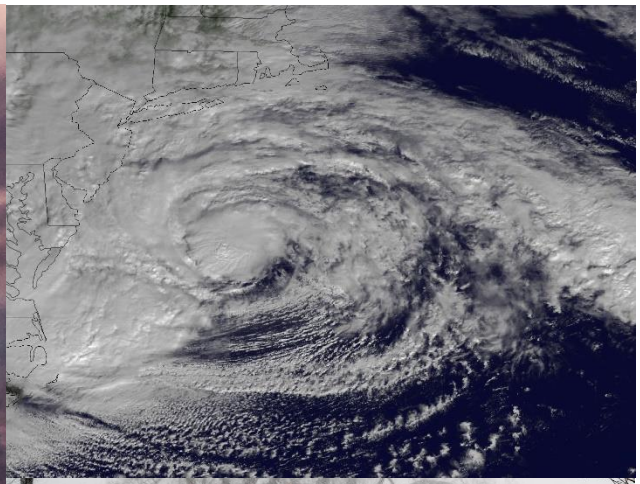

Calvert County Maryland

All-Hazard Mitigation Plan

June 1, 2017

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All-Hazard Mitigation Plan

Calvert County, Maryland

June 12, 2017

Prepared For:

Calvert County Department of Public Safety
Division of Emergency Management
175 Main Street
Prince Frederick, MD 20678

Acknowledgements:

This All-Hazard Mitigation Plan was prepared under the guidance of the County's Department of Public Safety and the Division of Emergency Management with the participation of the Hazard Mitigation Steering Committee. Members of the Steering Committee are listed in Chapter 1.

This plan was funded by a grant from the FEMA Pre-Disaster Mitigation Grant.

This plan is an update of the original 2010 Hazard Mitigation Plan. As such, certain sections of the plan, such as the county background and geography, have been retained for continuity.

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CHAPTER 1: INTRODUCTION

Introduction

This Chapter provides a general introduction to the 2017 Calvert County Hazard Mitigation Plan Update and is comprised of the following sections: Background, Mission, Purpose, Scope, Authority, and Organization.

Background

Hazard Mitigation is defined by the Federal Emergency Management Agency (FEMA) as "sustained action taken to reduce or eliminate long-term risk to people and property from hazards and their effects". The hazard mitigation planning process involves the formulation of actions to reduce injuries, deaths, property damage, economic losses, and degradation of natural resources caused by natural and man-made disasters as well as a community's risk. Hazard mitigation is considered one of four phases in the emergency management cycle. The other phases, emergency preparedness, emergency response, and recovery and are defined below.

- Hazard mitigation activities involve actions that reduce or eliminate the probability of an occurrence or reduce the impact of a disaster. The goal of the mitigation phase is to make communities more resistant to disasters and thereby decrease the need for a response. Mitigation occurs long before a disaster.
- Preparedness activities include planning and preparing for when a disaster strikes and includes response capability actions to ensure an effective and efficient use of resources and efforts to minimize damage. Preparedness occurs just before a disaster.
- Emergency response activities include providing emergency assistance to victims and minimizing property loss. The response phase begins during or immediately after the onset of

a disaster.

- Recovery activities include short and long-term activities that help return individuals and communities to normalcy as soon as possible. Recovery actions involve clean-up efforts, temporary housing, and replacement of infrastructure. Recovery activities typically commence several days or weeks after a disaster and are long-term in nature.

Mission

The Calvert County Hazard Mitigation Plan Steering Committee, through the 2017 Hazard Mitigation Plan Update, seeks to develop practical planning solutions for the variety of hazards that pose a risk to Calvert County, its two municipalities, Chesapeake Beach and North Beach, as well as the seven towns identified in the County Comprehensive Plan;

- Dunkirk
- Owings
- Huntingtown
- Prince Frederick
- St. Leonard
- Lusby
- Solomons

This all-hazards approach is a comprehensive and proactive planning process. It establishes a more efficient mobilization of resources that will ensure effective mitigation measures to protect life, property, and the environment in Calvert County.

