commissioners. They are working on continuity training for county departments and have developed a power point presentation for them. They are looking into Starting a CERT program. They have also developed templates for county departments for Active Assailant.

Ocean City- They have finalized their COVID-19 projects and are waiting for reimbursement. Their Ocean's Calling Festival was a huge success, and they are now taking time to relax now that their "Season" is over. Three of their staff attended the CERT TTT in Queen Anne's County

Queen Anne's County- They had another successful Bay Bridge Run. They are revitalizing their LEPC. They conducted a CERT Train the Trainer for the shore and are willing to work with those jurisdictions trying to get CERT programs started. Have several Hazard mitigation projects.

Somerset- The new planner, Laraine Buck, is getting oriented to the county and currently working on grants.

Talbot County- They are working on complete rewrite of their EOP; are conducting CERT trainings; working on their RAD Plan update; and working with MDH on the state shelter in their county.

Worcester- They have reorganized emergency management. They have created a new position of Emergency Preparedness Manager and Katy Viera from their

office has moved into that position. She will be the head for the Emergency Management Division. They will be advertising for an Emergency Management Specialist soon.

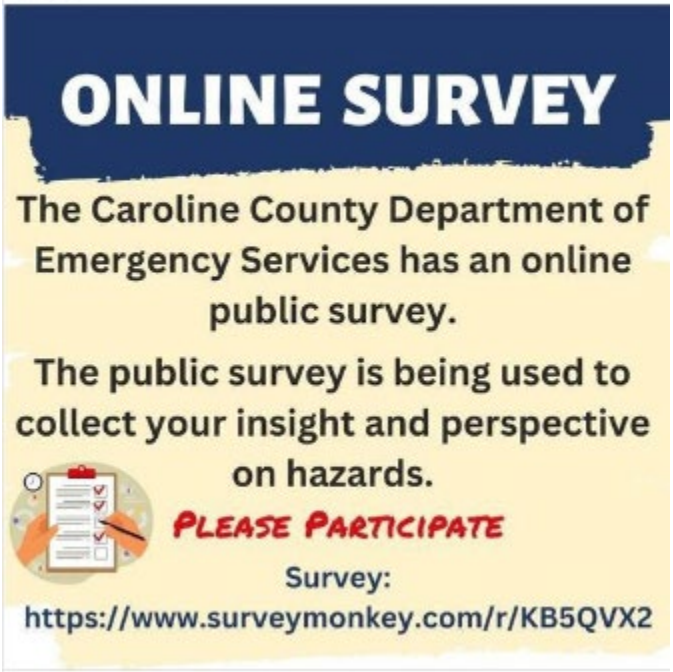
Wicomico- They are working on their RAD Ingestion Zone Plan update; EAP's and COOP Plans with county departments; Damage Assessment; and CPOD Plan update. They are in the planning process for a full-scale exercise with Salisbury Airport to be held in March of 2024. They have hired a Hazardous Materials Coordinator who will take over the LEPC and Teir II reporting. His name is Matt Munday.

Municipal Input

Municipal representatives participated in two or more plan update activities. Examples of municipal plan update activities are provided below.

Documentation of Municipal Plan Update Activities				
Municipality	**Documentation Example #1**	**Documentation Example #2**	**Documentation Example #3**	**Documentation Example #4**
Denton	Attended Meetings 1, 2 Mitigation Workshop– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6
Federalsburg	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2023 & 9/14/2023: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6	Phone Calls & Emails – 1/16/2024 & 2/7/2024 Mitigation Action Items
Goldsboro	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Shared Public Survey on social media – 8/29/2023	Email 2/6/2024: Mitigation Action Items
Greensboro	Attended Meeting 1, Mitigation Workshop– Appendix B	Complete Mitigation Status Update Form – Chapter 12, pages 12-12 to 12-14	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Provided Repetitive Flooded Roadway Information – Chapter 6
Henderson	Attended Meeting 1– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 12/4/2023: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Email 2/6/2024: Mitigation Action Items
Hillsboro	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2023 and 2/20/2024: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Phone Call 2/7/2024: Mitigation Action Items	Email 2/20/2024: Mitigation Action Items
Marydel	Attended Meeting 1– Appendix B	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Email 8/21.2023: Mitigation Action Items
Preston	Attended Meeting 1– Appendix B Email 8/28/2023: Mitigation Actions	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Shared Public Survey on social media & Email to Residents – 8/28/2023
Ridgely	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Complete Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Provided Repetitive Flooded Roadway Information – Chapter 6	Email 2/20/2024: Mitigation Action Items
Templeville	Participated in the Online Municipal Survey – Hazard Perspective & Capabilities	Email 9/7/2024, 12/4/2024 1/16/2024: Mitigation Status Update – Chapter 12, pages 12-12 to 12-14	Phone Call & Email 1/16/2024: Mitigation Action Items	Email 1/19/2024: Mitigation Action Items

Town of Preston
16h ·



Like Comment

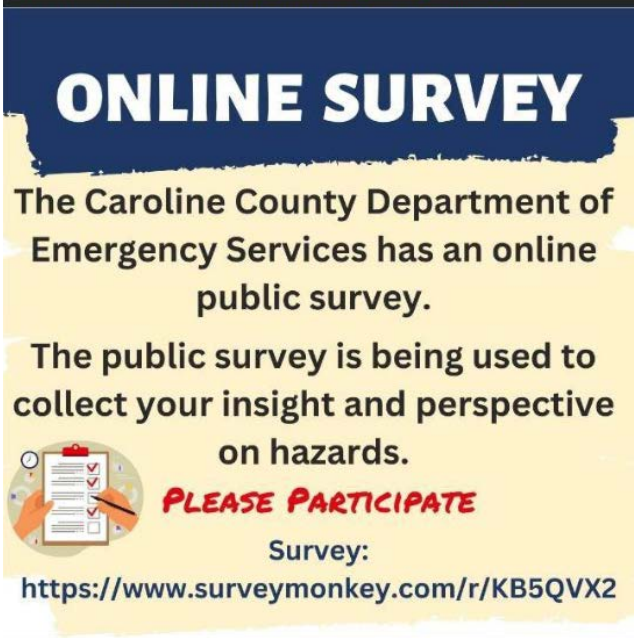
Goldsboro Clerk
August 29 at 8:34 AM ·

YOUR ASSITANCE IS REQUESTED - Please complete the survey!

The Caroline County Department of Emergency Services (DES) is seeking input regarding potential hazards and disasters. This survey is being used to collect your insight and perspective on hazards identified in the plan.

The Hazard Mitigation Plan forms the foundation for Caroline County and its municipalities' long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The purpose of this plan is to identify, plan, and implement cost-effective hazard mitigation measures through a comprehensive approach known as hazard mitigation planning. The Federal Emergency Management Agency (FEMA) requires hazard mitigation plans to be updated every five years.

To participate, please take the survey: https://www.surveymonkey.com/r/KB5QVX2.



#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, July 25, 2023 6:47:24 AM
Last Modified:	Tuesday, July 25, 2023 6:55:21 AM
Time Spent:	00:07:56
IP Address:	50.78.67.5

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Denton**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Somewhat Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Somewhat Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Very Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Very Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Very Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**

	Level of Concern
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Very Concerned**
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Emerging Infectious Disease,

Mass Outage,

Coastal Storms

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Aged 65 or Older,

Single-Parent Households,

Speaks English "Less than Well"

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Emerging Infectious Disease,

Power Outage,

Coastal Storms

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.

,

Retrofit infrastructure, such as elevating roadways and improving drainage systems

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

no

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Address drainage issues, federal and state level funding

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

yes, not sure

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

yes, 2002

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

not sure

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

yes, not sure

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

no

Q17

What Building Code/Year is your municipality using?

not sure

Q18

Has your municipality acquired land for open space or public recreation?

yes

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **No**

Does your municipality have land use authority?

Q20 **Respondent skipped this question**

Does your municipality participant in land use/development planning? If yes, how many staff members?

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

yes, 15

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

yes, not sure

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

yes

Q24

Does your municipality have finance staff? If yes, how many staff members?

yes

Q25

Does your municipality have a floodplain manager? If so, who?

yes

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

not sure

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

yes

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

not sure

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

not sure

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

yes

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

not sure

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

yes

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

not sure

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

no

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, July 25, 2023 12:17:12 PM
Last Modified:	Tuesday, July 25, 2023 2:50:20 PM
Time Spent:	02:33:07
IP Address:	73.87.152.159

Page 1

Q1

Are you a resident of Caroline County?

Yes

Q2

Please select which community you are representing.

Goldsboro

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Somewhat Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Not Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Somewhat Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Concerned**

	Level of Concern
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Somewhat Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Mass Outage

Q5

Are you concerned with any other hazards not identified in this survey?

Truck carrying hazardous materials having an accident on the highway running through town

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Aged 65 or Older,

Minority,

Speaks English "Less than Well"

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Power Outage

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Provide better information about hazard risk and high-hazard areas

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

No

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Better communication with residents, emergency preparedness outreach

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

No

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

Yes currently being updated.

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Currently creating

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

No

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

No

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

No

Q17

What Building Code/Year is your municipality using?

2021

Q18

Has your municipality acquired land for open space or public recreation?

In the process

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Yes**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

Yes - 1 staff member

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

No

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

Fire Dept.

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

No

Q24

Does your municipality have finance staff? If yes, how many staff members?

1 staff person

Q25

Does your municipality have a floodplain manager? If so, who?

No

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

No

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

No

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

No

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

No

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Yes. Previously used for connection to Greensboro WW system

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

No

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

Caroline County

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

No

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

No

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Wednesday, August 02, 2023 1:15:38 PM
Last Modified:	Wednesday, August 02, 2023 1:23:23 PM
Time Spent:	00:07:44
IP Address:	162.217.53.106

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Henderson**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Very Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Not Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Not Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Very Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Very Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Very Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Concerned**

	Level of Concern
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Very Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Mass Outage

Q5

Are you concerned with any other hazards not identified in this survey?

no

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Aged 65 or Older,

Civilian with a Disability,

Speaks English "Less than Well",

Mobile Homes

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Power Outage

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit infrastructure, such as elevating roadways and improving drainage systems

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Provide better information about hazard risk and high-hazard areas

,

Inform property owners of ways they can mitigate damage to their property

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

no

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

better communication with residents

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Road repairs Mill St, Cook St and Bell Street along with swm upgrades

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

yes 2009. Updating this year

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

no

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

no

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

yes 2009

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

no

Q17

What Building Code/Year is your municipality using?

2018

Q18

Has your municipality acquired land for open space or public recreation?

no

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Yes**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

consultant no staff

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

no

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

no

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

no

Q24

Does your municipality have finance staff? If yes, how many staff members?

no

Q25

Does your municipality have a floodplain manager? If so, who?

no

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

no

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

no

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

In progress road improvements and swm upgrades Mill St, Cook St, Bell St

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

no

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Yes roads improvement and swm upgrades, also water upgrades

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

no

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

no

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

no

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

no

#4

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Wednesday, August 02, 2023 3:17:38 PM
Last Modified:	Wednesday, August 02, 2023 3:31:02 PM
Time Spent:	00:13:24
IP Address:	74.95.79.101

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Ridgely**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Very Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Not Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Not Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Very Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Very Concerned**
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Very Concerned**

	Level of Concern
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Somewhat Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Very Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Tornado,

Mass Outage,

Coastal Storms

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Unemployment,

Income,

Aged 65 or Older,

Aged 17 or Younger,

Civilian with a Disability,

Single-Parent Households,

Minority,

Speaks English "Less than Well",

No Vehicle

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Tornado,

Power Outage,

Coastal Storms

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.

,

Retrofit infrastructure, such as elevating roadways and improving drainage systems

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Buyout flood prone properties and maintain as open space

,

Strengthen codes, ordinances, and plans to require higher hazard risk management standards

,

Provide better information about hazard risk and high-hazard areas

,

Inform property owners of ways they can mitigate damage to their property

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

no

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Particularly in Ridgely, the county needs to fix the ongoing flooding issue at Mr. Lloyd Tyler's property at the intersection of Hannah Henry Way and Second Street.

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

no

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

It was adopted in 2009. We have just hired an engineering firm to update.

Q13 **Respondent skipped this question**

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Q14 **Respondent skipped this question**

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

Q15 **Respondent skipped this question**

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

Q16 **Respondent skipped this question**

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

Q17

What Building Code/Year is your municipality using?

we use most current

Q18

Has your municipality acquired land for open space or public recreation?

yes

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Respondent skipped this question**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

no

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

3 public works. We have an on-call engineering firm.

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

Police 5 full time 4 part time
Ridgely Volunteer Fire Department

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

Respondent skipped this question

Q24

Does your municipality have finance staff? If yes, how many staff members?

3

Q25

Does your municipality have a floodplain manager? If so, who?

Respondent skipped this question

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

yes

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

Respondent skipped this question

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

Respondent skipped this question

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

Respondent skipped this question

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Respondent skipped this question

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

Respondent skipped this question

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

Respondent skipped this question

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

Respondent skipped this question

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

Respondent skipped this question

#5

INCOMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, August 03, 2023 10:49:38 AM
Last Modified:	Thursday, August 03, 2023 10:56:19 AM
Time Spent:	00:06:40
IP Address:	71.200.14.16

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Marydel**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Somewhat Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Not Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Somewhat Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Not Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Somewhat Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Somewhat Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Somewhat Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**

	Level of Concern
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Somewhat Concerned**
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Somewhat Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Winter Storm,

Emerging Infectious Disease

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Minority,

Speaks English "Less than Well",

Crowding

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Emerging Infectious Disease,

Power Outage

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

nono

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Respondent skipped this question

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

no

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

Respondent skipped this question

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Respondent skipped this question

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

Respondent skipped this question

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

Respondent skipped this question

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

Respondent skipped this question

Q17

What Building Code/Year is your municipality using?

Respondent skipped this question

Q18

Has your municipality acquired land for open space or public recreation?

Respondent skipped this question

Page 7: Municipal Capabilities - Administrative and Technical

Q19

Does your municipality have land use authority?

Respondent skipped this question

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

Respondent skipped this question

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

Respondent skipped this question

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

Respondent skipped this question

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

Respondent skipped this question

Q24

Does your municipality have finance staff? If yes, how many staff members?

Respondent skipped this question

Q25

Does your municipality have a floodplain manager? If so, who?

Respondent skipped this question

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

Respondent skipped this question

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

Respondent skipped this question

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

Respondent skipped this question

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

Respondent skipped this question

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Respondent skipped this question

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

Respondent skipped this question

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

Respondent skipped this question

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

Respondent skipped this question

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

Respondent skipped this question

#6

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, August 03, 2023 1:07:56 PM
Last Modified:	Thursday, August 03, 2023 1:14:42 PM
Time Spent:	00:06:45
IP Address:	73.129.77.41

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Preston**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Somewhat Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Somewhat Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Somewhat Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Not Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Somewhat Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Somewhat Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Somewhat Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**

	Level of Concern
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Somewhat Concerned**
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Somewhat Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Tornado,

Mass Outage,

Coastal Storms

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Income,

Aged 65 or Older,

Aged 17 or Younger,

Civilian with a Disability,

Single-Parent Households,

Multi-Unit Structures,

No Vehicle

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Drought & Extreme Heat,

Coastal Flood,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Tornado,

Power Outage,

Coastal Storms

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.

,

Replace inadequate or vulnerable bridges ,

Retrofit infrastructure, such as elevating roadways and improving drainage systems

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Strengthen codes, ordinances, and plans to require higher hazard risk management standards

,

Provide better information about hazard risk and high-hazard areas

,

Inform property owners of ways they can mitigate damage to their property

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

---

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

Respondent skipped this question

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Respondent skipped this question

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

2010

Q13 **Respondent skipped this question**

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Q14 **Respondent skipped this question**

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

2010

Q16 **Respondent skipped this question**

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

Q17

What Building Code/Year is your municipality using?

2021

Q18

Has your municipality acquired land for open space or public recreation?

we have open space in our park area

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Yes**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

5

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

2

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

0

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

0

Q24

Does your municipality have finance staff? If yes, how many staff members?

2

Q25

Does your municipality have a floodplain manager? If so, who?

town manager

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

no

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

sure

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

I&I repair sewer lines

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

yes

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Respondent skipped this question

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

Respondent skipped this question

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

yes

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

no

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

no

#7

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Wednesday, January 17, 2024 10:42:16 AM
Last Modified:	Thursday, January 18, 2024 4:49:23 PM
Time Spent:	Over a day
IP Address:	96.70.136.5

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Greensboro**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Very Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Very Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Not Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Somewhat Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Somewhat Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Concerned**

	Level of Concern
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Somewhat Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Coastal Flood,

Shoreline Erosion & Sea Level Rise,

Dam Failure,

Mass Outage,

Coastal Storms

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Aged 65 or Older,

Speaks English "Less than Well",

No Vehicle

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Drought & Extreme Heat,

Coastal Flood,

Winter Storm,

Emerging Infectious Disease,

Power Outage,

Coastal Storms

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Inform property owners of ways they can mitigate damage to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

Respondent skipped this question

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Implementation of hazard mitigation policies/procedures created by input from Town leadership, police, fire, public works, and representatives from residents.

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

Yes; 2010. Flooding is the only hazard addressed in the comp plan; however, no hazard mitigation plans are identified.

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Not currently although plans are being made to create one.

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

Yes; 2021.

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

Yes; 2010.

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

No

Q17

What Building Code/Year is your municipality using?

2021 International Building Code

Q18

Has your municipality acquired land for open space or public recreation?

No

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Yes**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

We have one Planning/Zoning staff person and a Planning/Zoning board.

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

We have a Public Works Department with four employees. We use outside engineering services.

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

We have a police department with two officers and two vacancies.
The Town has a volunteer fire company with approximately 45 members.

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

No

Q24

Does your municipality have finance staff? If yes, how many staff members?

Yes; one staff person designated as finance but all employees in Town Hall are responsible for financial transactions.

Q25

Does your municipality have a floodplain manager? If so, who?

No

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

We use mass notification system through Civic Plus.

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

That hasn't been asked at this point.

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

Early discussions on what may be needed but no planning as of yet.

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

No

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Yes, as a funding source for our WWTP.

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

Not that I am aware of

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

No

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

No

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

No

#8

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, January 19, 2024 1:51:48 PM
Last Modified:	Friday, January 19, 2024 2:24:06 PM
Time Spent:	00:32:17
IP Address:	69.251.3.167

Page 1

Q1

Are you a resident of Caroline County?

No

Q2

Please select which community you are representing.

Templeville

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Somewhat Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Somewhat Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Somewhat Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Concerned**
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Very Concerned**

	Level of Concern
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Somewhat Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Drought & Extreme Heat,

Winter Storm,

Thunderstorm,

Emerging Infectious Disease,

Tornado,

Mass Outage,

Other hazard events (please describe):

Stormwater Flooding (not related to Riverine)

Q5

Are you concerned with any other hazards not identified in this survey?

Hazards that affect the functionality of wells and septic systems.

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Income,

Aged 65 or Older,

Civilian with a Disability,

Minority,

Speaks English "Less than Well",

Crowding

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Drought & Extreme Heat,

Emerging Infectious Disease,

Power Outage

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit infrastructure, such as elevating roadways and improving drainage systems

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

Respondent skipped this question

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Respondent skipped this question

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

Yes, 2009. It does not specifically address Hazard Mitigation.

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

No

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

No

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

No

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

No

Q17

What Building Code/Year is your municipality using?

unknown

Q18

Has your municipality acquired land for open space or public recreation?

No

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **Yes**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

minimal, 0

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

No, 0

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

No, 0

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

No, 0, We are supported by Caroline Cty

Q24

Does your municipality have finance staff? If yes, how many staff members?

No, 0

Q25

Does your municipality have a floodplain manager? If so, who?

No, 0

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

No, 0

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

N/A

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

No, we are waiting for SHA to address stormwater flooding on Barclay Road.

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

No

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

CDBG supports the Circuit Rider program which provides a part time Town Manager.

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

No

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

Univ MD Seagrant Extension, Envision the Choptank, ShoreRivers, Caroline Cty Planning, Caroline Cty Rec&Park, Ches Multicultural Ctr

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

Interpretive Signage

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

No

#9

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Wednesday, February 14, 2024 4:26:01 PM
Last Modified:	Wednesday, February 14, 2024 5:03:24 PM
Time Spent:	00:37:22
IP Address:	24.126.69.245

Page 1

Q1 **Yes**

Are you a resident of Caroline County?

Q2 **Federalsburg**

Please select which community you are representing.

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Very Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Somewhat Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Very Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Somewhat Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Somewhat Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Somewhat Concerned**

	Level of Concern
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Concerned**
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Very Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Shoreline Erosion & Sea Level Rise,

Winter Storm,

Dam Failure,

Tornado,

Mass Outage,

Coastal Storms

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Below Poverty,

Unemployment,

Aged 65 or Older,

Minority,

Speaks English "Less than Well",

No Vehicle

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Riverine Flooding,

Shoreline Erosion & Sea Level Rise,

Winter Storm,

Dam Failure,

Tornado,

Power Outage,

Coastal Storms

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Retrofit infrastructure, such as elevating roadways and improving drainage systems

,

Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)

,

Provide better information about hazard risk and high-hazard areas

,

Inform property owners of ways they can mitigate damage to their property

,

Assist vulnerable property owners with securing funding to mitigate impacts to their property

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

No

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Not Sure

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

No

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Currently working on an Emergency Ops Plan

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

No

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

Not Sure

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

No

Q17

What Building Code/Year is your municipality using?

2021

Q18

Has your municipality acquired land for open space or public recreation?

Yes

Page 7: Municipal Capabilities - Administrative and Technical

Q19 **No**

Does your municipality have land use authority?

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

No

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

Public Works - staff 3

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

Police - 5 certified officers, Chief, Admin and 2 in training
Fire Dept - not on staff

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

No

Q24

Does your municipality have finance staff? If yes, how many staff members?

Yes - 4

Q25

Does your municipality have a floodplain manager? If so, who?

No

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

No

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

Not sure

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

Not Sure

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

No

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Yes in the past for Small Bus Loans

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

No

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

No

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

No

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

Not Sure

#10

INCOMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, February 20, 2024 7:28:21 PM
Last Modified:	Tuesday, February 20, 2024 7:34:05 PM
Time Spent:	00:05:44
IP Address:	71.200.81.34

Page 1

Q1

Are you a resident of Caroline County?

Yes

Q2

Please select which community you are representing.

Hillsboro

Page 2

Q3

Please indicate your level of concern for each hazard using the drop down menu.

	Level of Concern
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	**Not Concerned**
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	**Somewhat Concerned**
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	**Very Concerned**
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	**Somewhat Concerned**
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	**Somewhat Concerned**
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	**Somewhat Concerned**
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.	**Not Concerned**
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	**Not Concerned**

	Level of Concern
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	**Somewhat Concerned**
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	**Not Concerned**
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	**Not Concerned**

Page 3

Q4

Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Riverine Flooding,

Shoreline Erosion & Sea Level Rise

Q5

Are you concerned with any other hazards not identified in this survey?

Respondent skipped this question

Page 4

Q6

In terms of social vulnerability, do you feel that a specific group, or groups, in your municipality are particularly at risk for, or could be harmed by, any of the hazards listed in Question 4? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Income,

Aged 65 or Older,

Aged 17 or Younger,

Civilian with a Disability

Q7

Based on the group(s) you have selected in the previous question, please select which hazard events you feel may particularly affect those group(s). (Multiple options may be chosen).

Power Outage

Page 5

Q8

Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Respondent skipped this question

Q9

In the last 10 years, has there been an evacuation in your municipality as a result of a disaster (e.g., flooding, power, water failure)? If so, how long were citizens displaced? Was a shelter setup?

Respondent skipped this question

Q10

In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Respondent skipped this question

Q11

Do you have any mitigation action items specific for your municipality for inclusion in the Plan Update? If so, please provide action item and provide details, as available.

Respondent skipped this question

Page 6: Municipal Capabilities - Planning and Regulatory

Q12

Does your municipality have a comprehensive or master plan? If so, what year was it adopted? Does the plan include hazard risk areas and/or other hazard mitigation type information?

Respondent skipped this question

Q13

Does your municipality have an Emergency Operations Plan? If so, what year was it adopted?

Respondent skipped this question

Q14

Does your municipality have a Continuity of Operations Plan? If so, what year was it adopted?

Respondent skipped this question

Q15

Does your municipality have a Stormwater Management Plan? If so, what year was it adopted?

Respondent skipped this question

Q16

Does your municipality have a Natural Resources Protection Plan? If so, what year was it adopted?

Respondent skipped this question

Q17

What Building Code/Year is your municipality using?

Respondent skipped this question

Q18

Has your municipality acquired land for open space or public recreation?

Respondent skipped this question

Page 7: Municipal Capabilities - Administrative and Technical

Q19

Does your municipality have land use authority?

Respondent skipped this question

Q20

Does your municipality participant in land use/development planning? If yes, how many staff members?

Respondent skipped this question

Q21

Does your municipality have public works and engineering capabilities? If yes, how many staff members?

Respondent skipped this question

Q22

Does your municipality have emergency services (e.g., police, fire)? If yes, how many staff members?

Respondent skipped this question

Q23

Does your municipality have Geographic Information System (GIS) staff/capabilities? If yes, how many staff members?

Respondent skipped this question

Q24

Does your municipality have finance staff? If yes, how many staff members?

Respondent skipped this question

Q25

Does your municipality have a floodplain manager? If so, who?

Respondent skipped this question

Q26

Does your municipality use a hazard warning/notification system? If so, what is the name of the system?

Respondent skipped this question

Q27

Are any local officials/departments in your community interested in a FEMA floodplain management training? What topics relate most to your community?

Respondent skipped this question

Page 8: Municipal Capabilities - Financial

Q28

Does your municipality plan to expend funding, including grant funding, on hazard mitigation and resilience projects within the next five years? If so, please provide amount and project description.

Respondent skipped this question

Q29

Does your municipality levy taxes for specific purposes? If so, please explain.

Respondent skipped this question

Q30

Do you use the Community Development Block Grant? If so, how has your community used this funding or plan to use this funding?

Respondent skipped this question

Q31

Has your municipality completed flood acquisitions or elevation projects? If so, please provide funding source, year and project description(s).

Respondent skipped this question

Page 9: Municipal Capabilities - Education and Outreach

Q32

Does your municipality work with any local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, or vulnerable populations, etc.?

Respondent skipped this question

Q33

Does your municipality have any ongoing public education or information program (e.g., responsible water use, fire safety, household emergency preparedness, or environmental education)?

Respondent skipped this question

Q34

Has your municipality had a FEMA NFIP Community Assistance Visit in the last five years? If so, were any corrective actions required?

Respondent skipped this question

Appendix C
Public Outreach Documentation & Survey Results

Caroline County Hazard Mitigation Planning, Training, and Outreach Initiatives				
Date	**Meeting, Training, or Outreach Activity**	**Target Audience**	**Materials Provided**	**Comments/Input**
3-Jul-23	Social Media Post on Facebook	Public	Public Survey	Emergency Services and Caroline County Government posted the website link on their Facebook and Instagram pages.
5-Jul-23	Website Content	HMPC & Public	Hazard Mitigation Specific Content	Hazard miitgaiton plan information, public survey link, social media links, and contact information provided.
12-Jul-23	Press Release for Star Democrat	Public	Project Website & Public Survey	Notice about the Hazard Mitigation Plan Update and provided the project website and public survey link.
27-Jul-23	Website Content	HMPC & Public	Kickoff Meeting Notes	Notes discussing the kickoff meeting, surveys and social media posts.
23-Aug-23	Social Media Post	Public	Public Survey	HMPC members were requested to post the public survey link on their social media.
23-Aug-23	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook and Instagram pages.
24-Aug-23	Social Media Post on Facebook	Public	Public Survey	Maryland Department of Health posted the public survey link on their Facebook page.
28-Aug-23	Social Media Post & Residential Email	Public	Public Survey	The Town of Preston posted the public survey link on their Facebook page and did an email blast to residents.
29-Aug-23	Social Media Post	Public	Public Survey	Town of Goldsboro posted the public survey link on their social media pages.
14-Nov-23	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook and Instagram pages.
4-Dec-23	Website Content	Public	Draft Chapters	Chapters for public review and comment on the Hazard Mitigation Webpage. Comment form provided for comments.
16-Jan-24	Commissioner Meeting	Public	Plan Update	Emergency Services provided an update on the plan to County Commissioners and the public.
22-Jan-24	Social Media Post	Public	Public Survey	Emergency Services posted the public survey link on their Facebook page.
23-Jan-24	Social Media Post	Public	Public Survey	Caroline County Health Department posted the public survey link on their Facebook and website homepage.
29-Jan-24	Social Media Post	Public	Public Survey	The Department of Social Services posted the public survey link on their Facebook page.

https://www.stardem.com/news/local_news/caroline-county-seeks-input-for-hazard-mitigation-plan-update/article_4641b9d9-b090-511b-bc84-ea68e43a7f0d.html

FEATURED

Caroline County seeks input for Hazard Mitigation Plan Update

Angela Price
Jul 12, 2023

Privacy - Terms

SAMUEL GRANT
PHOTO BY TOM MCCALL

DENTON — Caroline County is seeking public input on its Hazard Mitigation Plan Update. The Hazard Mitigation Plan identifies potential hazards and lists future projects that may reduce or eliminate damage before a disaster strikes.

The Department of Emergency Services has secured federal grant funds to identify projects that reduce or eliminate the risk of hazard induced damage to buildings and infrastructure. The identification of various types of hazard mitigation and resilience strategies is part of the Federal Emergency Management Agency funding project eligibility criteria. Finally, all projects seeking FEMA grant funding should be identified within Caroline County's approved and adopted Hazard Mitigation Plan, which is currently being updated, as required by FEMA.

Over the past three decades, FEMA spent a total of $347 billion (in 2022 dollars) from the Disaster Relief Fund to respond to disasters. Mitigation not only saves lives, but also reduces disaster costs. Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants, according to an analysis by the National Institute of Building Sciences.

As part of this plan update, input from residents, community members, workers, and business owners will help ensure the success of the County's hazard mitigation plan and projects. There are a variety of ways community members may participate:

• Public Survey: Take a survey to provide feedback on concerns regarding local hazards and disaster risk. The survey takes around eight minutes to complete. Link: https://www.surveymonkey.com/r/KB5QVX2.

• Follow DES on Facebook at https://www.facebook.com/CarolineMDDES/, Instagram at https://www.instagram.com/carolinemddes/ or Twitter at https://twitter.com/carolinemddes for hazard mitigation updates and other emergency preparedness, response, and recovery information.

• Spread the Word: Tell your Caroline County family, friends, and neighbors about the plan and how they can help.

• Reach Out: For questions regarding the plan, contact Samuel Grant, Emergency Management Division chief, Caroline County Department of Emergency Services at sgrant@carolinemd.org.

Learn more about the Caroline County Hazard Mitigation Plan at

https://www.carolinemd.org/606/Emergency-Management.

Caroline County, Maryland
Hazard Mitigation Plan Update
Media Release

July 5, 2023

Denton, MD – Caroline County is seeking public input on its Hazard Mitigation Plan Update. The Hazard Mitigation Plan identifies potential hazards and lists future projects that may reduce or eliminate damage before a disaster strikes. The Department of Emergency Services has secured federal grant funds to identify projects that reduce or eliminate the risk of hazard induced damage to buildings and infrastructure. The identification of various types of hazard mitigation and resilience strategies is part of the Federal Emergency Management Agency (FEMA) funding project eligibility criteria. Finally, all projects seeking FEMA grant funding should be identified within Caroline County's approved and adopted Hazard Mitigation Plan, which is currently being updated, as required by FEMA.

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- ***Follow Us:*** Follow us on Facebook at https://www.facebook.com/CarolineMDDES/, Instagram at https://www.instagram.com/carolinemddes/ or Twitter at https://twitter.com/carolinemddes?lang=en for hazard mitigation updates and other emergency preparedness, response, and recovery information.
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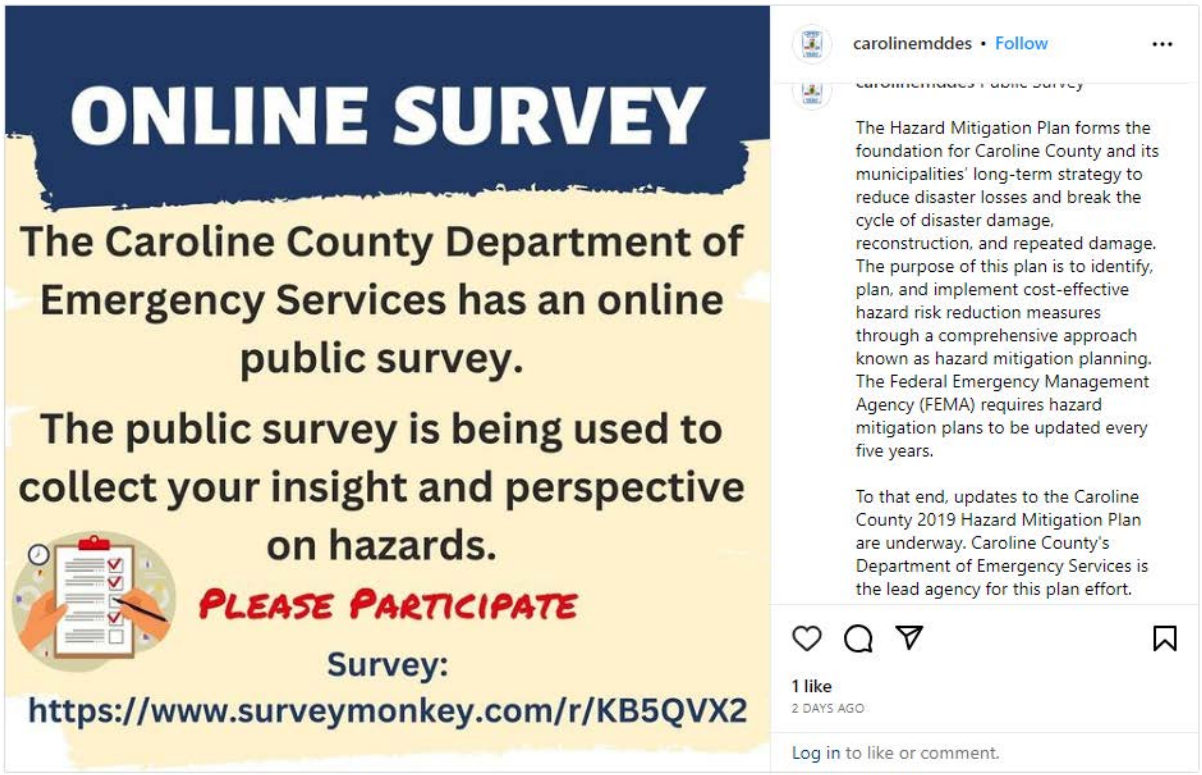
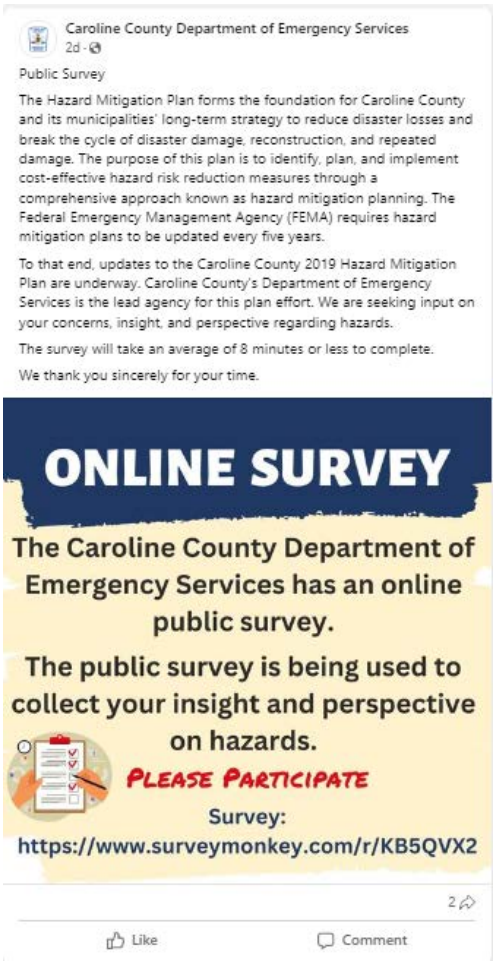
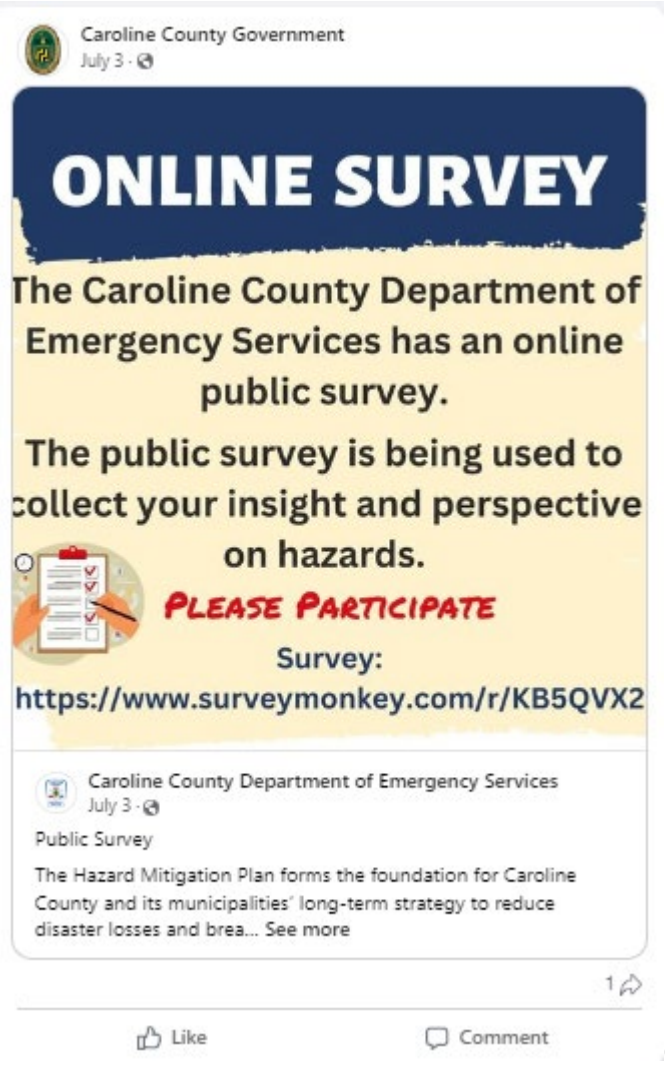


Posted July 3, 2023 - Instagram



Posted July 3, 2023 – Facebook



County posted on July 3, 2023 on Facebook

Caroline County Department of Emergency Services
16h ·

YOUR ASSITANCE IS REQUESTED - Please complete the survey!

The Caroline County Department of Emergency Services (DES) is seeking input regarding potential hazards and disasters. This survey is being used to collect your insight and perspective on hazards identified in the plan.

The Hazard Mitigation Plan forms the foundation for Caroline County and its municipalities' long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and r... See more

SURVEYMONKEY.COM
Caroline County Hazard Mitigation Plan Public Survey
Take this survey powered by surveymonkey.com. Create your own s...

Like Comment Share

posted on Facebook august 23, 2023

Caroline County Department of Emergency Services
18h ·

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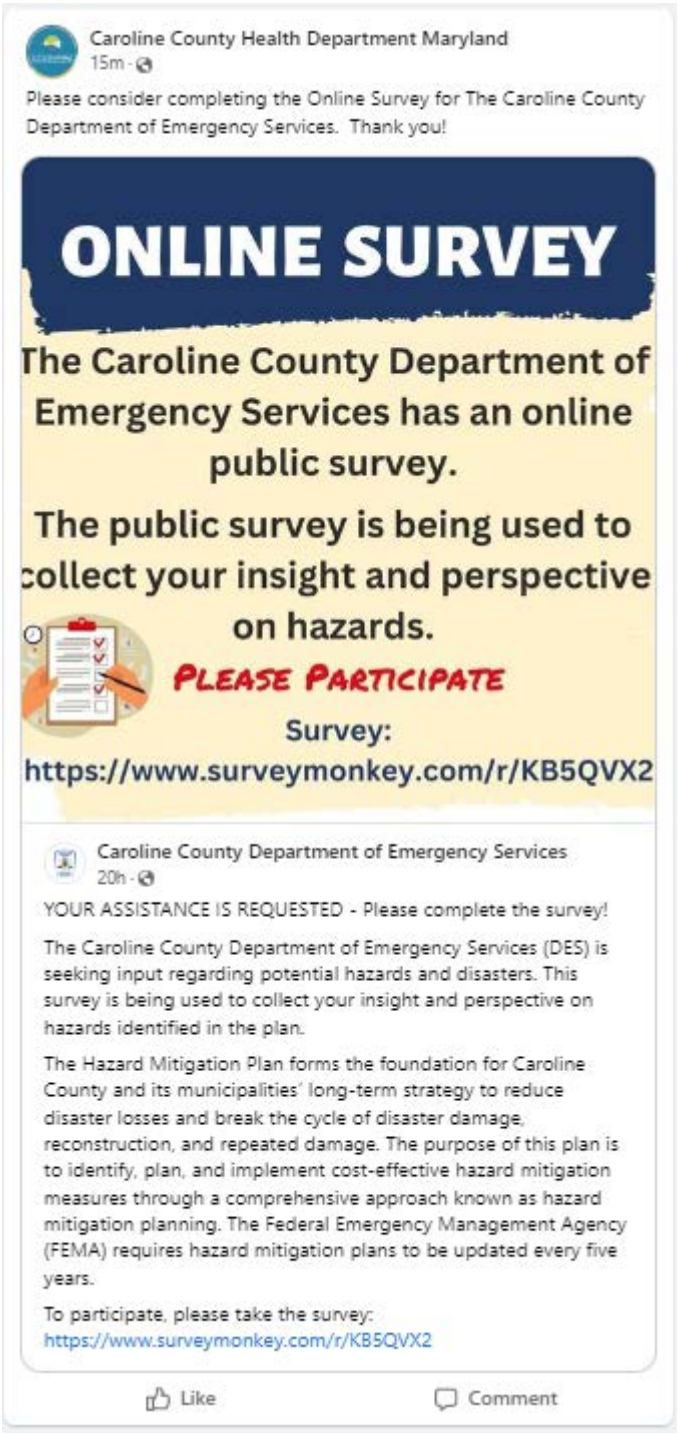
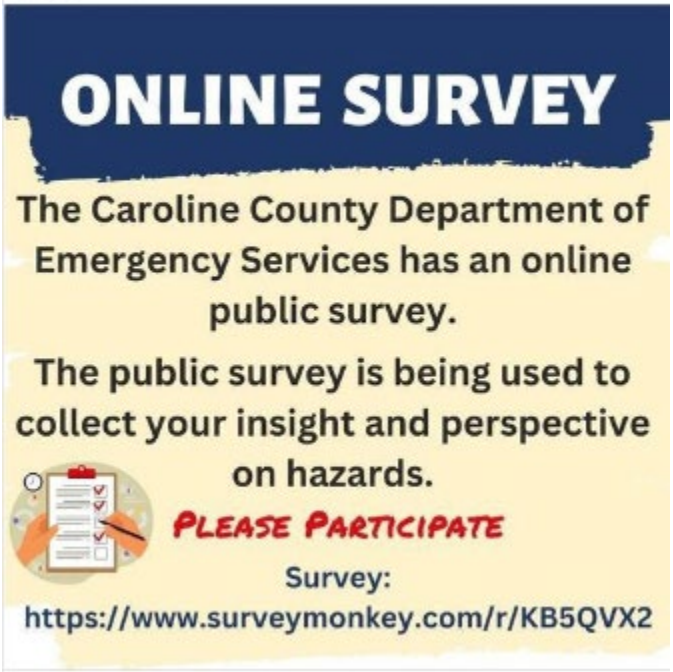
3

Like Comment



posted by health department's facebook page on august 24, 2023

Town of Preston
16h ·



Like Comment

Goldsboro Clerk
August 29 at 8:34 AM ·

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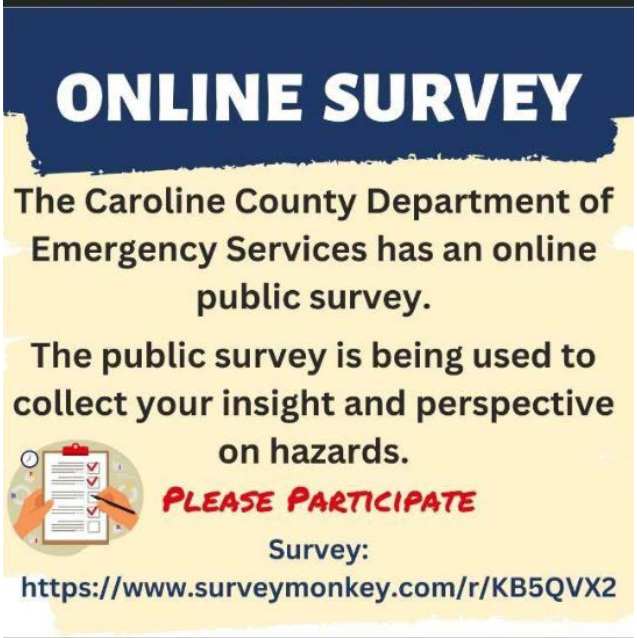

Caroline County Department of Emergency Services

Jan 22 ·

Community Voices Matter!

Participate in your local hazard mitigation plan survey to shape the future of safety in Caroline County. Your input = tailored strategies, increased resilience, and a safer community for all!

https://www.surveymonkey.com/r/KB5QVX2

6 1 comment • 4 shares

Like Comment Send Share

Caroline County Department of Emergency Services

Nov 14, 2023 ·

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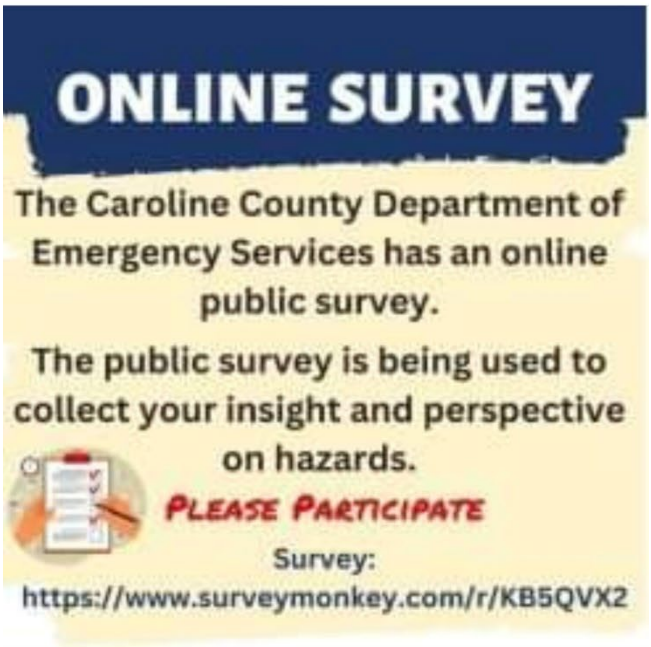


1 1 share

Like Comment Send Share

Caroline County Health Department
Maryland

Jan 23 ·

Your voice matters! Help our partners Caroline County Department of Emergency Services create a safer, more resilient community.