Purpose

The Calvert County Hazard Mitigation Plan was developed in accordance with the requirements of FEMA's Section 322 of the Disaster Mitigation Act of 2000. An essential aspect of comprehensive disaster mitigation planning is a thorough understanding of potential hazards, vulnerabilities, and risks. The purpose of the hazard vulnerability analysis is to determine; the extent to which natural hazards threaten Calvert County; areas of the community that are at greatest risk; the significance of the threats; any facilities that occupy at-risk areas; and the effects hazards can have on critical facilities. This Plan Update seeks to reduce the County's human, social, environmental and economic loss from future disasters. In addition to the Mitigation Plan Update, the County has also chosen to develop a county-wide THIRA (Threat Hazard Identification and Risk Assessment) which was conducted concurrently with the Plan Update process.

Scope

In October of 2016, the Calvert County Department of Public Safety, Emergency Management Division contracted with the Vision Planning and Consulting Team (comprised of Vision Planning and Consulting (VPC) from Fulton, Maryland, and the Eastern Shore Regional GIS Cooperative (ESRGC) from Salisbury, Maryland), to develop the Plan Update in compliance with the requirements of the Disaster Mitigation Act of 2000. The Hazard Mitigation Plan Update was funded by Hazard Mitigation Assistance (HMA) funds from the Federal Emergency Management Agency (FEMA) and administered by the Maryland Emergency Management Agency (MEMA). The Plan Update is a multi-jurisdictional all-hazards plan that covers Calvert County, its two municipalities and seven designated towns.

It must be noted that future funding for mitigation projects will be contingent upon having each individual jurisdiction within Calvert County adopt the Plan after the County has adopted the Plan. Any jurisdiction that does not adopt the 2016 Plan Update will become ineligible for pre- and post-disaster mitigation funds.

Authority and Reference

Authority for this Plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended

Authority for this Plan originates from the following Maryland sources:

- Maryland State Hazard Mitigation Plan Update

The following Federal Emergency Management Agency (FEMA) guides and reference documents were used to prepare this document:

- FEMA. Local Mitigation Planning Tool and Guide. March 2012
- FEMA. Local Mitigation Planning Handbook. March 2013.

Organization of the Plan

The 2016 Hazard Mitigation Plan Update comprises seven chapters. Chapter 1 contains an introduction to the Plan Update process. Chapter 2 includes an overview of the geographic, socio-economic and demographic characteristics of the county. Chapter 3 discusses the planning process. Chapter 4 comprises the hazard identification and risk assessment and examines vulnerability and the potential losses from the top priority hazards. Chapter 5 includes a historic profile of hazard types and associated losses as well as a vulnerability assessment, which analyzes the potential for future damages due to the hazards identified. Chapter 6 contains a capability assessment, including a review of existing plans and ordinances from the counties and municipalities. Chapter 7 discusses the mitigation strategy including updated mitigation goals and objectives, mitigation actions, and the method for prioritization and implementation of mitigation actions. Chapter 8 outlines how Calvert County and its municipalities will implement the Plan once it is adopted and ways to monitor its progress and ensure continued public involvement. The final chapter (Chapter 8) also includes the prerequisites of the Plan, including letters of adoption by the County Commission and the individual municipalities.

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CHAPTER 2: COMMUNITY PROFILE

Introduction

This Chapter is composed of the profile of Calvert County and its municipalities. Information on the County's geographic layout, climate, demographic makeup, and employment and industry profile are included below. The data used to develop the demographic, and housing profiles comes directly from the US Census Bureau's 2015 estimates.

Geography and Environment

Calvert County is located in southern Maryland approximately 30 miles southeast of Washington DC. The County is a peninsula and is bordered by the Chesapeake Bay in the south and east while the western shore is bounded by the Patuxent River. The two incorporated towns in the County are both located along the Chesapeake Bay; Chesapeake Beach, incorporated in 1886, and North Beach, incorporated in 1910. There are seven designated "town centers" within the county, including Prince Frederick, the county seat. Others include Dunkirk, Huntington, Lusby, Owings, St. Leonard, and Solomon's Island. According to the U.S. Census Bureau, the 2015 population estimate of Calvert County was 90,595[1], and the total number of households around 31,041.