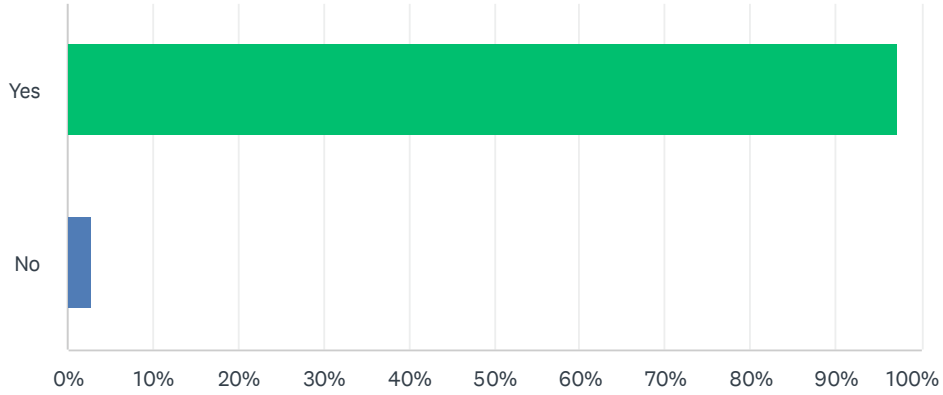
Participate in their short survey to shape the future of safety in Caroline County. Your input will help them build the strategies needed to protect our community from the effects of natural disasters, pandemics, and other hazards that impact public safety.

https://www.surveymonkey.com/r/KB5QVX2

Like Comment Send Share

Q1 Are you a resident of Caroline County?

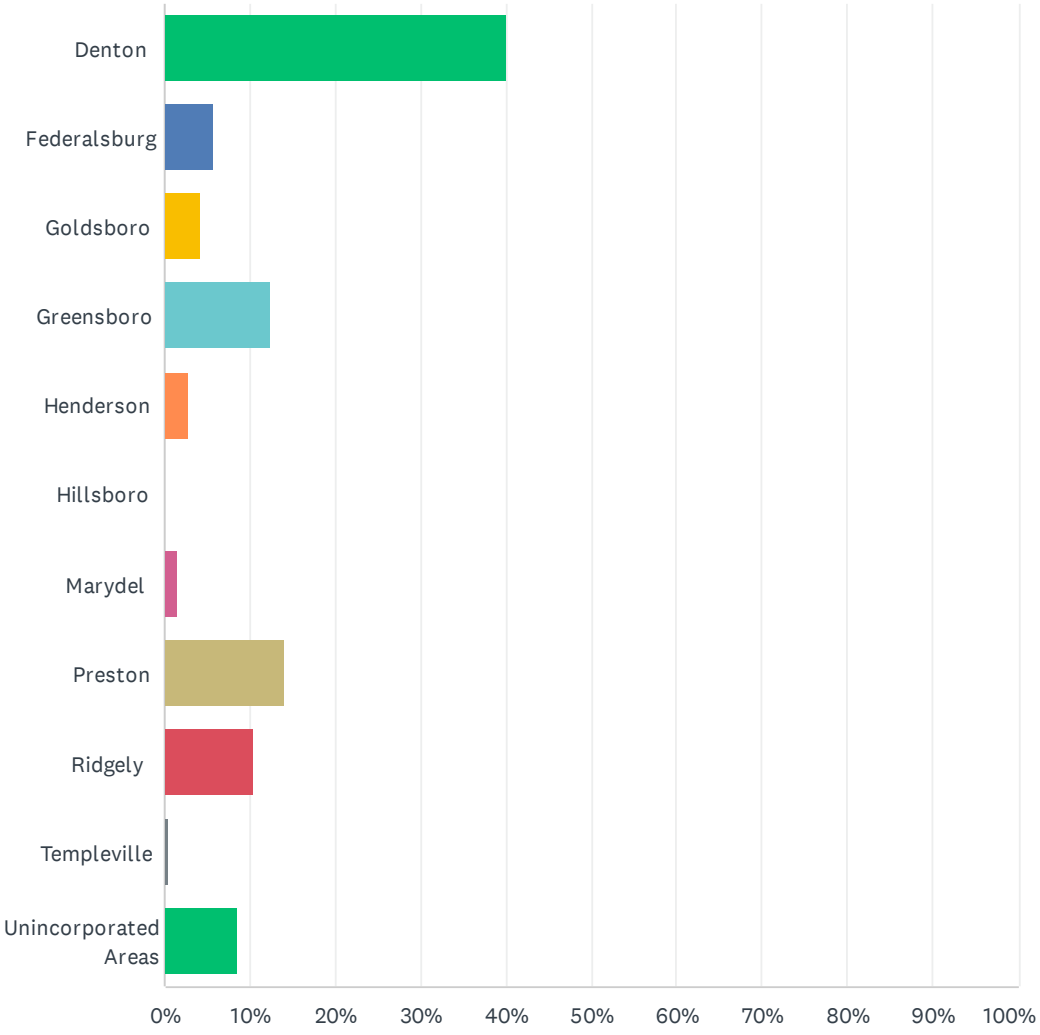
Answered: 213 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	97.18%	207
No	2.82%	6
TOTAL		213

Q2 Please provide the community where you currently live.

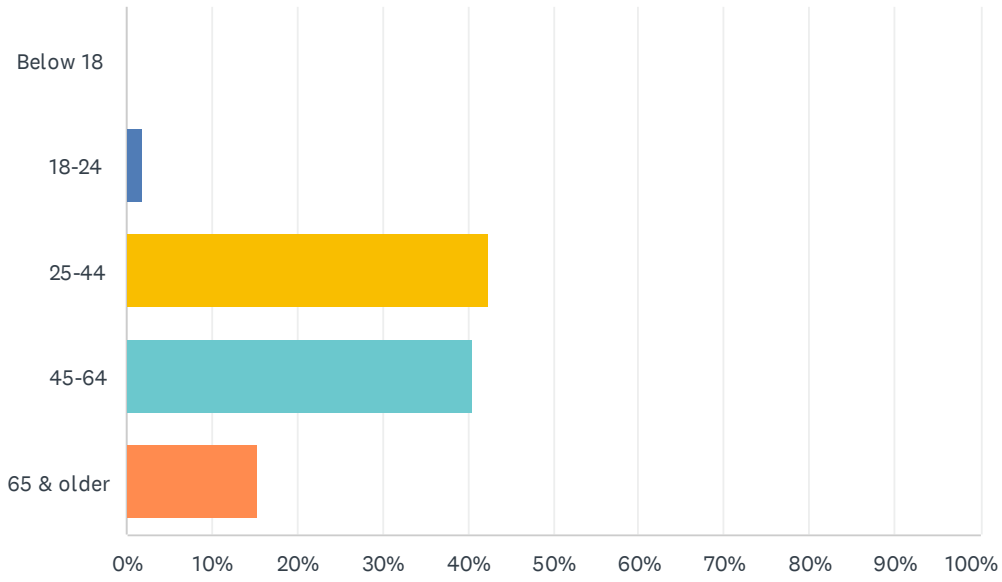
Answered: 212 Skipped: 4



ANSWER CHOICES	RESPONSES	
Denton	40.09%	85
Federalsburg	5.66%	12
Goldsboro	4.25%	9
Greensboro	12.26%	26
Henderson	2.83%	6
Hillsboro	0.00%	0
Marydel	1.42%	3
Preston	14.15%	30
Ridgely	10.38%	22
Templeville	0.47%	1
Unincorporated Areas	8.49%	18
TOTAL		212

Q3 Which age group are you in?

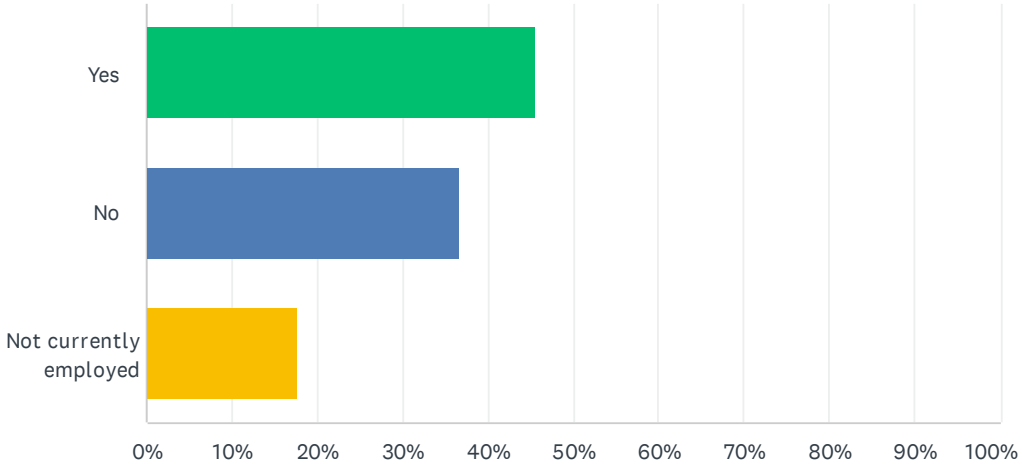
Answered: 215 Skipped: 1



ANSWER CHOICES	RESPONSES	
Below 18	0.00%	0
18-24	1.86%	4
25-44	42.33%	91
45-64	40.47%	87
65 & older	15.35%	33
TOTAL		215

Q4 Do you work in Caroline County?

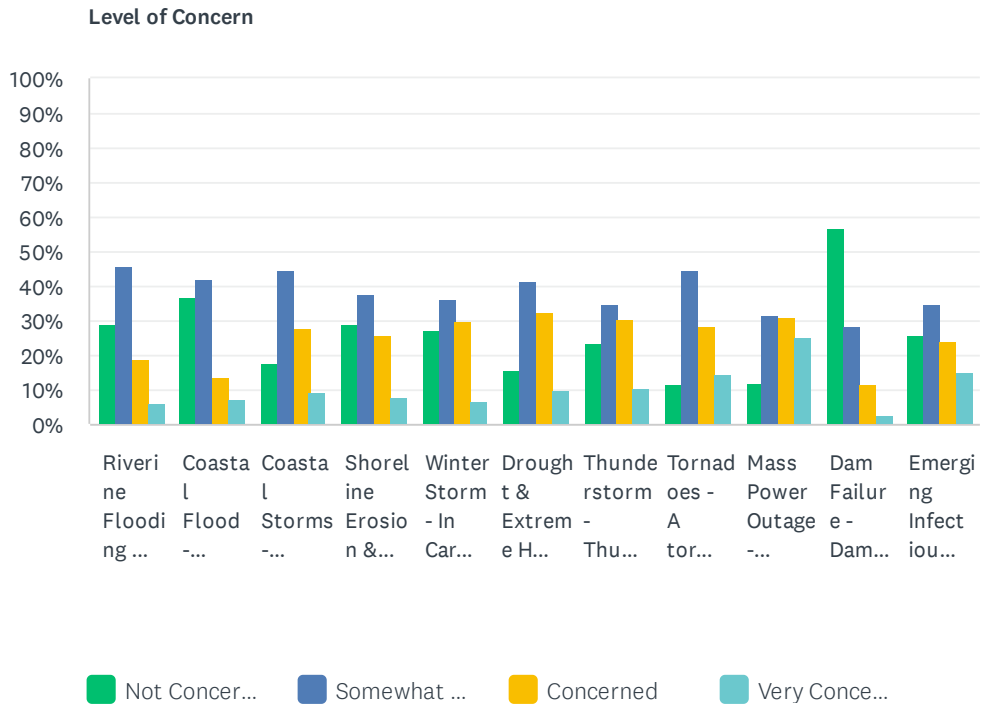
Answered: 215 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	45.58%	98
No	36.74%	79
Not currently employed	17.67%	38
TOTAL		215

Q5 Please indicate your level of concern for each hazard using the drop down menu.

Answered: 183 Skipped: 33

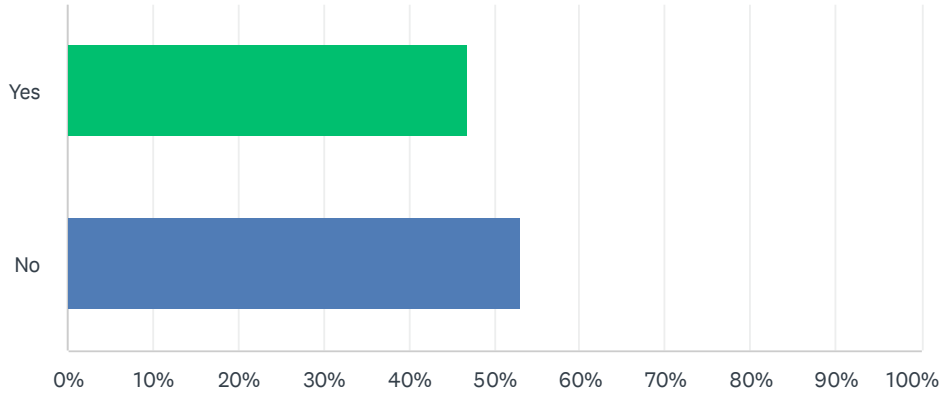


Level of Concern	NOT CONCERNED	SOMEWHAT CONCERNED	CONCERNED	VERY CONCERNED	TOTAL
Riverine Flooding - There are two different types of flooding that are associated with rivers and streams: flash flooding and riverine flooding. Flash flooding occurs from the combination of rainfall intensity and duration. Riverine flooding is caused by persistent moderate or heavy rain over one or more days. According to the 2015 FEMA Flood Insurance Study drainage characteristics in Caroline County are such that flood conditions are produced by high-intensity rainfall and by storm tides.	29.05% 52	45.81% 82	18.99% 34	6.15% 11	179
Coastal Flood - Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The county has flat terrain and poorly-draining soils, leading to problems with flooding during larger storm events. Coastal flooding in Caroline County primary occurs in areas along the Choptank River, Hunting Creek, Tuckahoe Creek, and Watts Creek.	36.67% 66	42.22% 76	13.89% 25	7.22% 13	180
Coastal Storms - Coastal storms are referring to major hurricane, hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The most common coastal storms that impact Caroline County are Category One Hurricanes and Tropical Storms.	18.08% 32	44.63% 79	27.68% 49	9.60% 17	177
Shoreline Erosion & Sea Level Rise - Shoreline erosion in Caroline County is influenced by natural conditions, which include soil composition, weather, topography, water depth, fetch, surface water/groundwater conditions. Sea level rise is another factor contributing to shore erosion in Maryland. Sea level rise contributes to shoreline erosion by influencing and exacerbating on-going coastal processes, making coastal areas more vulnerable to extreme events.	28.89% 52	37.78% 68	25.56% 46	7.78% 14	180
Winter Storm - In Caroline County winter storms occur with less frequency than in other areas of the State and are usually less severe in terms of cold temperature, snow accumulation, and the amount of time snow is on the ground. Caroline County normally receives an average of 12 inches of snow per year. In addition, the County sometimes receives freezing rain during storms that produce snow to the north and west.	27.22% 49	36.11% 65	30.00% 54	6.67% 12	180
Drought & Extreme Heat - Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Caroline County was one of four counties within Maryland with the highest number of recorded drought hazard events within the NCEI database. Dry conditions can impact water service to County residents and businesses. Extreme heat is a combination of high temperatures (significantly above normal) and high humidity. Caroline County experiences on average one or more extreme heat events per year.	15.56% 28	41.67% 75	32.78% 59	10.00% 18	180
Thunderstorm - Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that is either forced to rise by	23.89% 43	35.00% 63	30.56% 55	10.56% 19	180

mountainous terrain or by colliding with a cooler dense air mass. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes. Thunderstorms can cause damage to buildings, downed trees which can block roads, and power outages from downed poles and lines. Thunderstorms can also produce lightning, high winds, and hail. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice.					
Tornadoes - A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. Under the right temperature and moisture conditions, intense thunderstorms can produce tornados in areas of differential heating, which occurs on the Eastern Shore. Even though the possibility of such a tornado occurring in Caroline County is low, it is a real danger and can occur at almost any time, anywhere in the County.	11.67% 21	45.00% 81	28.33% 51	15.00% 27	180
Mass Power Outage - Power outages may last seconds, hours or days depending upon the cause. The most common causes of power outages are natural causes, human error, and equipment failure. Mass Power Outages occur over a widespread area and are one of the typical impacts of major disaster events.	12.15% 22	31.49% 57	30.94% 56	25.41% 46	181
Dam Failure - Dams present risks but they also provide many benefits, including irrigation, flood control, and recreation. Dams have been identified as a key resource of our national infrastructure that is vulnerable to terrorist attack. According to FEMA, dams can fail for several reasons, including: overtopping caused by floods, acts of sabotage, upstream dam failure (i.e., the failure of another nearby dam), structural failure of materials used in dam construction, or earthquakes. A total of six (6) dams are located within Caroline County.	56.98% 102	28.49% 51	11.73% 21	2.79% 5	179
Emerging Infectious Disease - Emerging Infectious Diseases can be considered as part of a broad hazard category that could be termed “public health emergencies.” In addition to disease epidemics, such events can take the form of large scale incidents of food or water contamination, infestations of disease bearing insects or rodents, or extended periods without adequate water or sewer service.	25.82% 47	34.62% 63	24.18% 44	15.38% 28	182

Q6 When you moved into your residence or commercial property, did you consider the impact a natural or non-natural hazard event could have on your property?

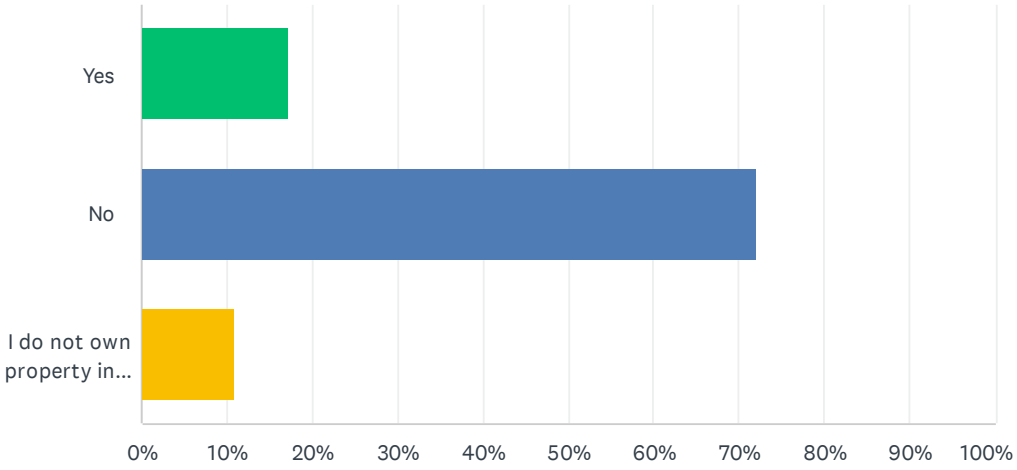
Answered: 160 Skipped: 56



ANSWER CHOICES	RESPONSES	
Yes	46.88%	75
No	53.13%	85
TOTAL		160

Q7 If you own your home or commercial property, do you have flood insurance?

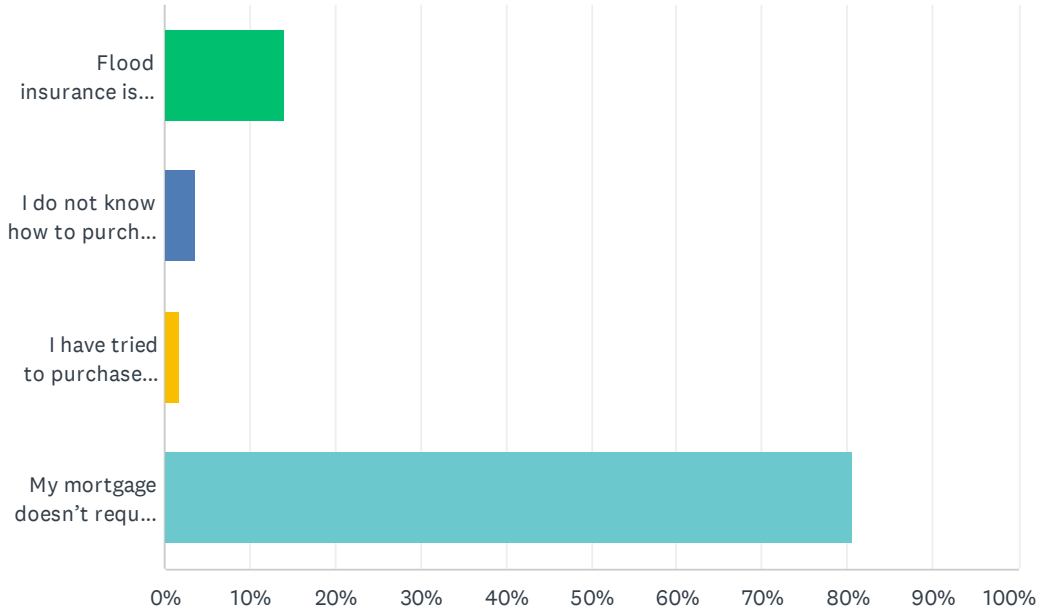
Answered: 157 Skipped: 59



ANSWER CHOICES	RESPONSES	
Yes	17.20%	27
No	71.97%	113
I do not own property in Caroline County	10.83%	17
TOTAL		157

Q8 If “No”, what is the primary reason why you do not carry flood insurance?

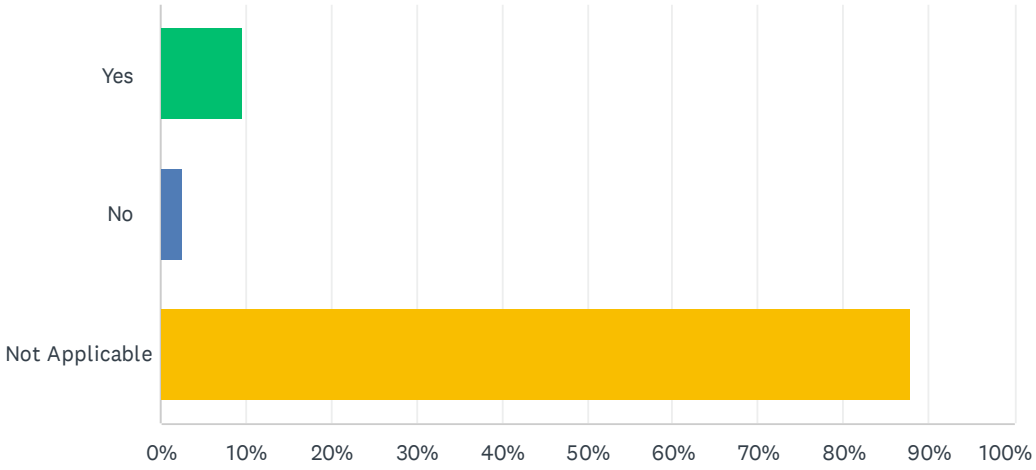
Answered: 113 Skipped: 103



ANSWER CHOICES	RESPONSES	
Flood insurance is too expensive	14.16%	16
I do not know how to purchase flood insurance	3.54%	4
I have tried to purchase flood insurance but have been unsuccessful	1.77%	2
My mortgage doesn’t require flood insurance	80.53%	91
TOTAL		113

Q9 If you rent your place of residence, do you have renter's content insurance?