[1] https://www.census.gov/quickfacts/table/PST045215/24009,00

Figure 2.1 Regional Context of Study Area

Physical Features

The topography in Calvert County is varied. There is an upland plain running the length of the County from the northwest to the southwest. The land is more rugged on the east side of the plain, ending in sharp cliffs, reaching heights of over 120 feet in places along the coast[2] of the Chesapeake Bay, which are mostly composed of clay, sand, and gravel, while the west side is marked by gradual down sloping land leading out towards the Patuxent River that provides excellent land for farming. This plain also divides the watersheds into The Lower Western Shore and the Patuxent River watersheds. The elevation ranges between 10 and 40 feet throughout the County.

Watersheds

Calvert County crosses two of the State's primary watersheds; the Lower Western Shore Watershed and the Patuxent Watershed. These two are separated along the central elevation line through the county with the Lower Western Shore on the east side of the county, draining into the Chesapeake Bay, and the Patuxent Watershed on the west, which drains into the Patuxent River.

Climate

Calvert County has a generally mild climate with four distinct seasons, low humidity, and mild temperatures. The average summer temperature is 74.4 degrees and there is an average of 200 freeze-free days a year. On average, 43.1 inches of precipitation fall annually. Snowfall averages 19.4 inches annually.[3]

[2] http://calvertgis.co.cal.md.us/toposeries/calvert_topo_page_868.pdf
[3] http://www.co.cal.md.us/index.aspx?nid=825

Population and Demographics

According to the US Census Bureau's 2015 estimates, the population of Calvert County is around 90,595 residents. The demographic breakdown from those 2015 estimates is as follows; Persons under 5 years old, 5.4%; Persons under 18 years old, 23.7%; Persons 65 or older, 13.5%. The census bureau also suggests that as many as 7% of the population under 65 years of age may experience some sort of disability.

The population per square mile according to the 2010 census is 416.3 person per square mile, with Calvert County being composed of 213.15 square miles.

There are approximately 31,041 households in the county (2010-2014) with an average of 2.87 persons per household. Additionally, it is estimated that over 81% of the housing units in the county are owner occupied[4].

Table 2.1: Population Projections

	2020 Projected	2025 Projected	2030 Projected	2035 Projected	2040 Projected
USA	334,503,000	347,335,000	359,402,000	370,338,000	380,219,000
State of Maryland	6,244,510	6,429,750	6,612,190	6,762,300	6,889,690
Calvert County	95,600	98,350	100,200	101,050	101,450
Female	48,800	50,380	51,480	52,060	52,350
Male	46,800	47,980	48,720	48,990	49,110
Aged 65+	15,480	19,210	23,110	25,070	24,870
Total Households	34,325	36,125	37,350	37,950	38,125

Source: U.S. Bureau of the Census; Maryland Department of Planning[5]

Employment and Industry Profile

Economy

According to the 2010 Census, it is estimated that around 92.5% of Calvert residents aged 25 or older have a High school diploma or higher, and that 29.3% of persons age 25 years and over have a Bachelor's degree or higher.

Calvert County's industry is as varied as its landscape. In addition to the traditional farming industry, which dates back to the early 1800's, there is also a large recreational and tourism component to the county which is represented by such businesses as waterfront restaurants, charter boat services, marinas, resorts, waterparks, and boardwalks. Additional major industries and employers are listed in Table 2.

Table 2.2: Calvert County Major Employers

Major Employers	Approximate Number of Employees
Calvert County Public Schools	2,133
Calvert County Government	1,226

[4] https://www.census.gov/quickfacts/table/PST045215/24009,00
[5] http://www.mdp.state.md.us/msdc/s3_projection.shtml

Major Employers	Approximate Number of Employees
Calvert Memorial Hospital	1,200
Exelon / Calvert Cliffs Nuclear Power Plant	850
Arc of Southern Maryland	360
Asbury Solomons	250
Chesapeake Beach Resort & Spa	220
DirectMail.com	200
Safeway Prince Frederick	200
Calvert County Nursing Center	179
Dominion Cove Point LNG	175
Walmart Dunkirk	170
Walmart Prince Frederick	170
The Calverton School	162
The Gott Company, Inc.	155
Solomons Nursing Center	154
Edward B. Howlin, Inc.	150
Recorded Books, LLC.	140
Safeway Dunkirk	140
Giant Food Dunkirk	130
Fantasy World Entertainment	125
URS	125
Calvert Internal Medicine Group	108
Giant Food Prince Frederick	120
College of Southern Maryland	117
Chesapeake Biological Laboratory	116
Giant Food Lusby	110

http://www.ecalvert.com/180/Major-Employers

Income and Poverty

The median income for a household in the county is estimated to be $95,828 (in 2015 dollars) with a per capita income of $39,011, greater than the state median household income of $74,511 and per capita income of $36,897, and greater than the national median household income of $53,889 and per capita income of $28,930. In addition, only 5.8% of the county population is living in poverty while 9.7% of the state population, and 12.7% of the national population, is living in poverty[6]. According to the Maryland Department of Commerce, there are approximately 1,826

[6] https://www.census.gov/quickfacts/table/PST045215/24009,00

people in the county unemployed, equaling a 3.8% unemployment rate, which is equal to the state unemployment rate, but less than the national unemployment rate of 4.1%[7].

Transportation

Calvert County is accessible across multiple major transportation networks, including highways and waterways. I-95, US 301, Maryland Routes 2, 4, and 5, and Route 235 make up the web of major highways crossing the county. Maryland Route 2 connects to US 50/301in the north, and Maryland Route 4 connects to US 301 in the south, and the Capital Beltway (I-495). The Thomas Johnson Bridge, which crosses over the Patuxent River, connects Maryland Routes 2 and 4 in the southern part of Calvert County to Maryland Routes 5 and 235 in neighboring St. Mary's County.

The Port of Baltimore is nearby and facilitates major imports and exports for the region. Calvert County is accessible by water with a 50-foot channel through the Chesapeake Bay.

Utilities

Power for the county is provided by Southern Maryland Electric Cooperative, Inc. (SMECO), Baltimore Gas and Electric (BG&E) and Washington Gas.

The majority of county residents are served by private water systems, individual wells and traditional septic systems. Public water and sewerage service is provided to pocket communities and town centers. The county's wastewater system is comprised of five wastewater treatment plants, 45 wastewater pump stations, 32 miles of sewer force main and 34 miles of gravity sewer. The water system is comprised of 19 municipal water systems, 77 miles of water main, 7 hydropneumatic tanks and 14 elevated storage tanks.

The Calvert Cliffs Nuclear Power Plant is run by Exelon Corporation and is located near Lusby, along the eastern side of the county, directly on the shore of the Chesapeake Bay.

The Cove Point Liquefied Natural Gas (LNG) plant is run by Dominion energy and is located near Lusby on the eastern side of the county, directly on the shore of the Chesapeake Bay.

Verizon Communications is the county's primary telecommunications carrier. Additionally, long-distance telecommunications services are also provided by AT&T, Comcast, MCI WorldCom, Sprint, and over 250 additional carriers and resellers of Wide Area Telephone Service (WATS) and cellular phone service. Additional communications utilities such as cable internet, ISDN switching, and fiber optics utilities are also offered to residents in the county.

Residential Construction

According to the 2015 Census estimates, there are around 34,766 housing units in Calvert County. Of these, 29,943 are listed as single detached housing units, 351 are listed as mobile home, and 840 are identified as structures with more than 20 units per building[8].

[7] http://commerce.maryland.gov/about/rankings-and-statistics/data-explorer
[8] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Educational/Institutional

Calvert County is home to thirteen elementary schools, six middle schools, and four high schools.

Elementary Schools

Appeal Elementary School 11655 H.G. Trueman Rd. Lusby, MD 20657	Mutual Elementary School 1455 Ball Rd. Port Republic, MD 20676
Barstow Elementary School 295 JW Williams Rd. Prince Frederick, MD 20678	Patuxent Elementary School 35 Appeal Ln. Lusby, MD 20657
Beach Elementary School 7900 Old Bayside Rd. Chesapeake Beach, MD 20732	Plum Point Elementary School 1245 Plum Point Rd. Huntingtown, MD 20639
Calvert Elementary School 1450 Dares Beach Road Prince Frederick, MD 20678	St. Leonard Elementary School 5370 St. Leonard Rd. St. Leonard, MD 20685
Dowell Elementary School 12680 H.G. Trueman Rd. Lusby, MD 20657	Sunderland Elementary School 150 Clyde Jones Road Sunderland, MD 20689
Huntingtown Elementary School 4345 Huntingtown Road Huntingtown, MD 20639	Windy Hill Elementary School 9550 Boyd's Turn Rd. Owings, MD 20736
Mt. Harmony Elementary School 900 West Mt. Harmony Rd. Owings, MD 20736	