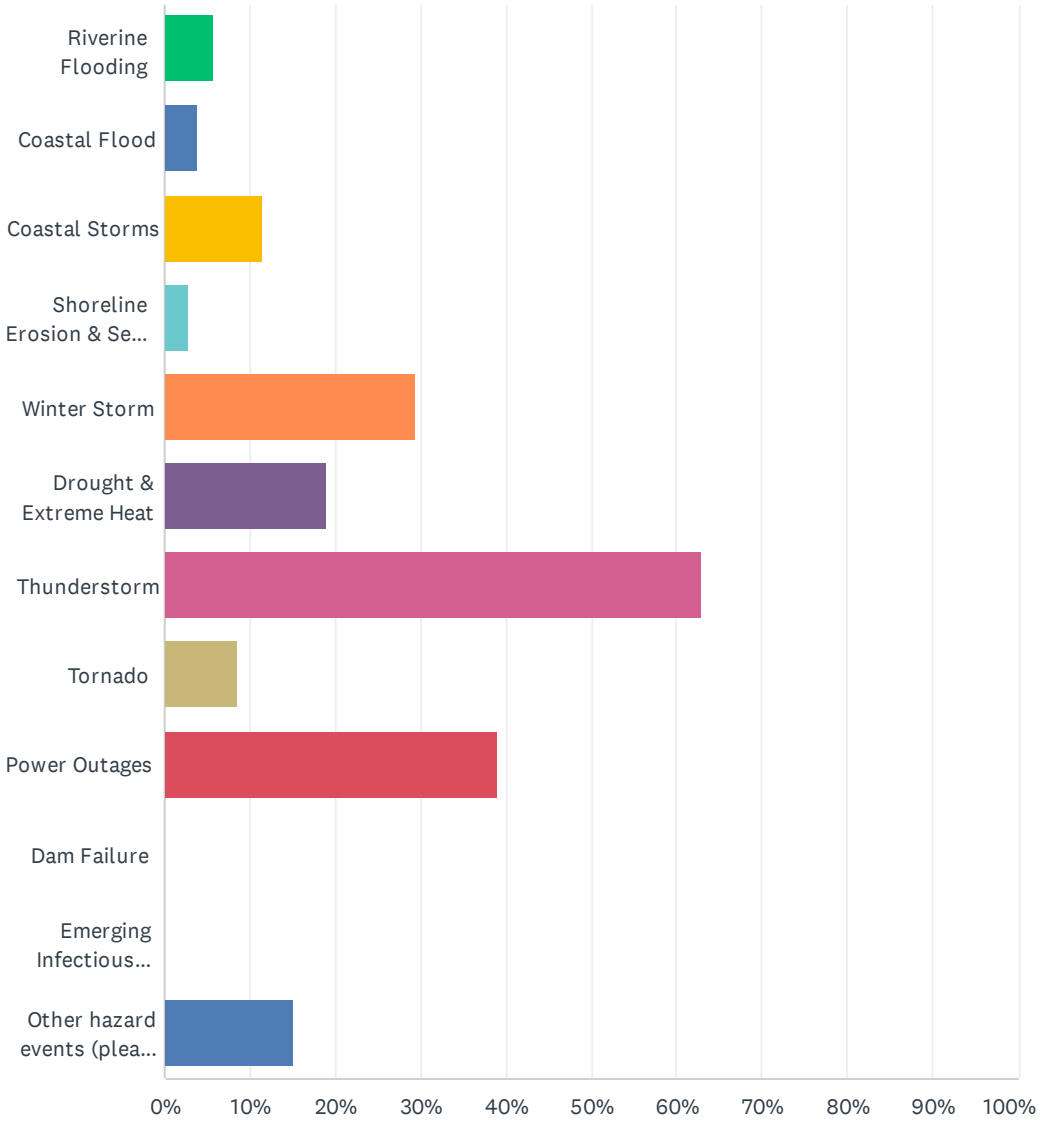
Answered: 157 Skipped: 59



ANSWER CHOICES	RESPONSES	
Yes	9.55%	15
No	2.55%	4
Not Applicable	87.90%	138
TOTAL		157

Q10 If your residence or commercial property has experienced damage from a hazard event, which of the following types of events have you experienced at your property?

Answered: 105 Skipped: 111

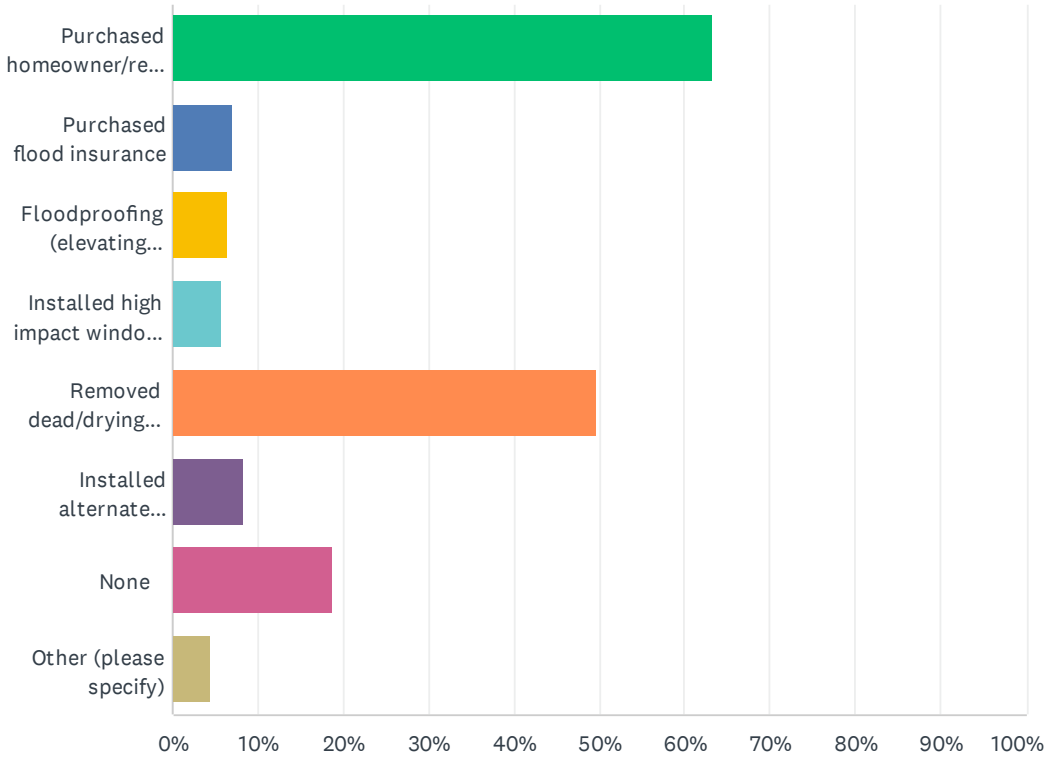


ANSWER CHOICES	RESPONSES	
Riverine Flooding	5.71%	6
Coastal Flood	3.81%	4
Coastal Storms	11.43%	12
Shoreline Erosion & Sea Level Rise	2.86%	3
Winter Storm	29.52%	31
Drought & Extreme Heat	19.05%	20
Thunderstorm	62.86%	66
Tornado	8.57%	9
Power Outages	39.05%	41
Dam Failure	0.00%	0
Emerging Infectious Disease	0.00%	0
Other hazard events (please describe)	15.24%	16
Total Respondents: 105		

#	OTHER HAZARD EVENTS (PLEASE DESCRIBE)	DATE
1	Wind	1/26/2024 1:24 AM
2	Trees down	1/23/2024 2:52 PM
3	Wind	1/22/2024 5:23 PM
4	High ground water collapsed our basement wall.	1/22/2024 2:46 PM
5	none	1/22/2024 1:21 PM
6	None	1/22/2024 1:10 PM
7	Straight line storm	11/14/2023 7:13 PM
8	lightening downed three huge trees, damage to fence only	8/29/2023 2:29 PM
9	Lack of plowing	8/27/2023 3:20 AM
10	Falling tree	8/26/2023 5:14 PM
11	Wind damage	8/23/2023 9:58 PM
12	large tree down	8/19/2023 2:03 PM
13	Frozen water pipes.	8/18/2023 2:02 PM
14	Road closure due to snow	7/6/2023 8:31 PM
15	:Over-reach-[ing]-Non-Governmental-Organizations: .	7/6/2023 4:54 PM
16	Groundwater rise resulting in stagnant flooding	7/5/2023 4:19 PM

Q11 Have you taken any of the following actions to reduce the risk of hazards to your residence or commercial property?

Answered: 155 Skipped: 61



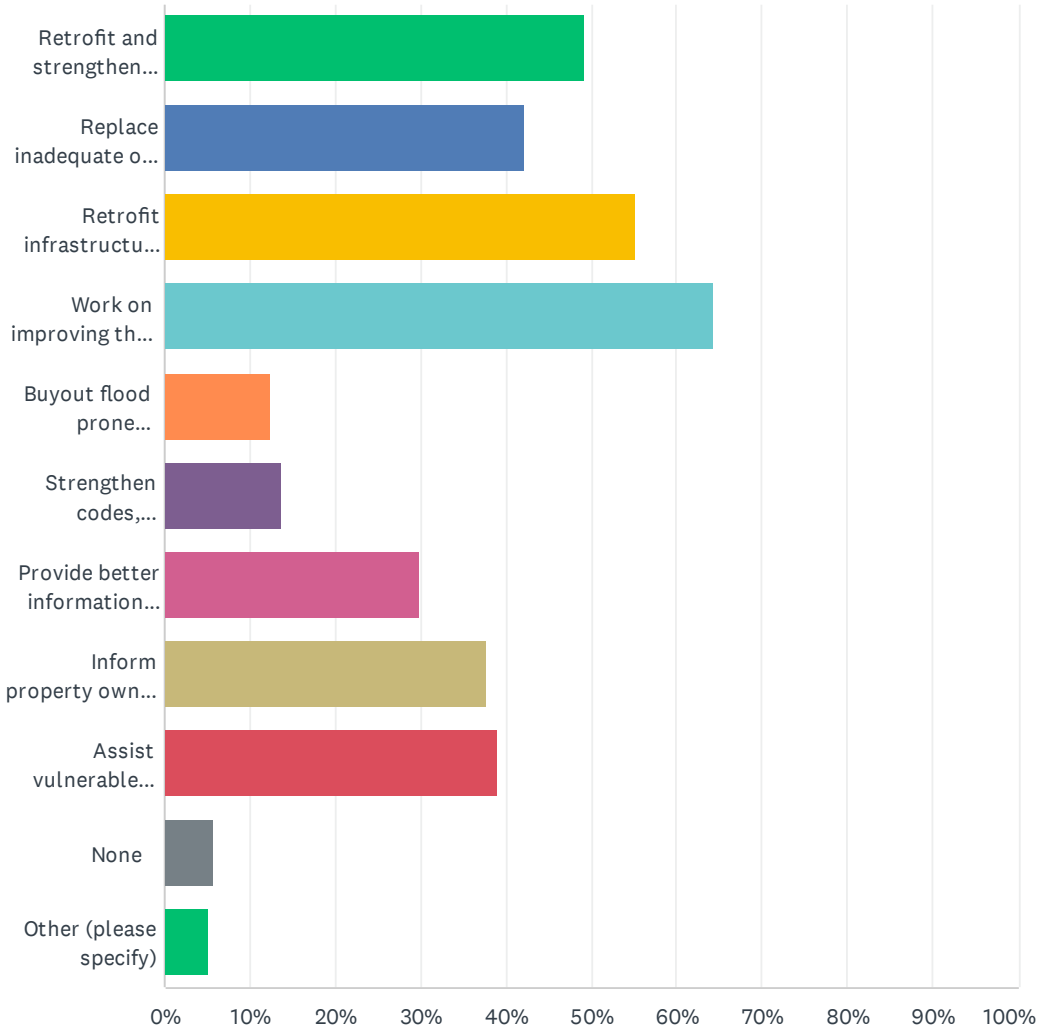
ANSWER CHOICES	RESPONSES	
Purchased homeowner/renter's insurance policies	63.23%	98
Purchased flood insurance	7.10%	11
Floodproofing (elevating furnace, water heaters, electric panels)	6.45%	10
Installed high impact windows or doors to withstand high winds	5.81%	9
Removed dead/drying trees and vegetation from around the home	49.68%	77
Installed alternate power/water supply	8.39%	13
None	18.71%	29
Other (please specify)	4.52%	7
Total Respondents: 155		

#	OTHER (PLEASE SPECIFY)	DATE
1	purchased portable generator	11/14/2023 4:37 PM
2	structural roof reinforcement	8/29/2023 7:09 AM
3	Put in plants and adjusted soil landscape to redirect water	8/24/2023 10:28 PM

4	Planted trees to break the wind away from my house.	8/23/2023 6:12 PM
5	Hired contractor to upgrade structure and install insulation.	8/18/2023 2:02 PM
6	: Complete[d]-joinder-with-Post-Master-General-of-the-Unity-States-of-the-World-Corporation: .	7/6/2023 4:54 PM
7	New roof	7/5/2023 4:10 PM

Q12 Which of the following mitigation project types do you believe should be focused on to reduce disruptions of services and strengthen the community (check all that apply)?

Answered: 154 Skipped: 62



ANSWER CHOICES	RESPONSES	
Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.	49.35%	76
Replace inadequate or vulnerable bridges	42.21%	65
Retrofit infrastructure, such as elevating roadways and improving drainage systems	55.19%	85
Work on improving the damage resistance of utilities (electricity, communications, water/sewer, etc.)	64.29%	99
Buyout flood prone properties and maintain as open space	12.34%	19
Strengthen codes, ordinances, and plans to require higher hazard risk management standards	13.64%	21
Provide better information about hazard risk and high-hazard areas	29.87%	46
Inform property owners of ways they can mitigate damage to their property	37.66%	58
Assist vulnerable property owners with securing funding to mitigate impacts to their property	38.96%	60
None	5.84%	9
Other (please specify)	5.19%	8
Total Respondents: 154		

#	OTHER (PLEASE SPECIFY)	DATE
1	During recent flooding called emergency services for Caroline for help getting disabled his out of house and told there was no help available.	1/23/2024 8:52 AM
2	Community Emergency Response Team (CERT)	11/17/2023 8:05 AM
3	You	8/26/2023 2:23 PM
4	Do something about farm runoff dumping chemicals into the rivers	8/26/2023 8:19 AM
5	Communication is a huge issue… cell and internet access is so poor here there are times when contacting emergency services is impossible. It is absolutely ludicrous that in 2023 basic communication can not consistently be achieved!	8/25/2023 5:11 AM
6	Providing pet friendly emergency shelter services, using/providing info/providing support for native plants to help with localized flooding, better info about storm emergency shelters, and support for thunderstorm and tornado proofing houses	8/24/2023 10:28 PM
7	Caroline County needs to deal with their dirt road situation. They’ve neglected it for far too long.	8/23/2023 6:12 PM
8	Na	7/5/2023 5:41 PM

Q13 In the last 10 years, have you evacuated from your home or business as a result of a disaster (e.g., flooding, power outage, water failure)? If so, how long were you displaced? Did you go to a shelter?

Answered: 117 Skipped: 99

#	RESPONSES	DATE
1	I left once during a winter storm since I live on a county road and would not be able to get out since they don't plow it very often. I stayed with my mom for about 4 days since she lived on rt 404. I was also afraid I wouldn't have electric during the storm and she had a generator	1/27/2024 8:48 AM
2	No	1/26/2024 4:41 AM
3	No	1/26/2024 1:24 AM
4	No	1/25/2024 8:37 AM
5	NO	1/24/2024 10:30 AM
6	No	1/24/2024 8:29 AM
7	No	1/24/2024 6:02 AM
8	No	1/23/2024 9:22 PM
9	N/A	1/23/2024 4:27 PM
10	No	1/23/2024 2:52 PM
11	No	1/23/2024 12:11 PM
12	Yes and are currently living at neighbors waiting for house to be cleaned and repaired	1/23/2024 8:52 AM
13	No	1/23/2024 3:23 AM
14	No	1/22/2024 10:52 PM
15	No	1/22/2024 9:56 PM
16	Never evacuated	1/22/2024 9:37 PM
17	No	1/22/2024 9:37 PM
18	No	1/22/2024 7:30 PM
19	No	1/22/2024 6:25 PM
20	No	1/22/2024 5:56 PM
21	No	1/22/2024 5:23 PM
22	No.	1/22/2024 4:16 PM
23	No	1/22/2024 4:07 PM
24	No	1/22/2024 3:11 PM
25	Basement collapsed due to high ground water. We evacuated until damage was assessed. We were cleared to go back into the house after floor was jacked up.	1/22/2024 2:46 PM
26	No	1/22/2024 2:28 PM
27	No	1/22/2024 1:59 PM
28	No	1/22/2024 1:51 PM
29	No	1/22/2024 1:47 PM

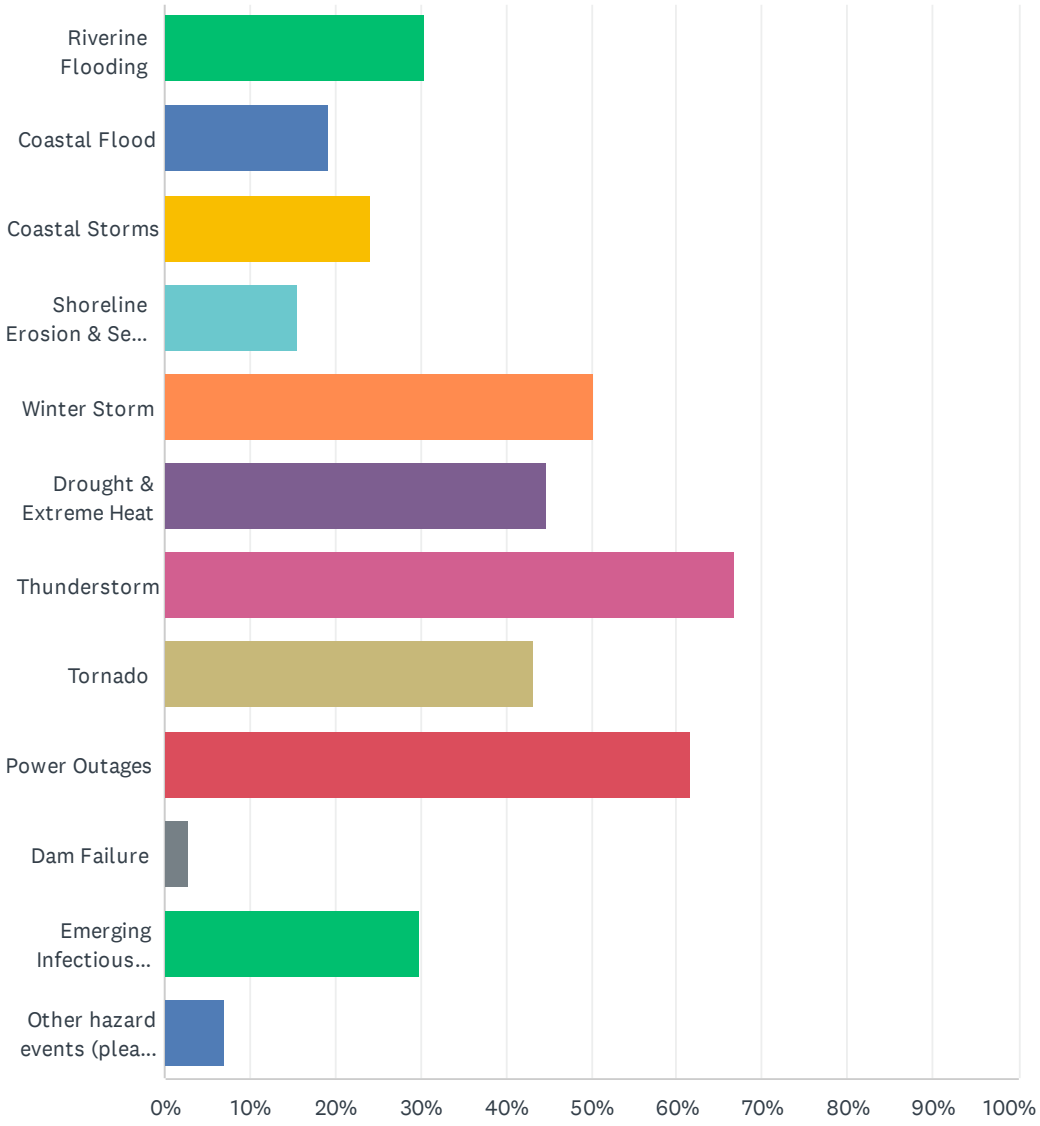
30	No	1/22/2024 1:36 PM
31	No	1/22/2024 1:32 PM
32	No	1/22/2024 1:31 PM
33	no	1/22/2024 1:21 PM
34	No	1/22/2024 1:14 PM
35	No	1/22/2024 1:10 PM
36	No	1/22/2024 1:08 PM
37	No	1/22/2024 1:07 PM
38	No	1/22/2024 12:52 PM
39	No	1/22/2024 12:47 PM
40	No	1/22/2024 12:43 PM
41	No	1/22/2024 12:37 PM
42	No	1/22/2024 12:26 PM
43	N/A	1/22/2024 12:21 PM
44	No	1/22/2024 11:17 AM
45	No	1/11/2024 4:35 PM
46	Yes, Tornado. Displaced for 2.5 weeks to rebuild 50% of house Shelter wasn't needed, my family & I stayed at our other home in Talbot County	11/26/2023 5:31 AM
47	No	11/17/2023 8:05 AM
48	No	11/15/2023 10:07 PM
49	No	11/14/2023 8:41 PM
50	No	11/14/2023 7:13 PM
51	No	11/14/2023 6:55 PM
52	No	11/14/2023 4:47 PM
53	No	11/14/2023 4:37 PM
54	No	11/14/2023 4:15 PM
55	No	8/30/2023 7:40 AM
56	No	8/29/2023 9:42 PM
57	no	8/29/2023 7:46 PM
58	No	8/29/2023 2:29 PM
59	no	8/29/2023 8:53 AM
60	No	8/29/2023 8:30 AM
61	no	8/29/2023 7:09 AM
62	No	8/28/2023 8:16 PM
63	No	8/28/2023 7:32 PM
64	No	8/28/2023 6:32 PM
65	No	8/28/2023 2:40 PM
66	No	8/27/2023 3:13 PM