Middle Schools

Calvert Middle School 655 Chesapeake Blvd. Prince Frederick, MD 20678	Plum Point Middle School 1475 Plum Point Rd. Huntingtown, MD 20639
Mill Creek Middle School 601 Margaret Taylor Rd. Lusby, MD 20657	Southern Middle School 9615 H.G. Trueman Rd. Lusby, MD 20657
Northern Middle School 2954 Chaneyville Road Owings, MD 20736	Windy Hill Middle School 9560 Boyd's Turn Road Owings, MD 20736

High Schools

Calvert High School 520 Fox Run Blvd. Prince Frederick, MD 20678	Northern High School 2950 Chaneyville Rd. Owings, MD 20736
Huntingtown High School 4125 Solomons Island Rd. Huntingtown, MD 20639	Patuxent High School 12485 Southern Connector Blvd. Lusby, MD 20657

Other Facilities

Arthur Storer Planetarium 600 Dares Beach Rd. Prince Frederick, MD 20678	Calvert Country School 1350 Dares Beach Rd. Prince Frederick, MD 20678
Career & Technology Academy 330 Dorsey Rd. Prince Frederick, MD 20678	Hunting Creek Annex 4105 Old Town Rd. Huntingtown, MD 20639

In addition to the County Schools, Calvert is home to two Institutions of higher education. The College of Southern Maryland has a campus in Prince Frederick and the University of Maryland Center for Environmental Science has their Chesapeake Biological Laboratory in Solomons Island. Both of these institutions maintain their own Emergency Operations Plans and Disaster Management Plans respectively.

Calvert County is also home to Calvert Memorial Hospital, a full-service institution including emergency care, birthing center, behavioral health center, cardiac, and surgical centers in addition to several other services.

Development Trends

The Maryland Department of Planning estimates that the Calvert County population will grow at an average rate of .85% percent per year between 2015 and 2030 with an estimated population in 2030 of 100,200.

In Calvert County, the Town Centers are the homes of concentrated development. The Town Centers are: the incorporated Towns of North Beach and Chesapeake Beach, Owings, Dunkirk, Huntingtown, Prince Frederick, St. Leonard, Lusby, and Solomons Island. To continue to promote this development pattern, the county has developed Master Plans for each of the Town Centers and rezoned areas within one mile of each town to permit higher density with the purchase of Transferable Development Rights. Calvert County strives to provide safe and efficient roads, water, wastewater systems, public transportation, and utilities. Additionally, the county creates and encourages such public amenities as sidewalks, bike trails, parks, town squares, walking/hiking paths, and indoor recreational and cultural facilities. The county's goal of creating a more compact pattern of development is aimed at reducing dependence on automobiles and enabling people to live within close proximity to stores, offices, entertainment, and services and encouraging alternate transportation methods.

Originally, residential development in Calvert County was limited to small-lot communities along the Chesapeake Bay, which were originally intended only for seasonal/recreational use during the summer and shoulder seasons. These neighborhoods were developed prior to the adoption of county zoning regulations in 1967.

These small-lot communities, which are predominately right on the Chesapeake Bay, were developed and occupied before many of the health and safety regulations and mandates were created and adopted by the county. This causes multiple problems in these areas now with challenges such as beach/shoreline erosion, sewage disposal, stormwater management, road maintenance, and nuisance flooding.

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CHAPTER 3: PLANNING PROCESS

Introduction

The Hazard Mitigation Plan Update process was comprised of the following four main phases: Phase 1 – Organize Steering Committee and Process; Phase 2 – Assess Hazards, Risks, Vulnerability, and Mitigation Capability; Phase 3 – Develop a Mitigation Plan; and Phase 4 – Implement the Plan. Each phase was performed to obtain maximum participation from steering committee members, municipalities, and residents. The Hazard Mitigation Plan Update process was conducted over a 10-month period from October 2016- July 2017.

Phase 1 – Organize Steering Committee and Process: The first phase focused on energizing residents to become interested, involved, and educated in the Plan Update process. In order to achieve this goal, input was solicited throughout the planning process via a two-prong approach: 1) Steering Committee Meetings; and 2) Public Outreach Meetings. Members of the Steering Committee from the 2010 Planning Process were contacted and invited to become members of the Hazard Mitigation Planning Committee for the 2017 Plan Update in an effort to ensure continuity as well as to capitalize on their local knowledge. Each of these avenues for public involvement served its own purpose and required a different tier of involvement to ensure participation from local, county, state, and regional levels. They are discussed in detail in the next section of this Chapter.

Phase 2 – Assess Hazards, Risks, Vulnerability, and Mitigation Capability: In this step, information on past hazard events that affected Calvert County was gathered and specific hazards identified in the 2010 Plan were revisited. This step also involved a literature review of publications addressing historical hazard events, an internet search for data related to historic events, and an inventory and review of the existing GIS coverage and other pertinent documentation. The hazard identification phase included summaries on past occurrences and the probability of future events.

The vulnerability analysis section identified specific areas including critical facilities that were vulnerable to hazards and included estimates of potential losses. Past and future development trends and high hazard areas not suited for development were also analyzed as part of this step.

A Mitigation Capability Assessment was conducted to identify the roles and capabilities of various departments and agencies within the County and individual municipalities. The Assessment also involved a Plan Integration component, which included a review of a select few county and municipal plans and ordinances. The analysis included a report of those documents that addressed or had the potential to address hazard mitigation issues.

Phase 3 – Develop a Mitigation Plan- Based on data from the hazard, vulnerability, and capability assessments, a set of mitigation goals were developed, that were aimed at protecting Calvert County from long-term vulnerability to the hazards that were identified in the THIRA. A comprehensive range of mitigation actions and projects to reduce the effects of each hazard, with emphasis on new and existing buildings and infrastructure, was developed in this step.

The Plan explored mitigation actions in the following six categories to attain their goals:

- Preventative Measures – e.g., zoning, floodplain, stormwater, and other mandates or ordinances.
- Property Protection – e.g., elevating structures or utilities, flood proofing, etc.
- Structural Projects – e.g., levees, reservoirs, drainage channel improvements, dams, etc.
- Education and Outreach – e.g., outreach projects, technical, application and grant assistance
- Natural Resource Protection – e.g., wetlands protection, best management practices for stormwater management, and buyouts and demolitions.
- Emergency Services – e.g., warnings/alerts, sandbagging, evacuation, retrofitting, critical facilities protection, etc.

While some mitigation actions are more 'broad' in nature and cover the entire County, others are specific to each municipality, community, or town center. Municipal actions from the 2010 plan were revisited and it was ensured that each municipality identified at least one action, along with a timeline, estimated cost, and entity(ies) responsible for implementation.

Phase 4 – Implement the Plan - In the final phase, an action plan was developed, that described how the mitigation strategies and activities identified would be prioritized, implemented, funded, and administered by the County and its municipalities. Cost estimates and possible funding sources to implement recommended projects were identified. This phase also included methods to monitor, evaluate, and update the mitigation plan within a five-year cycle as well as recommendations on how to incorporate community participation into the plan maintenance process.

Update Process and Participation Summary

Requirement §201.6(c)(1): *The Plan must document the planning process, including how it was prepared and who was involved in the process for each jurisdiction.*

As mentioned above, community input was solicited throughout the planning process via Steering Committee Meetings and Public Meetings, each of which are detailed below.

Steering Committee Involvement

The Steering Committee which undertook the Plan Update process was comprised of representatives from the Calvert County Division of Emergency Management, Calvert County Community Planning and Building, Calvert County Public Works, Chesapeake Biological Lab, and citizen representatives from the Chesapeake Beach, Broomes Island, Cove Point, Neeld Estate, and North Beach communities.