67	No	8/27/2023 8:03 AM
68	No	8/27/2023 3:20 AM
69	No	8/27/2023 1:51 AM
70	No	8/26/2023 10:28 PM
71	No	8/26/2023 7:52 PM
72	Not applicable	8/26/2023 5:57 PM
73	No	8/26/2023 5:14 PM
74	No	8/26/2023 2:25 PM
75	No	8/26/2023 2:23 PM
76	No	8/26/2023 2:23 PM
77	no	8/26/2023 1:28 PM
78	We had no power or intermittent power for over 3 weeks during an ice storm. We stayed with family. It happened days after I gave birth.	8/26/2023 8:12 AM
79	No	8/25/2023 10:07 PM
80	No.	8/25/2023 2:46 PM
81	No	8/25/2023 1:00 PM
82	None	8/25/2023 11:59 AM
83	No	8/25/2023 5:11 AM
84	No	8/24/2023 10:28 PM
85	No	8/24/2023 10:21 PM
86	No	8/24/2023 9:33 PM
87	No	8/24/2023 8:34 PM
88	No	8/24/2023 4:59 PM
89	Not applicable	8/24/2023 4:01 PM
90	No	8/24/2023 10:08 AM
91	No	8/24/2023 8:28 AM
92	No	8/24/2023 7:39 AM
93	No	8/24/2023 7:05 AM
94	No	8/23/2023 10:32 PM
95	No	8/23/2023 9:58 PM
96	No	8/23/2023 9:47 PM
97	No	8/23/2023 9:10 PM
98	No	8/23/2023 6:28 PM
99	No	8/23/2023 6:12 PM
100	No	8/23/2023 5:43 PM
101	No.	8/23/2023 4:18 PM
102	No	8/23/2023 3:53 PM
103	No	8/23/2023 3:39 PM
104	No	8/23/2023 3:33 PM

105	No	8/23/2023 2:58 PM
106	N/A	8/19/2023 2:03 PM
107	Yes. Power outage. Several hours in a Denton business with heat and power. No shelter needed but would have gone if outage had lasted longer.	8/18/2023 2:02 PM
108	NA	8/18/2023 10:10 AM
109	No	7/12/2023 2:49 PM
110	No	7/9/2023 12:32 PM
111	No	7/7/2023 12:00 AM
112	No	7/6/2023 8:31 PM
113	Negative.	7/6/2023 4:54 PM
114	No	7/5/2023 6:23 PM
115	No	7/5/2023 5:41 PM
116	No	7/5/2023 4:19 PM
117	No	7/5/2023 4:10 PM

Q14 Please indicate which hazard events you feel may particularly affect your community. (Please check all that apply)

Answered: 141 Skipped: 75

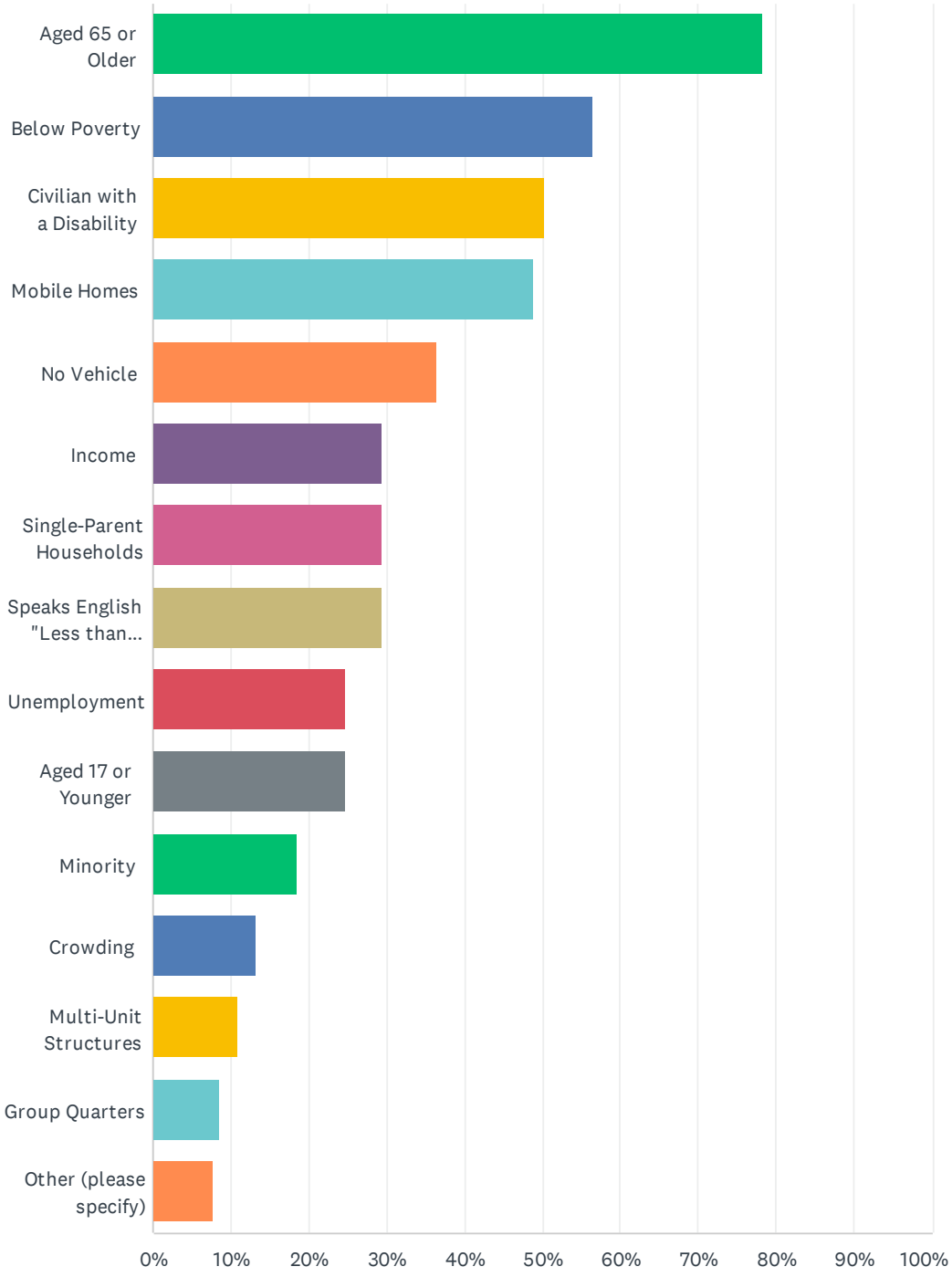


ANSWER CHOICES	RESPONSES	
Riverine Flooding	30.50%	43
Coastal Flood	19.15%	27
Coastal Storms	24.11%	34
Shoreline Erosion & Sea Level Rise	15.60%	22
Winter Storm	50.35%	71
Drought & Extreme Heat	44.68%	63
Thunderstorm	66.67%	94
Tornado	43.26%	61
Power Outages	61.70%	87
Dam Failure	2.84%	4
Emerging Infectious Disease	29.79%	42
Other hazard events (please describe)	7.09%	10
Total Respondents: 141		

#	OTHER HAZARD EVENTS (PLEASE DESCRIBE)	DATE
1	Train derailment, gas/propane hazmat	1/26/2024 4:45 AM
2	DAF	1/22/2024 3:33 PM
3	None	1/22/2024 1:18 PM
4	Farm runoff damaging the local aquatic areas	8/26/2023 8:22 AM
5	All events could potentially affect the community!	8/25/2023 5:16 AM
6	Poorly maintained “non essential” roads	8/23/2023 10:01 PM
7	Government takeover	8/23/2023 6:30 PM
8	Extreme cold	8/18/2023 2:08 PM
9	[en]slave-ment-of-:WE-The-PEOPLE- with-the-non-closure-of-the-fact[s]: .	7/6/2023 5:15 PM
10	Power Loss	7/5/2023 6:24 PM

Q15 In terms of social vulnerability, do you feel that a specific group, or groups, in Caroline County are particularly at risk for, or could be harmed by, any of the hazards listed in Question 14? This question is not intended to be limited to certain groups - we are eager to learn of any and all types and sizes of groups you think might be at particular risk.Note: CDC 15 Social Factors below.

Answered: 129 Skipped: 87


Aged 65 or Older
Below Poverty
Civilian with a Disability
Mobile Homes
No Vehicle
Income
Single-Parent Households
Speaks English "Less than...
Unemployment
Aged 17 or Younger
Minority
Crowding
Multi-Unit Structures
Group Quarters
Other (please specify)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
Aged 65 or Older	78.29%	101
Below Poverty	56.59%	73
Civilian with a Disability	50.39%	65
Mobile Homes	48.84%	63
No Vehicle	36.43%	47
Income	29.46%	38
Single-Parent Households	29.46%	38
Speaks English "Less than Well"	29.46%	38
Unemployment	24.81%	32
Aged 17 or Younger	24.81%	32
Minority	18.60%	24
Crowding	13.18%	17
Multi-Unit Structures	10.85%	14
Group Quarters	8.53%	11
Other (please specify)	7.75%	10
Total Respondents: 129		

#	OTHER (PLEASE SPECIFY)	DATE
1	Any or all groups could be impacted no matter age or income.	1/22/2024 1:38 PM
2	Ome	1/22/2024 1:18 PM
3	No	11/14/2023 4:49 PM
4	All persons would be affected should a disaster occur.	8/25/2023 5:16 AM
5	People who live alone or don't have local/family connections	8/24/2023 10:35 PM
6	Deaf residents need certified ASL interpreters	8/24/2023 8:48 PM
7	None	8/23/2023 9:04 PM
8	Every one in one way or the other	8/23/2023 6:30 PM
9	Hazards and storms don’t care what social group you apart of. This is a stupid question.	8/23/2023 6:15 PM
10	:For-the-"U.S." Is-Not-With-the-Honor-of-The-AUTHOR[ity]-for-The-FULL-FAITH-CREDIT-of-WE-THE-PEOPLE: .	7/6/2023 5:15 PM

Q16 Are you concerned with any other hazards not identified in this survey?

Answered: 66 Skipped: 150

#	RESPONSES	DATE
1	Train hazmat, gas,natural gas, propane	1/26/2024 4:45 AM
2	No	1/25/2024 8:39 AM
3	no	1/24/2024 10:31 AM
4	No	1/24/2024 1:23 AM
5	No	1/23/2024 9:25 PM
6	No	1/23/2024 4:28 PM
7	No	1/23/2024 2:53 PM
8	No	1/23/2024 3:24 AM
9	No	1/22/2024 9:39 PM
10	No	1/22/2024 6:26 PM
11	DAF	1/22/2024 5:25 PM
12	No	1/22/2024 4:09 PM
13	No	1/22/2024 3:13 PM
14	Homeless people	1/22/2024 2:52 PM
15	No	1/22/2024 2:29 PM
16	No	1/22/2024 2:00 PM
17	No	1/22/2024 1:52 PM
18	Daf	1/22/2024 1:49 PM
19	No	1/22/2024 1:34 PM
20	No	1/22/2024 1:32 PM
21	no	1/22/2024 1:23 PM
22	No	1/22/2024 1:18 PM
23	No	1/22/2024 1:10 PM
24	No	1/22/2024 12:48 PM
25	Woods flooding due to the lack of drainage ditches or the ditches that are not cleared and cleaned on a regular basis.	1/22/2024 12:41 PM
26	No	1/22/2024 12:30 PM
27	Yes - This may be irrelevant to this particular survey, but the amount of people driving around intoxicated with drugs & alcohol on local roads & highways is unbelievable and in my eyes, a SIGNIFICANT hazard... if you go to any local store, anywhere in Caroline County, chances are you will see/smell multiple intoxicated people, at anytime of day/night. Especially in the town of Denton. Very dangerous and it's sad...	11/26/2023 5:47 AM
28	-	11/15/2023 10:09 PM
29	No	11/14/2023 7:14 PM

30	No	11/14/2023 4:49 PM
31	No	8/30/2023 7:43 AM
32	no	8/29/2023 7:49 PM
33	no	8/29/2023 2:33 PM
34	battery storage thermal runaway	8/29/2023 10:59 AM
35	no	8/29/2023 8:54 AM
36	No	8/28/2023 8:18 PM
37	No	8/27/2023 3:15 PM
38	Lack of good police	8/27/2023 3:22 AM
39	No	8/27/2023 1:53 AM
40	Corruption in town politics	8/26/2023 10:29 PM
41	No	8/26/2023 7:53 PM
42	no	8/26/2023 3:00 PM
43	Fires	8/26/2023 2:26 PM
44	No	8/26/2023 2:24 PM
45	no	8/26/2023 1:30 PM
46	No	8/26/2023 9:48 AM
47	FARM RUNOFF INTO WATER LACK OF TOPSOIL	8/26/2023 8:22 AM
48	Over growth of trees on Double Hills Road. No one wants to take responsibility for. They are old, diseased and dangerous.	8/26/2023 8:14 AM
49	No	8/25/2023 10:09 PM
50	COMMUNICATION	8/25/2023 5:16 AM
51	Home fires	8/24/2023 10:35 PM
52	No	8/24/2023 4:04 PM
53	No	8/24/2023 8:30 AM
54	Not sure	8/24/2023 7:05 AM
55	Frost heave on damaged roads that are not a priority for the town	8/23/2023 10:01 PM
56	No	8/23/2023 9:12 PM
57	Not yet	8/23/2023 9:04 PM
58	Government lockdowns	8/23/2023 6:30 PM
59	Washouts of dirt roads. With these massive rain falls this summer it’s happening continuously. This county has far too many dirt roads.	8/23/2023 6:15 PM
60	Long term power outages.	8/23/2023 4:22 PM
61	No	8/23/2023 2:59 PM
62	Hate groups!	8/19/2023 2:06 PM
63	Well we had an oil spill from Tri Gas and Oil into the adjacent creek several years ago. That was concerning and I am pretty sure it had happened a couple times before it was caught. I think the MD EPA responded and set up a boom.	8/18/2023 10:17 AM
64	No	7/6/2023 8:32 PM
65	:for-the-"U.S."-is-with-the-spy- [ing]and-the-harvest-[ing]-of-the-PEOPLE-for-the-PEOPLES-	7/6/2023 5:15 PM

	FULL-FAITH-CREDIT: .	
66	No	7/5/2023 4:11 PM

Q17 In your opinion, what steps could be undertaken to reduce or eliminate the risk of future hazard damages?

Answered: 62 Skipped: 154

#	RESPONSES	DATE
1	More funding for fire and ems, equipment, training and expansion of departments. Retaining emergency service personnel.	1/26/2024 4:45 AM
2	Back roads during snow storms	1/25/2024 8:39 AM
3	Communication to all citizens of impending dangers. Knowledge is power.	1/24/2024 10:31 AM
4	More public awareness	1/23/2024 9:25 PM
5	Early warning	1/23/2024 2:53 PM
6	Acceptance of climate change in order to respond appropriately. It's not just a safety issue, but increased heat and draught will wreck what is largely still an agriculture based economy. Leaders talk about supporting farmers, but deny the effects of climate change.	1/23/2024 12:13 PM
7	Help when you need it not being told none available	1/23/2024 8:53 AM
8	Invest in drainage maintenance and infrastructure on a regular basis. Invest in mitigation education at all levels of government. Invest in mitigation education in the community.	1/22/2024 10:55 PM
9	Educating the public	1/22/2024 7:32 PM
10	Find a way to fix areas like River road. Educate the public on what they can do to help	1/22/2024 5:25 PM
11	None	1/22/2024 4:09 PM
12	Have a police station in Preston, and a Career fire department	1/22/2024 3:13 PM
13	The county needs to put some money in. The roads in Federalsburg are horrible and cause damage to vehicles. The marshy hope floods constantly. It feels as though our area doesn't get much from the county.	1/22/2024 2:52 PM
14	I don't know	1/22/2024 2:29 PM
15	No idea	1/22/2024 1:52 PM
16	Roadway updates, cleaning out ditches	1/22/2024 1:38 PM
17	Clean and maintain ditches along back roads	1/22/2024 1:34 PM
18	none	1/22/2024 1:23 PM
19	I feel a focus needs to be on improving the roads by re-paving especially well traveled and hazard prone like River Rd. Already worn or damaged roads will succumb to harsh elements at a faster pace	1/22/2024 1:19 PM
20	Better infrastructure (ie raising River Road between 404 and the High School)	1/22/2024 12:45 PM
21	Provide assistance, aid and or knowledge to allow the citezens to assist the county in clearing projects.	1/22/2024 12:41 PM
22	Education, preparation	1/22/2024 11:25 AM
23	The biggest/first step, I would say, would be securing State funding to implement changes. Caroline County is the poorest county in Maryland. It's a proven fact that we most certainly can NOT rely on the Caroline County government to actually implement any changes on their own, due to lack of funds. Although, we all do pay hefty local & county taxes … wonder where that money is actually being used? That new sheriffs office sure is elegant tho.	11/26/2023 5:47 AM
24	Implement the Community Emergency Response Team (CERT) program that has never been	11/17/2023 8:07 AM

	completed.	
25	-	11/15/2023 10:09 PM
26	Lower taxes so people can protect themselves	11/14/2023 4:49 PM
27	If it is possible make sure that any and all community members are made aware of impending hazards whether major or minor risks is involved. Sometimes the weather is very unpredictable and things can intensify rapidly.	8/30/2023 7:43 AM
28	Share information ahead of time.	8/29/2023 7:49 PM
29	Increase funding and staff at Department of Emergency Services to address and minimize these identified risks. Thank you.	8/29/2023 2:33 PM
30	strong infrastructure, adequate emergency response, strong communication, practical info (e.g. refrigerator magnet) for residents	8/29/2023 10:59 AM
31	remove corrupt bureaucrats	8/29/2023 8:54 AM
32	Bridge and roadway failures/vulnerabilities should be addressed and all the suggestions tackled as feasible.	8/29/2023 8:32 AM
33	increase awareness	8/29/2023 7:11 AM
34	Tips previously mentioned. Focus on funding when people need help and insurance won't cover it all	8/27/2023 3:15 PM
35	Grants and education	8/27/2023 3:22 AM
36	None	8/27/2023 1:53 AM
37	Have a second power line feed into County	8/26/2023 5:16 PM
38	Better police and fire capabilities	8/26/2023 2:26 PM
39	?	8/26/2023 1:30 PM
40	No	8/26/2023 9:48 AM
41	FUNDING TO ASSIST FARMERS WITH IRRIGATION DRAINAGE TO THEIR OWN FIELDS RATHER THAN THE RIVER	8/26/2023 8:22 AM
42	Maintaining trees near power lines and private property.	8/26/2023 8:14 AM
43	I'm not sure a better tracking system that provides more accurate timing to bug out or nail everything down in time	8/25/2023 10:09 PM
44	All residents should have access to cell and internet!	8/25/2023 5:16 AM
45	Better info about getting and using services and support, weatherproofing electrical and internet lines, create family and pet friendly shelters, more clarity in community alarm systems (Ex fire department alarm sequence/type decoding), provide/sell window protection for storms, easier avenues to provide community support for those who need it	8/24/2023 10:35 PM
46	Communication to those in areas prone to high rush scenarios. Also a transparent emergency management planner. One that's communicative on all levels to the community about what to do in a hazard situation	8/24/2023 10:24 PM
47	Improving infrastructure (not just bridges, but roads too), making sure landlords and rental management companies are keeping structures up to code and upgrading appliances/equipment, limiting new construction in at-risk areas, connecting with communities that have been historically segregated and ensuring they are receiving equal services and opportunities to improve properties and infrastructure.	8/24/2023 8:43 PM
48	More communication from county to its residents. This questionnaire is a great idea. I hope the results and resolutions will be shared with us.	8/24/2023 4:04 PM
49	Preparation	8/24/2023 7:05 AM
50	Proactive maintenance and investing in upgrading utilities that are old and outdated, sewer and water lines.	8/23/2023 10:01 PM

51	With the roads flooding on side roads, fields need a drain ditch so the water doesn't run on to the road and cover it. The trees that hang over roads need to be cut back	8/23/2023 9:51 PM
52	Public tree trimming along power lines.	8/23/2023 9:12 PM
53	Mother nature you can't stop it .	8/23/2023 9:04 PM
54	Can't control Mother Nature	8/23/2023 6:30 PM
55	Ensure people have the proper insurance. If they can't pay to insure the property correctly. They shouldn't own it or expect other people to pay for their damages.	8/23/2023 6:15 PM
56	Stricter ordinances on where people can build close to tidal water. Building homes less likely to be damaged by strong winds or tornadoes. Recommend homeowners have multiple alternative energy like solar and wind on their property.	8/23/2023 4:22 PM
57	Have a civilian hazard corp of volunteers trained and ready to react to any hazard.	8/19/2023 2:06 PM
58	Increase taxes and/or fees to help pay for what's needed.	8/18/2023 2:08 PM
59	Early warning notifications are so important. I was in bridgeville shopping during the last tornado that took a life of a local resident and there was no warning whatsoever. I was shocked to find out that I was very close to the tornado.	8/18/2023 10:17 AM
60	I don't know	7/6/2023 8:32 PM
61	:Give-Paise-to-the-LIVING-GOD-and-Jesus-Christ: .	7/6/2023 5:15 PM
62	Not sure	7/5/2023 4:11 PM

Appendix D
Funding Sources

The following is a list of Federal and State Grants that may assist in implementing local Hazard Mitigation Plans.

Disclaimer: This information is subject to change at any time, contact the federal or state agency for current grant status.