Photo 3.1 Steering Committee Meeting #1

Six Steering Committee meetings were held during the Plan Update Process which included meetings for both the Flood Mitigation and Hazard Mitigation Plans:
The first Steering Committee Meeting was held on 24 October 2016 at the Calvert County Courthouse Square Building in Prince Frederick. At this meeting, VPC Consultants:

- Discussed the plan integration process;
- Finalized timeline and deliverables;
- Reviewed goals and objectives from the 2010 Hazard Mitigation Plan with the Committee for clarity, cohesiveness, and relevance.

The second Steering Committee Meeting was held on 14 November 2016 at the Calvert County Emergency Operations Center in Prince Frederick. At this meeting, VPC Consultants:

- Reviewed goals and objectives from the 2010 Flood Mitigation Plan with the Committee for clarity, cohesiveness, and relevance
- Discussed the status (Completed, In Progress, Deferred) of the Action Items from the 2010 Flood Mitigation Plan
- Collected input regarding key questions and concerns from the Steering Committee's community representatives;

Photo 3.2 Steering Committee Meeting #2

The third Steering Committee Meeting, held on 28 November 2016, at the Harriet Brown Community Center in Prince Frederick;

- Explained the Hazard Identification and Vulnerability Assessment process to the Committee
- Answered questions related to potential hazards and their likelihood of occurrence
- Provided maps for display and markup by steering committee members to gather more input on stormwater runoff and nuisance flooding

Photo 3.3 Steering Committee Meeting #3

A fourth meeting was held on 9 January 2017 to finalize the Flood Mitigation Plan action items, and implementation plan. This information can be found in the County Flood Mitigation Plan.

The fifth Steering Committee Meeting was held on February 22, 2017 at the Calvert County EOC in Prince Frederick. The Committee was provided a brief overview and loss statistics for the various hazards that are most likely to face the County. A short Q/A session was held for anyone unfamiliar with the current science behind the hazards and projection estimates. The meeting focused on:

- Ranking hazards according to potential damage and likelihood of occurrence.
- Action items for each of the hazards were suggested and discussed.
- Discussing how to provide the public with the most up to date information available, through the most likely channels (text, email, social media, mass notification, etc.)

The final Steering Committee Meeting was held on the 13th of April 2017, at the Harriet Brown Community Center in Prince Frederick. The steering committee met to finalize the mitigation actions developed for the County and both municipalities. The actions had been emailed out weeks ahead of the meeting to ensure the committee had time to review them and develop any questions or comments for the actions developed. The committee also;

- Ranked the actions by social, administrative, and economic impacts.
- Determined the Lead Agency, Timeline, Estimated Cost and potential Funding Sources for each action item.
- Was provided a printed draft of the plan up to this point for review and to provide comments and notes. One copy of the draft plan was also provided to the Emergency Management Division for extensive review and notation.

Public & Stakeholder Participation

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

The VPC team and the Calvert County Emergency Management Division Chief held a kick-off meeting on October 3rd, 2016. This meeting officially initiated the planning process and included

discussions on the project tasks, project schedule, deliverables, and Steering Committee composition.

Following the kick-off meeting, the Steering Committee from the 2010 Plan was contacted to determine their interest in participating in this Plan Update process. **Table 3.1** includes the members of the Calvert County Steering Committee and representative agencies for this Plan Update.

Table 3.1 – Hazard Mitigation Plan Update Steering Committee

NAME	AGENCY/LOCATION
John Hoffman – Town Engineer	Town of North Beach
Joanne Hunt – Secretary	Town of North Beach
Mark Frazer – Mayor	Town of North Beach
Bill Watson – Zoning Administrator	Town of Chesapeake Beach
Bruce Wahl – Mayor	Town of Chesapeake Beach
Christopher Jakubiack – Town Planner	Town of Chesapeake Beach
Al Jeffery	Calvert County Public Safety, Division of Emergency Management
Shelly Gooding	Calvert County Public Safety, Division of Emergency Management
Andy Balchin	Calvert County Public Works
Kian Liong	Calvert County Public Works
Wilson Freeland	Calvert County Department of General Services
Linda Vassallo	Calvert County Economic Development
Dave Brownlee	Calvert County Department of Planning and Zoning
Tay Harris	Calvert County Department of Planning and Zoning
Lisa Harford	Breezy Point Community
Jennifer Anderson	Breezy Point Community
Lori McCarty	Broomes Island Community
Brandi Elliot	Broomes Island Community
Steve Ferrell	Broomes Island Community
Allan Spahr	Cove Point Community
Bob Boxwell	Cove Point Natural Heritage Trust
Jeff Green, President	Long Beach Civic Association
Janet Gean	Neeld Estate Community
Betsy Ross	Neeld Estate Community
James Shepard	Solomon's Island Community
Terry Cox	Dominion Energy
Rick Woods	Exelon Corporation
Hali Kilbourne	University of Maryland - Chesapeake Biological Lab

Multi-Jurisdictional Planning

Table 3.2 identifies the level of participation of each municipality during the Plan Update process.