Database last updated February 2024

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
Federal Emergency Management Agency, Hazard Mitigation Grant Program (HMGP)	Maryland Department of Emergency Management 5401 Rue Saint Lo Drive Reisterstown, MD 21136	All Hazards Mitigation Planning. Acquisition, relocation, elevation and flood-proofing of flood-prone insured properties, flood mitigation planning, wind retrofit, stormwater improvements, education and awareness.	Federal - 75% Non-Federal - 25%	Local governments must follow the NFIP when a proposed project is located within the 100-year floodplain, also known as the Special Flood Hazard Area (SFHA). Projects must be cost effective, environmentally sound and solve problems. Repetitive loss properties are a high priority.	After a Presidential Disaster Declaration
Federal Emergency Management Agency, Building Resilient Infrastructure and Communities (BRIC)	Maryland Department of Emergency Management 5401 Rue Saint Lo Drive Reisterstown, MD 21136	BRIC funds may be used for: Capability and Capacity Building (C&CB) Activities, Mitigation Projects, and Management Costs.	Federal - 75% Non-Federal - 25% Economically Disadvantaged Rural Communities (EDRC) are eligible for an increase in funding up to 90% federal cost share/10% non-federal cost share. FEMA provides 100% federal cost share funding for management costs.	Projects must: Be cost-effective, Reduce or eliminate risk and damage from future natural hazards, Meet either of the two latest published editions of relevant consensus-based codes, specifications, and standards, Align with the applicable hazard mitigation plan, Meet all environmental and historic preservation (EHP) requirements.	Annual- Spring/Summer
Federal Emergency Management Agency, Flood Mitigation Assistance Program (FMA)	Maryland Department of Emergency Management 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Assist States and communities to implement measures that reduce or eliminate the long- term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.	RL: Federal - 90% Non-Federal - 10% SRL: Federal - 100% Non-Federal - 0%	Available once a Flood Mitigation Plan has been developed and approved by FEMA.	Annual- Spring/Summer
National Flood Insurance Program (NFIP)	Maryland Department of Emergency Management 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Provides financial protection by enabling persons to purchase insurance against floods, mudslide or flood related erosion.	Varies	Includes Federally backed insurance against flooding, available to individuals and businesses that participate in the NFIP.	Anytime
Increased Cost of Compliance	Maryland Department of Emergency Management 5401 Rue Saint Lo Drive Reisterstown, MD 21136	ICC coverage provides payment to help cover the cost of mitigation activities that will reduce the risk of future flood damage to a building. If a Flood Insurance Policy Holder suffers a flood loss and is declared to be substantially or repetitively damaged, ICC will pay up to 30,000 to bring the building into compliance with State or community floodplain management laws or ordinances. Usually this means elevating or relocating the building so that it is above the base flood elevation (BFE).	Varies	Once the local jurisdiction determines the building is substantially or repetitively damaged, the policy holder can contact an insurance agent to file an ICC claim. When applicable, based on provisions in the 2015 HMA Guidance, up to $30,000 of ICC funding can be used towards the non-federal share for a Hazard Mitigation Assistance (HMA) project.	Anytime
U.S. Economic Development Administration,	U.S. Department of Commerce Economic Development Administration Curtis Center, 601	Improvements and reconstruction of public facilities after a disaster or industry closing. Research studies designed to facilitate economic development.	Federal - 50%-70% Local- 30%-50%	Documenting economic distress, job impact and proposing a project that is consistent with a Comprehensive Economic Development Strategy are important funding selection criteria.	Anytime

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
Economic Adjustment Program	Walnut Street, Ste 140 South Philadelphia, PA 19106-3323 215-597-4603				
U.S Economic Development Administration, Public Works and Development Facilities	U.S. Department of Commerce Economic Development Administration Curtis Center, 601 Walnut Street, Ste 140 South Philadelphia, PA 19106-3323 215-597-4603	Water and sewer, Industrial access roads, rail spurs, port improvements technological and related infrastructure	Federal - 50%-70% Local- 30%-50%	Documenting economic distress, job impact and projects that is consistency with a Comprehensive Economic Development Strategy are important funding selection criteria.	Quarterly Basis
Small Business Administration (SBA) Pre-disaster Mitigation Loan Program	James Rivera, Office of Disaster Assistance, Small Business Administration, 409 3rd Street, SW, STE 6050 Washington, DC 20416 202-205-6734	Activities done for the purpose of protecting real and personal property against disaster related damage.	No information	The mitigation measures must protect property or contents from damage that may be caused by future disasters and must conform to the priorities and goals of the state or local government's mitigation plan.	
Community Development Block Grants / States Program	U.S Department of Housing and Urban Development, Office of Block Grant Assistance, 451 7th Street SW., Washington, DC 20410-7000 202- 708-1112	Used for long-term recovery needs, such as: rehabilitation residential and commercial building; homeownership assistance, including down-payment assistance and interest rate subsidies; building new replacement housing; code enforcement; acquiring, construction, or reconstructing public facilities.	No information	Citizen participation procedures must be followed. At least 70 percent of funds must be used for activities that principally benefit persons of low and moderate income. Formula grants to States for non-entitlement communities.	After a Presidential Disaster Declaration
Fire Suppression Assistance Program	Infrastructure Division, Response and Recovery Directorate, FEMA, 500 C Street SW., Washington DC 20024 202-646-2500	Provides real-time assistance for the suppression of any fire on public (non- Federal) or privately owned forest or grassland that threatens to become a major disaster.	Federal - 70% Local - 30%	The State must first meet annual floor cost (if percent of average fiscal year fire costs) on a single declared fire. After the State's out-of- pocket expenses exceed twice the average fiscal year costs, funds are made available for 100 percent of all costs for each declared fire.	Funds from President's Disaster Relief Fund for use in a designated emergency or major disaster area.
Historic Preservation: Repair and Restoration of Disaster- Damaged Historic Properties	Infrastructure Division, Response and Recovery Directorate, FEMA, 500 C Street SW., Washington DC 20024 202-646-4621	To evaluate the effects of repairs to, restoration of, or mitigation hazards to disaster-damaged historic structures working in concert with the requirements of the Stafford Act.	Federal - 75% Local - 25%	Eligible to State and local governments, and any political subdivision of a State. Also, eligible are private non-profit organizations that operate educational, utility, emergency, or medical facilities.	After a Presidential Disaster Declaration
Transportation: Emergency Relief Program	Federal Transit Authority, FHWA, DOT, 1200 New Jersey Avenue Washington, DC 20590 202-366-4043	Provides aid for the repair of Federal-aid roads and roads on Federal lands.	Federal - 100%	Application is submitted by the State department of transportation for damages to Federal-aid highway routes, and by the applicable Federal agency for damages to roads on Federal lands.	After serious damage to Federal-aid roads or roads on Federal lands caused by a natural disaster or by catastrophic failure.
Animals: Emergency Haying and Grazing	Emergency and Non-insured Assistance Programs, FSA, USDA, 1400 Independence	To help livestock producers in approved counties when the growth and yield of hay and pasture have been substantially reduced because of a widespread natural disaster.	No information	Assistance is provided by the Secretary of Agriculture to harvest hay or graze cropland, or other commercial use of forage devoted to the Conservation Reserve Program	Anytime

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
	Ave, SW, Washington, DC 20013 202-720-4053			(CRP0 in response to a drought or other similar emergency.	
Emergency Watershed Protection Program	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	Implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed.	Federal - 75% Local - 25%	It cannot fund operation and maintenance work or repair private or public transportation facilities or utilities. The work cannot adversely affect downstream water rights and funds cannot be used to install measures not essential to the reduction of hazards.	TBD
Watershed Protection and Flood Prevention Program	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	To provide technical and financial assistance in carrying out works of improvement to protect, develop, and utilize the land and water resources in watersheds.	Varies due to project type.	Watershed area must not exceed 250,000 acres. Capacity of a single structure is limited to 25,000 acre-feet of total capacity and 12,500 acre- feet of floodwater detention capacity.	TBD
Watershed Surveys and Planning	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	To provide planning assistance to Federal, State, and local agencies for the development of coordinated water and related programs in watersheds and river basins. Emphasis is on flood damage reduction, erosion control, water conservation, preservation of wetlands and water quality improvements.	No information	These watershed plans form the basis for installing needed works of improvement and include estimated benefits and costs, cost- sharing, operation and maintenance arrangements, and other information necessary to justify the need for Federal assistance in carrying out the plan.	Anytime
Emergency Advance Measures for Flood Prevention	USACE 441 G Street, NW, Washington DC 20314 202-761-0011	To perform activities prior to flooding or flood fight that would assist in protecting against loss of life and damages to property due to flooding.	No information	There must be an immediate threat of unusual flooding present before advance measures can be considered. Any work performed under this program will be temporary in nature and must have a favorable benefit cost ratio.	Governor of State must request assistance
Emergency Streambank and Shoreline Protection	USACE 441 G Street, NW, Washington DC 20314 202-761-0011	Authorizes the construction of emergency streambank protection measures to prevent damage to highways, bridge approaches, municipal water supply systems, sewage disposal plants, and other essential public works facilities endangered by floods or storms due to bank erosion.	No information	Churches, hospitals, schools, and other non- profit service facilities may also be protected under this program. This authority does not apply to privately-owned property or structures.	TBD
Small Flood Control Projects	USACE 441 G Street, NW, Washington DC 20314 202-761-0011	Authorizes the construction of small flood control projects that have not already been specifically authorized by Congress.	No information	There are two general categories of projects: structural and nonstructural. Structural projects may include levees, floodwalls, diversion channels, pumping plants, and bridge modifications. Nonstructural projects have little or no effect on water surface elevations, and may include flood proofing, the relocation of structures, and flood warning systems.	TBD
Flood: Emergency Advance Measures for Flood Prevention	USACE 441 G Street, NW, Washington DC 20314 202-761-0011	To mitigate, before an event, the potential loss of life and damages to property due to floods.	No information	Assistance may consist of temporary levees, channel cleaning, preparation for abnormal snowpacks, etc.	Governor of State must request assistance

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
Continuing Authorities Program (CAP)	USACE 441 G Street, NW, Washington DC 20314 202-761-0011	Initiates a short reconnaissance effort to determine Federal interest in proceeding. If there is interest, a feasibility study is performed.	Federal - 65% Local - 35%	A local sponsor must identify the problem and request assistance. Small flood control projects are also available.	Anytime
Hazardous Materials: State Access to the Oil Spill Liability Trust Fund	Director, USCG National Pollution Funds Center, U.S. Coast Guard Stop 7605. 2703 Martin Luther King Jr. Avenue, SE Washington, DC 20593-7605 202-795-6000	To encourage greater State participation in response to actual or threatened discharges of oil.	No information	Eligible to States and U.S. Trust Territories and possessions.	Anytime
Emergency Management Assistance (EMA)	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Funds may be used for salaries, travel expenses, and other administrative cost essential to the day-to-day operations of State and Local emergency management agencies. Program also includes management processes that ensure coordinated planning, accountability for progress, and trained qualified staffing.	Federal - 50%	EMA funded activities may include specific mitigation management efforts not otherwise eligible for Federal funding. Management Assistance program funds may not be used for construction, repairs, equipment, materials or physical operations required for damage mitigation projects for public or private buildings, roads, bridges, or other facilities.	Anytime
Maryland Program Open Space	Department of Natural Resources 580 Taylor Ave. Annapolis, MD 21401 410-260-8445	Local provides financial and technical assistance to local subdivisions for the planning, acquisition, and/or development of recreation land or open space areas.	A local governing body may use up to $25,000 annually from its 100% (Acquisition) money to fund planning projects that update the Local Land Preservation and Recreation Plans.	Acquires outdoor recreation and open space areas for public use Administers funds made available to local communities for open and recreational space by the Outdoor Recreation Land Loan of 1969 and from the Land and Water Conservation Fund of the National Park Service, U.S. Department of the Interior.	July 1st
Maryland Recreational Trails Program	Maryland Scenic Byways/Recreational Trails Program* Office of Planning & Preliminary Engineering State Highway Administration 707 N Calvert Street Baltimore, MD 21201 (p) 410.545.8637 (f) 410.209-5012 tmaxwell@sha.state.md.us	Maintenance and restoration of existing recreational trail; Development and rehabilitation of trailside facilities and trail linkages; Purchase and lease of trail construction equipment; Construction of new trails; Acquisition of easements or property for recreational trails or recreational trail corridors; and Implementation of interpretive/educational programs to promote intrinsic qualities, safety, and environmental protection, as those objectives relate to the use of recreational trails.	Administered by the State Highway Administration (SHA), this program matches federal funds with local funds or in-kind contributions to implement trail projects. Projects can be sponsored by a county or municipal government, a private non-profit agency, a community group or an individual (non-governmental agencies must secure an appropriate government agency as a co-sponsor). Federal funds administered by the State Highway Administration are available for up to 80% of the project cost, matched by at least 20% funding from the project	Projects must meet state and federal environmental regulatory requirements (NEPA, MEPA, Section 106, Section 4(f)). SHA will aid the project sponsor to acquire these approvals.	July 1st

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
			sponsor. Matching funds must be committed and documented in the local jurisdiction's budget. A Memorandum of Understanding outlining funding and project implementation responsibilities will be prepared by SHA and signed by all parties before the project funds are released.		
CoastSmart Communities Grant Program	Maryland Department of Natural Resources Chesapeake and Coastal Service (p) 410.260.8718 (f) 410.260.8739 sasha.land@maryland.gov	Municipalities and counties in the coastal zone are eligible to apply for and receive funds: Anne Arundel, Baltimore, Calvert, Caroline, Cecil, Charles, Dorchester, Harford, Kent, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Wicomico, and Worcester counties and Baltimore City. Funding for a one- year project that contributes to understanding, planning for, or implementing planning and outreach measures to address coastal hazard issues.	Up to $75,000 annually	Track A can fund flood vulnerability and risk assessments, updates to planning documents (e.g. hazard mitigation plans, zoning ordinances, building codes, floodplain ordinances, comprehensive plans), education and outreach campaigns and materials, applications to FEMA's Community Rating System in concert with other task outcomes, support for adopting an updated plan and integrating the plan into day-to-day existing planning processes that reduce overall flood risk due to tidal events or stormwater and rain events.	TBD
Green Infrastructure Resiliency Grant Program	Maryland Department of Natural Resources Chesapeake and Coastal Service (p) 410.260.8799 (f) 410.260.8739 (e) megan.granato@maryland.gov	Municipalities and counties within the Maryland portion of the Chesapeake Bay watershed are eligible to apply for and receive funds. Please note that projects proposed in Cecil, Garrett and Worcester counties must be located within the portions of those counties that are within the watershed to be eligible. Funding for one year for Phase 1 and Phase 2 projects and up to 2 years for Phase 3 projects that will assess stormwater management needs associated with localized flooding and design or construct targeted green infrastructure practices to address those needs.	Up to $100,000 per project	Track B can fund watershed assessments that focus on determining local flood risks and how green infrastructure can be used to address those risks, site or watershed-level green infrastructure implementation plans, and green infrastructure project designs. This track can also fund construction of green infrastructure projects. To apply for construction funding, all applicable permit preapplication meetings must be complete.	TBD
Maryland Community Parks and Playgrounds Program	Department of Natural Resources 580 Taylor Ave. Annapolis, MD 21401 410-260-8445	1. Development of new parks 2. Rehabilitation of existing parks 3. Expansion or improvement of existing parks 4. Purchase and installation of playground equipment 5. Development of environmentally oriented parks and recreation projects 6. Development of new trails or extension of existing trails	The source of funds for this program is primarily State General Obligation Bonds, which may be authorized on an annual basis. The Community Parks and Playgrounds Program provides funding to incorporated municipalities and Baltimore City. Grants may be for	The Department of Natural Resources works to provide opportunities for Marylanders, especially our children, to experience nature. The DNR has developed a web site www.dnr.state.md.us/cin/NPS/index.asp that provides information about Nature Play Spaces. Nature Play Spaces are one of the many types of public recreation projects eligible for consideration for Community Parks and Playgrounds grant funding. While	TBD

Potential Funding Sources					
Grant Program Name	**Address and Telephone Contact Information**	**Eligible Activities**	**Federal, State and Local Cost Share Requirements**	**Other Program Characteristics**	**Grant Application Due Date**
		7. Creation of access points to water recreation resources 8. Acquisition of land to create new parks.	up to 100% of the project cost and are selected on a competitive basis. Each applicant will be limited to one (1) Grant Proposal List submission package, which may contain several prioritized projects, per award cycle.	land acquisition costs may be considered for project funding, the highest priority will be placed on capital costs associated with park development and improvement.	

Appendix E
2019 Caroline County Flood Risk Report

Source: https://www. Myeasternshoremd.com

STATE OF MARYLAND

FLOOD RISK REPORT

CAROLINE COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

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Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Caroline County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Caroline County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Caroline County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

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1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Choptank River floods G. Daniel Crouse Memorial Park in Denton. Source: MyEasternShoreMD

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Greensboro Fairgrounds
Source: The Democrat Star

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: Long Swamp Road, Federalsburg June 2006 Flood
Source: https://www.carolinemd.org/227/Road-or-Bridge-Closures

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 32 to 34.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.
- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective date January 16, 2015), provided by FEMA Region III and Maryland Department of the Environment. In conjunction with this regulatory FIRM update, non-regulatory flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed for coastal flood hazards in Caroline County, and have been leveraged as part of this countywide flood risk assessment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of June 2016), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Caroline County Project Management & GIS Office – https://www.carolinemd.org/Directory.aspx?did=18 *(Limited Distribution; data available by purchase/ request).*

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.

- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Section 2 - Subsection ii Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be

identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The *2019 Caroline County Hazard Mitigation Plan Update* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Caroline County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the

potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

  Caroline County encourage residents to " Stay in Touch." According to the Department of Emergency Services' Emergency Preparedness webpage, "In order to be prepared citizens must "Stay In Touch." This means plugging in to various media and keeping up to date on what is happening. Check all types of media – websites, newspapers, radio, TV, e-

Figure 1.6

Caroline County's Hurricane Evacuation Zone Map.

Source: www.knowyourzonemd.com

mails, mobile and land phones – for national and local information. During an emergency, the Emergency Services office provides information on shelter openings and evacuation orders. The Department of Emergency Services (DES) utilizes social media to provide updates on breaking. Please visit DES Facebook and Twitter pages; access is on the DES home page."

In addition, a small protion of Caroline County is within the Maryland Emergency Management Agency's "Know Your Zone" evacuation initiative. Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Caroline County evacuation zones can be found at www.knowyourzonemd.com.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore was developed in January 2019 to provides local government leaders and staff with data, analyses, policy options, and implementation guidance. A *Caroline County Coastal Flood Vulnerability Study* (https://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf) was completed and incldued in the Appendix of the document. According to the sudy, the goal was to model the potential damage to buildings and their contents from severe periodic coastal flooding events, both today and in the future using a value for predicted sea level change.

- **Emergency Action Plans.** Emergency Action Plans (EPA) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans

specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

Seven (7) dams are located within Caroline County, two (2) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Caroline County, MD,* on page 18 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  The *Flood Risk Report Caroline County, Maryland Coastal Study*, developed by FEMA using Hazus Version 2.2, was released on July 17, 2015. This report provides estimated coastal flood losses for the 1-percent-annual-chance flood event, and has been leveraged as part of this enhanced countywide flood risk assessment. The 2015 Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Floodwaters in Federalsburg
Source: https://www.carolinemd.org/312/Weather-Information
Bottom Photo: Federalsburg Marina after the 25 June 2006 Flood
Source: Caroline County Emergency Services

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

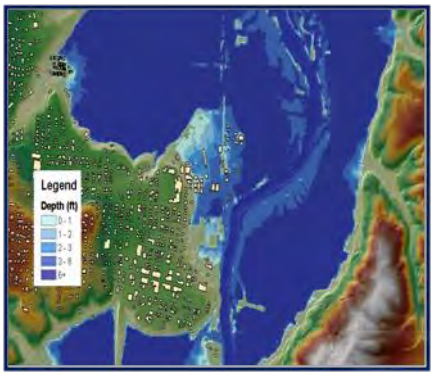
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

depth is a function of the difference between the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and data development for each study type were performed by different mapping partners.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses

include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Figure 2.4

An essential facility, Federalsburg Police Department, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: Google Maps

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 37 essential facilities located within Caroline County with a total esitmated building value of $95,711,000.00.

Table 1: Caroline County Essential Facilities

Facility Type	Number of Structure	Estimated Building Value
Emergency Operations Center (EOC)	2	$3,548,000
Fire/Rescue Stations	12	$5,394,000
Hospital & Medical Clinics	5	$18,222,000
Police Stations	5	$2,190,000
Schools (K-12 & Colleges)	13	$66,357,000
Total	**37**	**$3,548,000**

Source: 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 4 high risk areas were identified within Caroline County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Tuckahoe State Park Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: Tuckahoe State Park Dam
Source:
https://dnr.maryland.gov/fisheries/Pages/hotspots/tuckahoe.aspx

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, seven (7) dams are located in Caroline County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Caroline County, MD

Name	Owner Type	Purpose	River	EAP Last Revision Date
Tuckahoe State Park Dam (Crouse Mill Road)	State	Recreation	Tuckahoe Creek	No
Lake Bonnie	Private	Recreation	Broadway Branch	No
Scull Farm Pond	Private	Recreation	Tuckahoe Creek-TR	No
Williston Mill Dam (MD 617 Old Harmony Road)	Private	Recreation	Mill Creek	No
Nagels Mill Pond	Private	Recreation	Nagels Pond	Yes
Smithville Dam (Possum Hill Road)	State	Recreation	TR-Smithville Ditch	No
Chambers Lake	Local Government	Recreation	Tanyard Branch	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

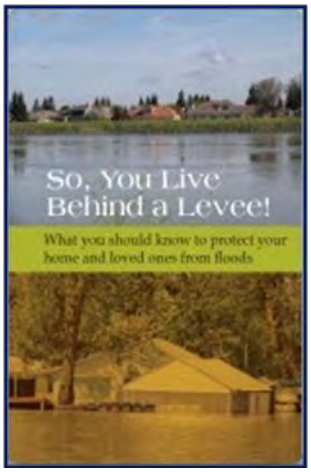
This dam failure caused flooding that damaged several homes and vehicles.

- A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are

erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Acccording to US Army Corps of Engineers, National Levee Database, there are no levees located within Caroline County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly

maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
    - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
    - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
  - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
  - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
  - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of December 2018, one (1) FEMA Designated Repetitive Loss Properties was within Caroline County. This residential property is located in Greensboro. There are no non-residential repetitive loss structures located in Caroline County. There are no Severe Repetitive Loss (SRL) properties within Caroline County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of

mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.

- Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Figure 2.9

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

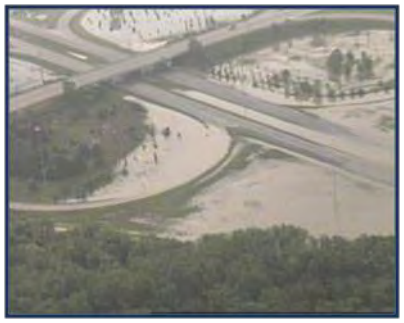
- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.

- Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.10

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2019 Caroline County Hazard Mitigation Plan* provided a listing of repetitive flood locations identified by the Hazard Mitigation Planning Committee. The listing of repetitive flooding issues is within Chapter 4 Riverine Flooding on Table 4.13 of the Plan. A total of 53 repetitive flood locations were identifed in the unincorporated areas of the County and municipalities.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**

- So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
- To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 25.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.

- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems
- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Caroline County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Caroline County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Caroline County, MD & Communities

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Caroline County (Unincorporated Areas)	240130	20,788	317.44	Y	08	Y
Town of Denton	240104	4,418	5.50	Y	N/A	Y
Town of Federalsburg	240013	2,739	1.99	Y	N/A	Y
Town of Greensboro	240014	1,931	1.07	Y	N/A	Y

Note: The Towns of Goldsboro, Henderson, Hillsboro, Marydel, Preston, Ridgely and Templeville are not included in this report since they have no buildings within the 1-percent-annual-chance Special Flood Hazard Areas (SFHAs).

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Caroline County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1 (Riverine) and version 2.2 (Coastal), and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Table 4: Caroline County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Caroline County (Unincorporated Areas)	20,788	113	$3,000,000	$144	16%
Town of Denton	4,418	2	$40,000	$9	< 1%
Town of Federalsburg	2,739	235	$14,900,000	$5,440	81%
Town of Goldsboro	246	0	$0	$0	0%
Town of Greensboro	1,931	36	$560,000	$290	3%
Town of Henderson	146	0	$0	$0	0%
Town of Hillsboro	161	0	$0	$0	0%
Town of Marydel	141	0	$0	$0	0%
Town of Preston	719	0	$0	$0	0%
Town of Ridgely	1,639	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**33,066**	**386**	**$18,500,000**	**$559**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Caroline County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	288	$35,500,000	51%	$4,700,000	13.0%
Commercial Building & Contents	65	$17,200,000	25%	$5,400,000	31.0%
Other Building & Contents	33	$17,000,000	24%	$5,800,000	34.0%
Total Building & Contents[3]	386	$69,700,000	100%	$15,900,000	23.0%
Business Disruption[4]	N/A	N/A	N/A	$2,600,000	N/A
TOTAL[5]	**386**	**$69,700,000**	**100%**	**$18,500,000**	**27.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Caroline County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	31	8%	$7,900,000	$300,000	$10,000	$0	0%
1 - 10%	64	17%	$10,500,000	$200,000	$500,000	$10,000	3%
10 - 20%	138	36%	$16,300,000	$100,000	$2,300,000	$20,000	14%
20 - 30%	68	18%	$11,200,000	$200,000	$2,800,000	$40,000	18%
30 - 40%	40	10%	$9,800,000	$200,000	$3,400,000	$90,000	21%
40 - 50%	28	7%	$6,300,000	$200,000	$2,800,000	$100,000	18%
50% or More	17	4%	$7,600,000	$400,000	$4,100,000	$200,000	26%
TOTAL	**386**	**100%**	**$69,600,000**	**$200,000**	**$15,910,000**	**$40,000**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables onrepresent information within the Caroline County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Caroline County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities impacted by the 1-percent-annual-chance flood event is listed on page 35.

Table 7: Caroline County, Maryland – Essential Facilities Summary for Riverine and Coastal Areas

Type	Estimated Building Value	Total Essential Facilities	1% Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$3,548,000	2	$0	0
Fire Station	$5,394,000	12	$0	0
Hospital	$18,222,000	5	$0	0
Police Station	$2,190,000	5	$52,010	1
School	$66,357,000	13	$0	0
TOTAL	**$95,711,000**	**37**	**$52,010**	**1**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Table 8: Caroline County, Maryland – Building & Content Loss Estimate Summary for the 1%-Annual-Chance Flood (Essential Facilities in Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
Fire Station	$141,170	$52,010	37%	$89,160	63%
TOTAL	**$141,170**	**$52,010**	**N/A**	**$89,160**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Caroline County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Caroline County contains 115 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 2,215 tons of debris will be generated. Of the total amount, Finishes comprises 62% of the total, Structure comprises 17% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 89 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 9: Caroline County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	1,377	62%	55
Structure	366	17%	15
Foundation	472	21%	19
TOTAL	**2,215**	**100%**	**89**

Source: Hazus 3.1: Flood Modual – Caroline County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

- Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 360 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 614 people (out of a total population of 33,066) will seek temporary shelter in public shelters.

Table 10: Caroline County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	360	1,080	614

Source: Hazus 3.1: Flood Modual – Caroline County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Types of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	1	Depth grids, Emergency Management Dept.
High-Risk Areas	4	Depth grids, UDFs, Loss estimates
Repetitive Flood Issues	53	Hazard Mitigation Planning Committee
Repetitive Loss Properties	1	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database, except where noted.

- **At-Risk Essential Facilities:**
  - Results from the 1-percent-annual-chance flood event analysis indicate one (1) essential facility are at-risk, the Federalsburg Police Station. The flood depth for this facility is provided below.
    - Federalsburg Police Station, Federalsburg – 2.0'

  A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Caroline County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Federalsburg	682	25	237	$15,069,805	81%
Area 2	Greensboro / Mill St	557	13	46	$701,869	4%
Area 3	Choptank Wetlands Preserve / Little Creek	175	9	21	$207,357	1%
Area 4	Choptank / Maryland Ave / Main St	73	7	19	$777,206	4%
Total for High-Risk Areas		**1,414**	**47**	**304**	**$15,979,031**	**86%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flooded roadways and issues identified in the *2019 Caroline County Hazard Mitigation Plan Update,* several repetitive flood locations were found to be within high risk areas listed in Table 13 of this report. However, because the spatial extents are not fully defined, repetitive flooded roads are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. One (1) FEMA Designated Repetitive Loss Property was identified in the Town of Greensboro. Due to sensitivity of public disclosure for flood insurance claims, Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

The Flood Risk Maps for Caroline County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Caroline County (Unincorporated Areas) Summary (CID 240130A)

The following pages include Flood Risk data for the Caroline County (Unincorporated Areas).

Overview

The Caroline County (Unincorporated Areas) is located in eastern Maryland and consists of 317.44 square miles. It is bordered by Queen Anne's County to the north and northwest, Talbot County to the west, Dorchester County to the south, and the State of Delaware to the east.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Caroline County (Unincorporated Areas)	240130	23,978	317.44	Y	08	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 105 policies totaling approximately $45,961,500.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Caroline County (Unincorporated Areas) that are located within the Caroline County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Caroline County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood (for both riverine and coastal flood hazards), along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 13. Then, Tables 14 and 15 shows the severity of damage to buildings from flooding for riverine and coastal areas. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Caroline County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	95	$15,600,000	72%	$1,400,000	9.0%
Riverine	*38*	*$5,700,000*	*55%*	*$600,000*	*11.0%*
Coastal	*57*	*$9,900,000*	*88%*	*$800,000*	*8.0%*
Commercial Building & Contents	10	$2,600,000	12%	$800,000	31.0%
Riverine	*7*	*$1,700,000*	*16%*	*$500,000*	*29.0%*
Coastal	*3*	*$900,000*	*8%*	*$300,000*	*33.0%*
Other Building & Contents	8	$3,400,000	16%	$400,000	12.0%
Riverine	*6*	*$3,000,000*	*29%*	*$300,000*	*10.0%*
Coastal	*2*	*$400,000*	*4%*	*$200,000*	*50.0%*
Total Building & Contents[3]	**113**	**$21,600,000**	**100%**	**$2,600,000**	**12.0%**
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	*$200,000*	N/A
Business Disruption[4] *(Coastal)*				*$200,000*	
TOTAL[5]	**113**	**$21,600,000**	**100%**	**$3,000,000**	**14.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

Table 14: Caroline County (Unincorporated Area)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	12	24%	$3,300,000	$300,000	$0	$0	0%
1 - 10%	12	24%	$3,200,000	$300,000	$100,000	$10,000	8%
10 - 20%	10	20%	$1,100,000	$100,000	$200,000	$20,000	16%
20 - 30%	4	8%	$500,000	$100,000	$100,000	$30,000	8%
30 - 40%	7	14%	$1,900,000	$300,000	$700,000	$100,000	56%
40 - 50%	3	6%	$300,000	$100,000	$100,000	$30,000	8%
50% or More	3	6%	$90,000	$30,000	$60,000	$20,000	5%
TOTAL	**51**	**100%**	**$10,390,000**	**$200,000**	**$1,260,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

Table 15: Caroline County (Unincorporated Area)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	15	24%	$3,700,000	$200,000	$0	$0	0%
1 - 10%	13	21%	$2,400,000	$200,000	$100,000	$10,000	8%
10 - 20%	16	26%	$2,600,000	$200,000	$400,000	$30,000	31%
20 - 30%	12	19%	$1,200,000	$100,000	$300,000	$30,000	23%
30 - 40%	4	6%	$1,100,000	$300,000	$400,000	$100,000	31%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	2	3%	$200,000	$100,000	$80,000	$40,000	6%
TOTAL	**62**	**100%**	**$11,200,000**	**$200,000**	**$1,280,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Denton Summary (CID 240104A)

The following pages include Flood Risk data for the Town of Denton.

Overview

The Town of Denton is in central Caroline County. It consists of 5.50 square miles along State Highway 404. The primary flooding sources in the town are Choptank River, Watts Creek, Tributary No. 4 to Choptank River, and Tributary No. 7 to Choptank River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Denton	240104	4,418	5.50	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 4 policies totaling approximately $1,330,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Denton that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Denton flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Denton, so only riverine flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: Town of Denton – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1	$300,000	100%	$40,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$0	0%	$0	0.0%
Total Building & Contents[3]	2	$300,000	100%	$40,000	13.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**2**	**$300,000**	**100%**	**$40,000**	**13.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: Town of Denton – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	0	0%	$0	$0	$0	$0	0%
10 - 20%	1	50%	$300,000	$300,000	$40,000	$40,000	100%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	1	50%	<$5,000	$0	<$5,000	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**2**	**100%**	**$300,000**	**$200,000**	**$40,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Denton.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Federalsburg Summary (CID 240013)

The following pages include Flood Risk data for the Town of Federalsburg.

Overview

The Town of Federalsburg is in southern Caroline County, with small portions of the town in Dorchester County. It consists of 1.99 square miles along State Highway 318. The primary flooding sources in the town are Marshy Hope Creek, Tanyard Branch, Tributary No. 1 to Marshy Hope Creek, and Miles Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Federalsburg	240013	2,739	1.99	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 55 policies totaling approximately $10,031,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Federalsburg that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Federalsburg flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Federalsburg, and no UDFs are present in the portions of Federalsburg in Dorchester County, so only riverine flood loss estimates within Caroline County are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Federalsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	161	$15,700,000	36%	$2,800,000	18.0%
Commercial Building & Contents	55	$14,600,000	34%	$4,600,000	32.0%
Other Building & Contents	19	$12,900,000	30%	$5,300,000	41.0%
Total Building & Contents[3]	235	$43,200,000	100%	$12,700,000	29.0%
Business Disruption[4]	N/A	N/A	N/A	$2,200,000	N/A
TOTAL[5]	**235**	**$43,200,000**	**100%**	**$14,900,000**	**34.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Federalsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	0%	$100,000	$100,000	$0	$0	0%
1 - 10%	30	13%	$3,500,000	$100,000	$200,000	$10,000	2%
10 - 20%	98	42%	$10,800,000	$100,000	$1,600,000	$20,000	12%
20 - 30%	49	21%	$9,300,000	$200,000	$2,300,000	$50,000	18%
30 - 40%	25	11%	$6,600,000	$300,000	$2,200,000	$90,000	17%
40 - 50%	21	9%	$5,700,000	$300,000	$2,600,000	$100,000	20%
50% or More	11	5%	$7,400,000	$700,000	$4,000,000	$400,000	31%
TOTAL	**235**	**100%**	**$43,400,000**	**$200,000**	**$12,900,000**	**$50,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Federalsburg.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Greensboro Summary (CID 240014A)

The following pages include Flood Risk data for the Town of Greensboro.

Overview

The Town of Greensboro is in northern Caroline County. It consists of 1.07 square miles along State Highway 480. The primary flooding sources in the town are Choptank River and Forge Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Greensboro	240014	1,931	1.07	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 21 policies totaling approximately $4,252,200.00
- NFIP-recognized repetitive loss properties = 1 Single Family Home
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Greensboro that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Greensboro flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Greensboro, so only riverine flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20. Additionally, Table 21 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: Town of Greensboro – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	31	$3,800,000	84%	$500,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	5	$700,000	16%	$50,000	7.0%
Total Building & Contents[3]	36	$4,500,000	100%	$550,000	12.0%
Business Disruption[4]	N/A	N/A	N/A	$10,000	N/A
TOTAL[5]	**36**	**$4,500,000**	**100%**	**$560,000**	**12.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21: Town of Greensboro – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	3	8%	$800,000	$300,000	$0	$0	0%
1 - 10%	9	25%	$1,500,000	$200,000	$80,000	$10,000	16%
10 - 20%	13	36%	$1,500,000	$100,000	$200,000	$20,000	40%
20 - 30%	3	8%	$200,000	$70,000	$70,000	$20,000	14%
30 - 40%	3	8%	$200,000	$70,000	$50,000	$20,000	10%
40 - 50%	4	11%	$200,000	$50,000	$100,000	$30,000	20%
50% or More	1	3%	$0	$0	$0	$0	0%
TOTAL	**36**	**100%**	**$4,400,000**	**$100,000**	**$500,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Greensboro.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 22 below identifies possible mitigation actions for each AoMI to consider.

Table 22: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***

AoMI	Possible Actions to Reduce Flood Risk
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?

- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

Your local Hazard Mitigation Plan is a valuable place to identify and prioritize possible mitigation actions. The plan includes a mitigation strategy with mitigation actions that were developed through a public and open process. You can then add to or modify those actions based on what is learned during the course of the Risk MAP project and the information provided within this FRR.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 23 below.

Table 23: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.
FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Room 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Caroline County Department of Emergency Services
9391 Double Hills Road Denton, MD 21629
https://www.carolinemd.org/181/Emergency-Services

Caroline County Department of Planning and Codes
403 South 7th Street, Suite 210, Denton, MD 21629
https://www.carolinemd.org/138/Planning-Codes

Caroline County Department of Public Works
520 Wilmuth Street, Denton, MD 21629
https://www.carolinemd.org/139/Public-Works

Caroline County Department of Planning and Codes –GIS & Programming
403 South 7th Street, Suite 210, Denton, MD 21629
https://www.dorchestercountymd.com/planning-zoning/maps-gis-data/

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Source: https://www. Myeasternshoremd.com

STATE OF MARYLAND

FLOOD RISK REPORT

CAROLINE COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

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List of Flood Risk Maps

Caroline County, Maryland – Countywide Flood Risk Map (FRM)

Caroline County, Maryland – High Risk Area 1: Federalsburg – Dollar Losses

Caroline County, Maryland – High Risk Area 1: Federalsburg – Percent Losses

Caroline County, Maryland – High Risk Area 2: Greensboro / Mill St – Dollar Losses

Caroline County, Maryland – High Risk Area 2: Greensboro / Mill St – Percent Losses

Caroline County, Maryland – High Risk Area 3: Choptank Wetlands Preserve / Little Creek – Dollar Losses

Caroline County, Maryland – High Risk Area 3: Choptank Wetlands Preserve / Little Creek – Percent Losses

Caroline County, Maryland – High Risk Area 4: Choptank / Maryland Ave / Main St – Dollar Losses

Caroline County, Maryland – High Risk Area 4: Choptank / Maryland Ave / Main St – Percent Losses

Caroline County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Caroline County, Maryland

Town of Templeville
Town of Marydel
Town of Henderson
Town of Goldsboro
Town of Greensboro
Area 2
Town of Ridgely
Town of Hillsboro
Town of Denton
Eastern Bay
Area 3
Town of Preston
Area 4
Town of Federalsburg
Area 1

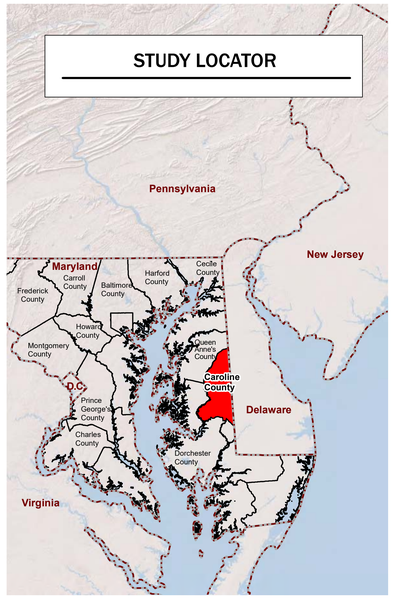
0 0.75 1.5 3
Miles

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	*Federalsburg*	*682*	*25*	*237*	*$15,069,805*	*81%*
Area 2	*Greensboro / Mill St*	*557*	*13*	*46*	*$701,869*	*4%*
Area 3	*Choptank Wetlands Preserve / Little Creek*	*175*	*9*	*21*	*$207,357*	*1%*
Area 4	*Choptank / Maryland Ave / Main St*	*73*	*7*	*19*	*$777,206*	*4%*
Total for High-Risk Areas		**1,414**	**47**	**304**	**$15,979,031**	**86%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Caroline County (Unincorporated Areas)	20,788	113	$3,000,000	$144	16%
Town of Denton	4,418	2	$40,000	$9	< 1%
Town of Federalsburg	2,739	235	$14,900,000	$5,440	81%
Town of Goldsboro	246	0	$0	$0	0%
Town of Greensboro	1,931	36	$560,000	$290	3%
Town of Henderson	146	0	$0	$0	0%
Town of Hillsboro	161	0	$0	$0	0%
Town of Marydel	141	0	$0	$0	0%
Town of Preston	719	0	$0	$0	0%
Town of Ridgely	1,639	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**33,066**	**386**	**$18,500,000**	**$47,927**	**100%**



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Essential Facility

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

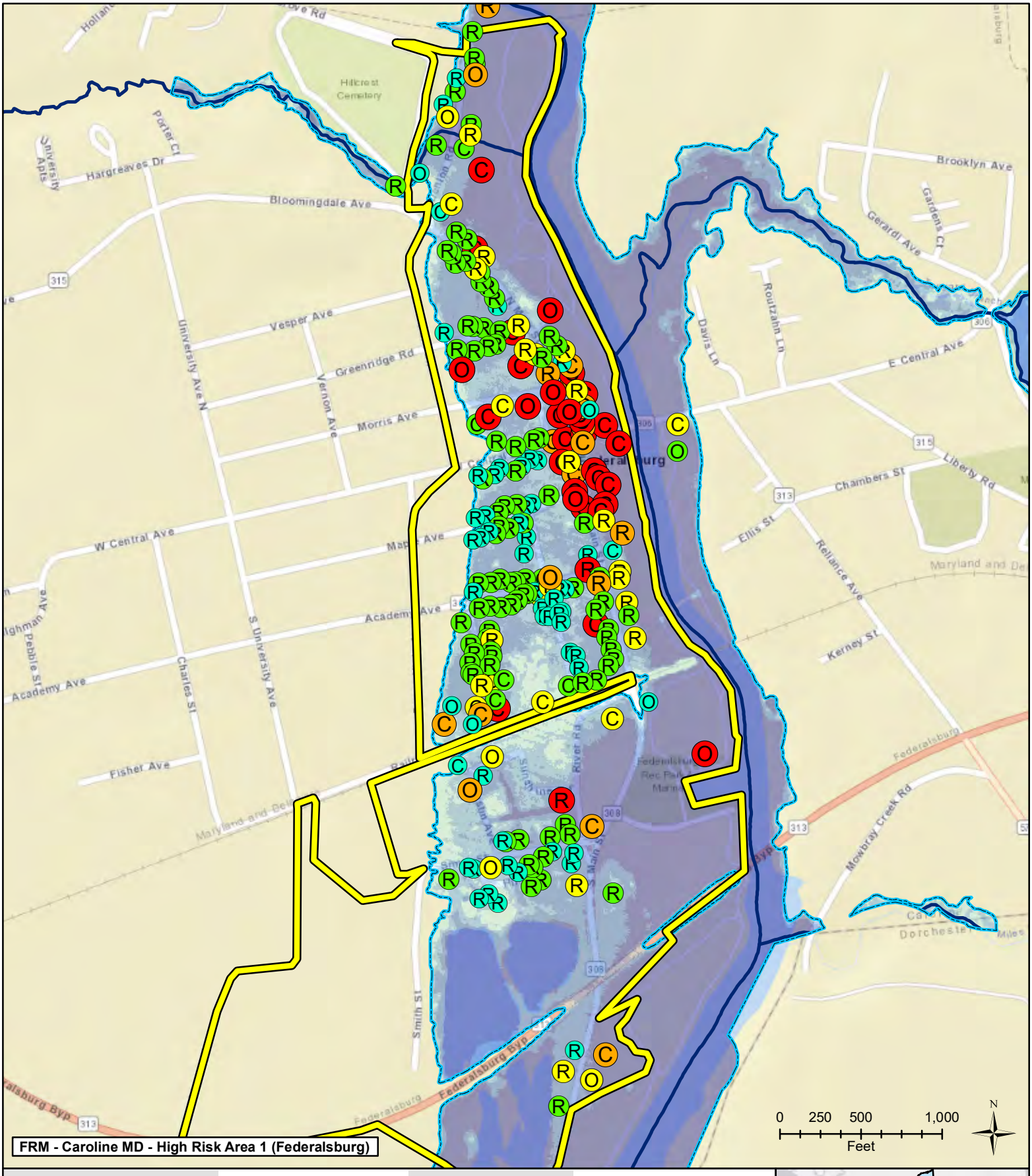
Caroline County and Incorporated Areas, MD

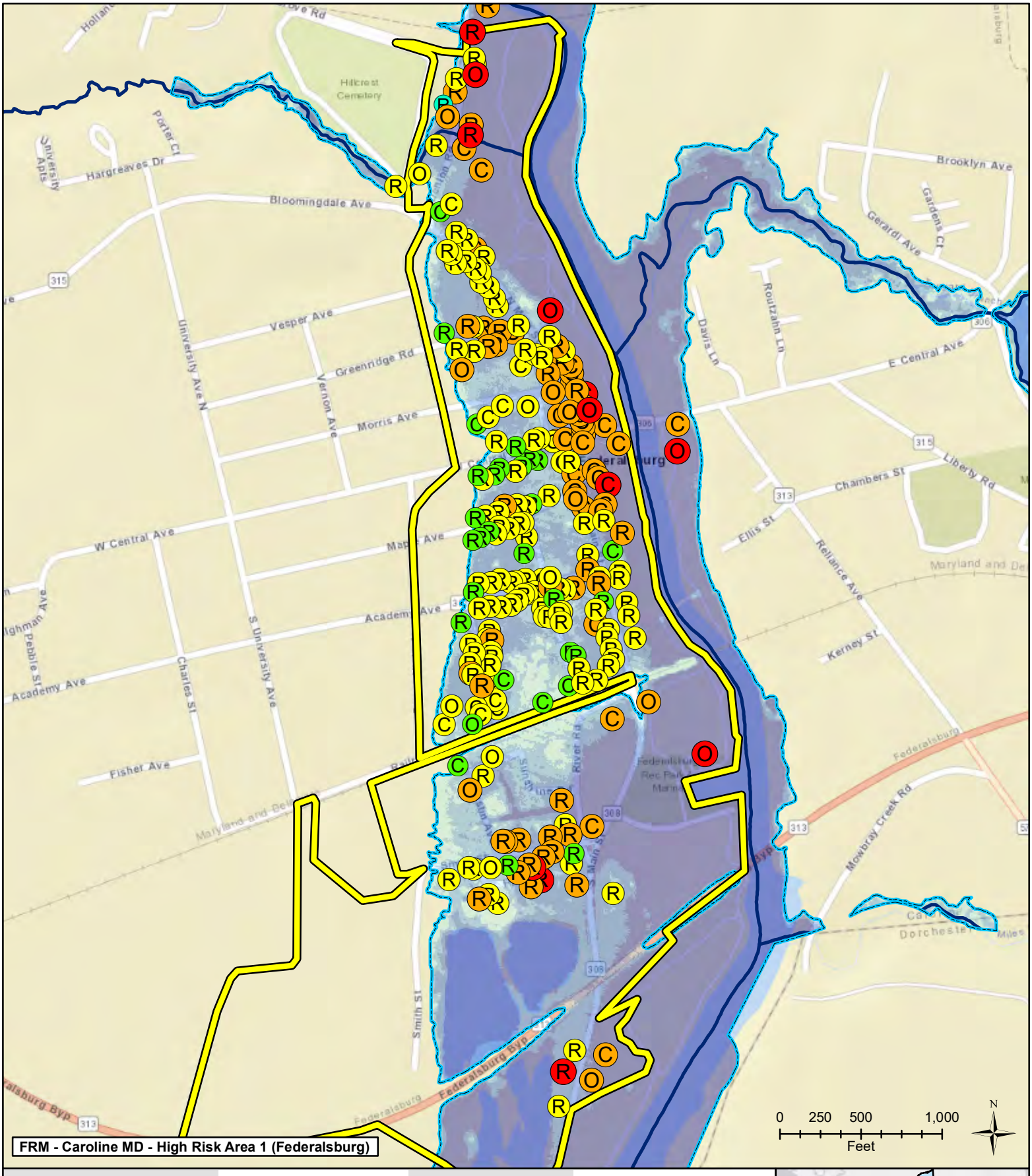
MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Caroline County, MD.

RELEASE DATE
12/31/2019


Hillcrest Cemetery
Hargreaves Dr
Porter Ct
University Apts
Bloomingdale Ave
Vesper Ave
Greenridge Rd
Morris Ave
University Ave N
Vernon Ave
W Central Ave
Academy Ave
S University Ave
Charles St
Fisher Ave
Pebble St
Maryland and Delaware
Brooklyn Ave
Gerardi Ave
Gardens Ct
Davis Ln
Routzahn Ln
E Central Ave
Chambers St
Liberty Rd
Ellis St
Reliance Ave
Kerney St
Federalsburg
Mowbray Creek Rd
Federalsburg Byp
Smith St
S Main St
River Rd
Dorchester
Miles
313
315
306
308
0 250 500 1,000
Feet
N
FRM - Caroline MD - High Risk Area 1 (Federalsburg)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
DELAWARE
Caroline County
Map Extent


Hillcrest Cemetery
Hargreaves Dr
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W Central Ave
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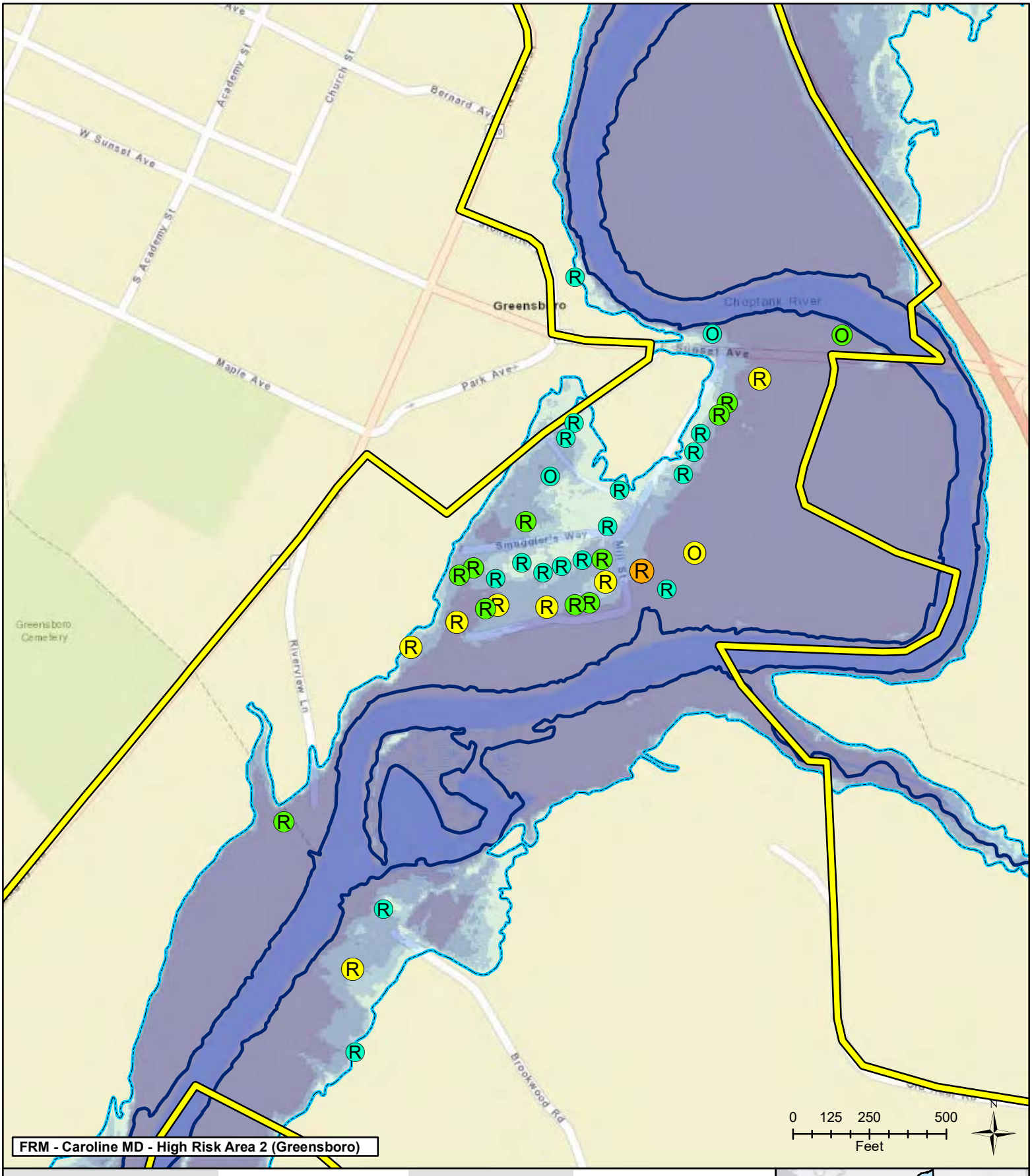
Main St
River Rd
Dorchester
Miles
315
313
308
306
FRM - Caroline MD - High Risk Area 1 (Federalsburg)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Caroline County
Map Extent



FRM - Caroline MD - High Risk Area 2 (Greensboro)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

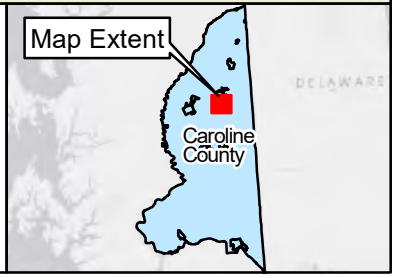
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

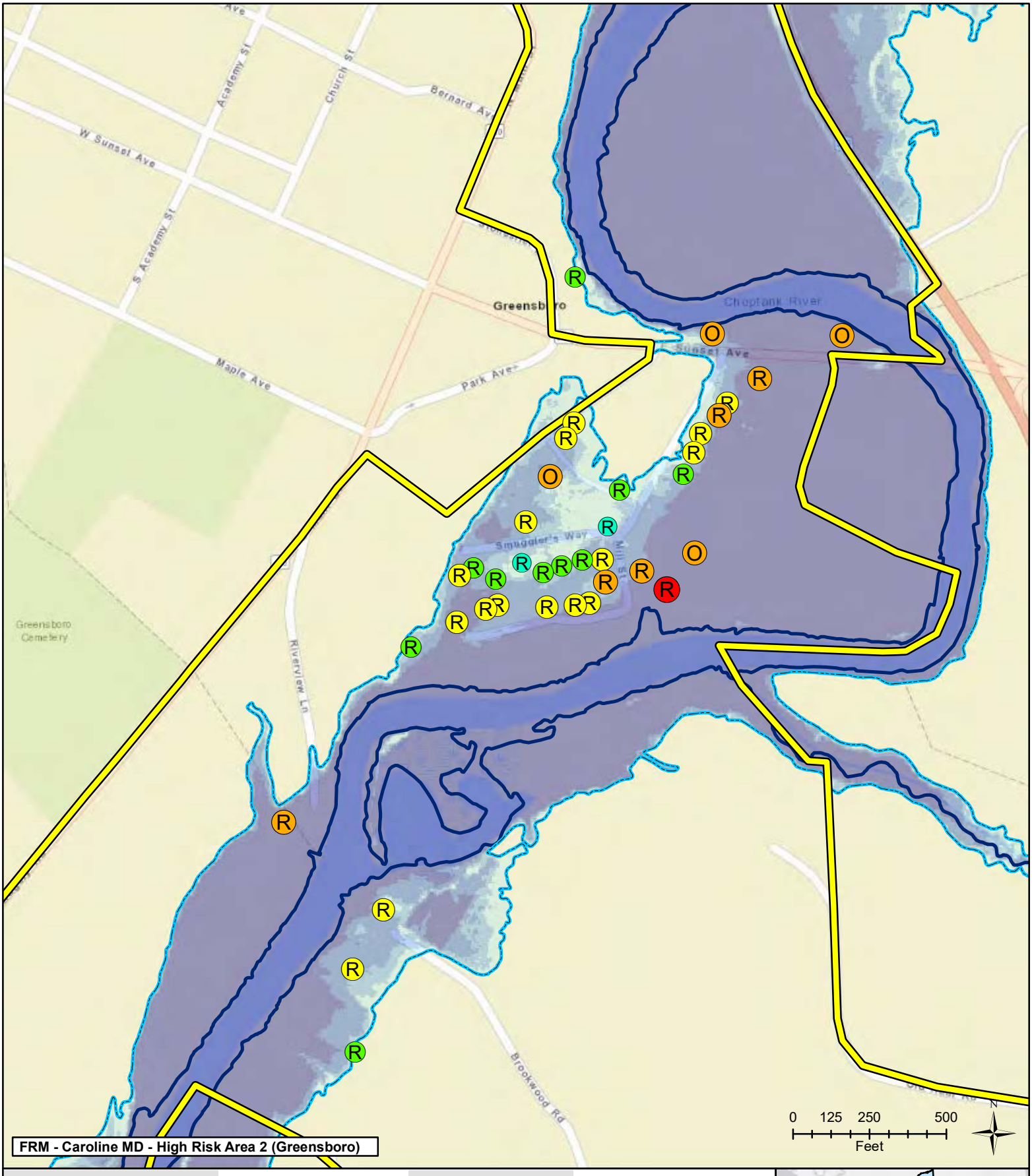
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

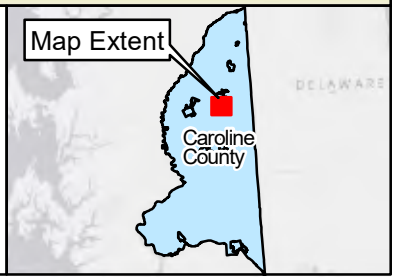
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

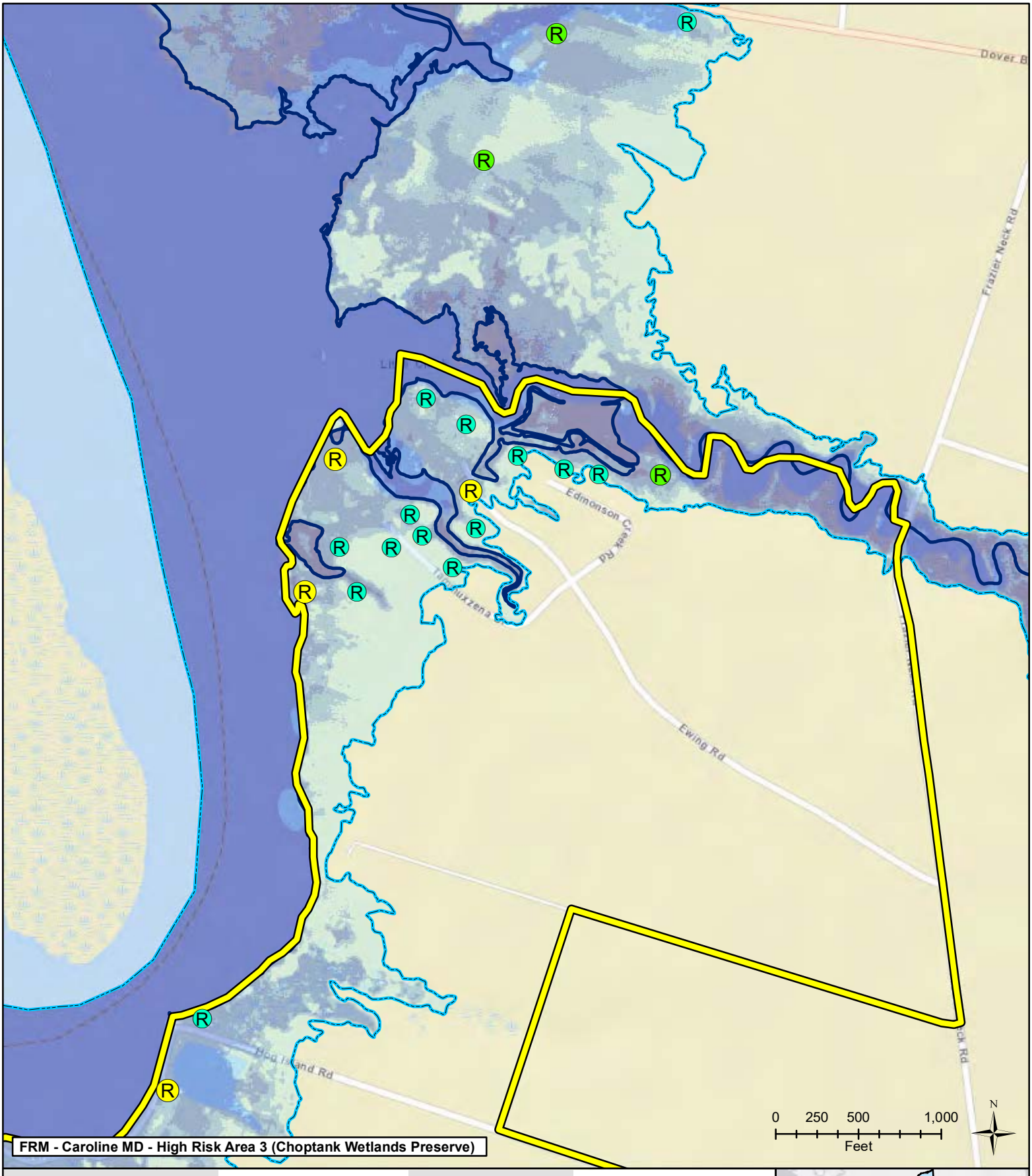
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

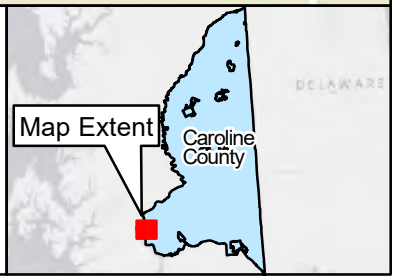
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

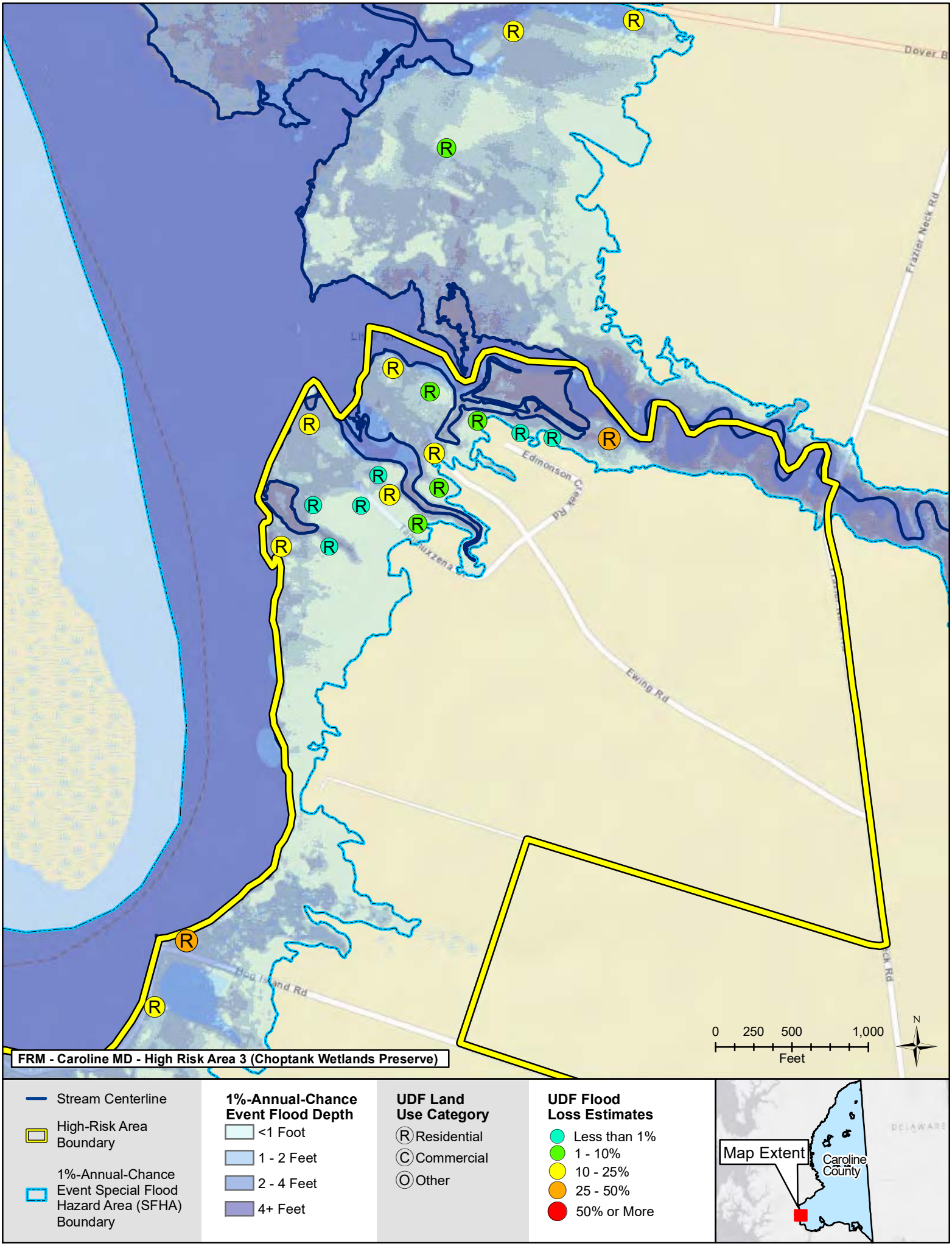
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Dover B
Frazier Neck Rd
Edmonson Creek Rd
Ewing Rd
Hog Island Rd
FRM - Caroline MD - High Risk Area 3 (Choptank Wetlands Preserve)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Caroline County

Choptank Rd
Choptank Main St
Myrtle Ave
0
250
500
1,000
Feet
N
FRM - Caroline MD - High Risk Area 4 (Choptank)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Caroline County
DELAWARE

Choptank Rd
Choptank Main St
Myrtle Ave
0
250
500
1,000
Feet
N
FRM - Caroline MD - High Risk Area 4 (Choptank)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
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UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
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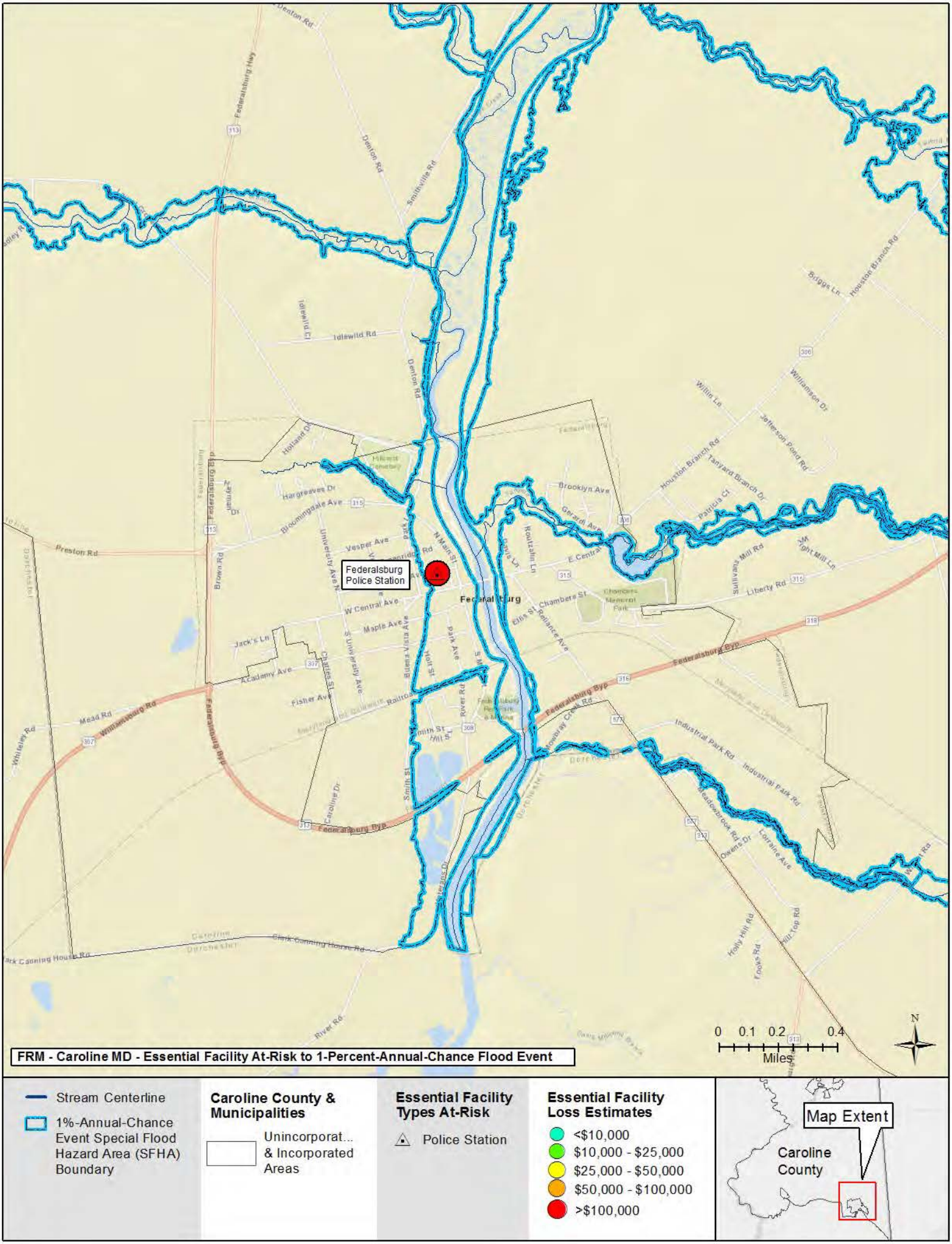
Map Extent
Caroline County
DELAWARE


Federalsburg Police Station
Federalsburg
Denton Rd
Federalsburg Hwy
Idlewild Rd
Preston Rd
Brown Rd
Hargreaves Dr
Bloomingdale Ave
Vesper Ave
N Main St
W Central Ave
Maple Ave
Jack's Ln
Academy Ave
Fisher Ave
Mead Rd
Whiteley Rd
Williamsburg Rd
Federalsburg Byp
Caroline Dr
Smith St
Hill St
Park Ave
River Rd
Buena Vista Ave
University Ave
Charles St
Brooklyn Ave
Houston Branch Rd
Briggs Ln
Williamson Dr
Jefferson Point Rd
Tanyard Branch Dr
Patricia Ct
Gerard Ave
Routzahn Ln
E Central
Elks St
Chambers St
Reliance Ave
Chambers Memorial Park
Sullivans Mill Rd
Tight Mill Ln
Liberty Rd
Industrial Park Rd
Meadowbrook Rd
Owens Dr
Lorraine Ave
Holly Hill Rd
Hill Top Rd
Crowbray Creek Rd
Clark Canning House Rd
River Rd
0 0.1 0.2 0.4
Miles
N
FRM - Caroline MD - Essential Facility At-Risk to 1-Percent-Annual-Chance Flood Event
Stream Centerline
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
Caroline County & Municipalities
Unincorporat... & Incorporated Areas
Essential Facility Types At-Risk
Police Station
Essential Facility Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Caroline County

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