Table 3.2 – Municipal Participation

Municipality	Questionnaire Completion	Attendance at Steering Committee Meetings	Mitigation Goals and Actions Input
Chesapeake Beach	YES	__	YES
North Beach	__	YES	YES

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:*

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process;

Public Involvement

An initial Public Meeting was held on 28 November 2016 at the Harriet Brown Community Center in Prince Frederick. The meeting was advertised in three local newspapers, County social media outlets, and on the County website http://www.co.cal.md.us/. A PowerPoint was developed and presented by VPC Consultants. The public was provided an opportunity to:

- Review the results of the updated Hazard Risk and Vulnerability Assessment;
- Review updated goals and objectives;
- Examine options for mitigation actions and projects, and
- Review proposed prioritization criteria for mitigation projects.
- Review and edit maps to include known flooding problems or other hazards

Additionally, a presentation was given by Dr. Mike Scott of Salisbury University;

- Explained the Hazard Identification and Vulnerability Assessment process to the public and the committee.
- Answered questions related to potential hazards and the likelihood of their occurrence.
- Provided maps for display and markup by all attendees to gather more input on stormwater runoff and nuisance flooding in the County.

Finally, VPC explained the planning process and deliverable schedule to the public and emphasized the importance of the public and municipalities involvement in the process for the Community Rating System (CRS) program to be effective.

Copies of the draft Plan Update were made available online at the Calvert County website for a period of three-and-a-half weeks for public comment. This request for public review was advertised on the County website, Social Media Page, and in the local newspaper. Copies of these postings are included in Appendix B of this document. No comments were received during this review period.

A final Public Meeting was held on April 13th, 2017 at the Harriet Brown Community Center in Prince Frederick. Representatives from the County Division of Emergency Management and Vision Planning and Consulting were on location from 6:30-8:30pm to answer any questions.

CHAPTER 4: HAZARD IDENTIFICATION AND RISK ANALYSIS

Introduction – Hazard Identification

The United States and its communities are vulnerable to a wide array of natural and human-caused hazards that threaten life and property. These hazards include:

Natural

- Flood
- Hurricanes and Coastal Storms
- Severe Thunderstorms
- Tornadoes
- Wildfire
- Drought/Extreme Heat
- Winter Storms and Freezes
- Hail
- Erosion
- Dam/Levee Failure
- Earthquakes, Sinkholes and Landslides

Human-Caused

- Hazardous Materials (HazMat)
- Energy Pipeline Failures
- Terrorism

Some of these hazards are interrelated (i.e., hurricanes can cause flooding and tornadoes), and some consist of hazardous elements that are not listed separately (i.e., severe thunderstorms can cause lightning; hurricanes can cause coastal erosion). In addition, terrorist-related incidents or accidents involving chemical, radiological or biological agents can coincide with natural hazard events, such as flooding caused by destruction of a dam or an accidental chemical release caused by a tornado. It should also be noted that some hazards, such as severe winter storms, may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small area yet cause extensive damage. This section provides a general description for each of the hazards listed above along with their hazardous elements, written from a national perspective.

Natural Hazards

Flood

Flooding is the most frequent and costly natural hazard in the United States, a hazard that has caused more than 10,000 deaths since 1900. Nearly 90 percent of presidential disaster declarations result from natural events in which flooding was a major component.

Floods are generally the result of excessive precipitation, and can be classified under two categories: general floods, precipitation over a given river basin for a long period of time; and flash floods, the product of heavy localized precipitation in a short time period over a given location. The severity of a flooding event is determined by the following: a combination of stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing.

Photo 4.1 Midwest Floods in June 1994

A total of 534 counties in nine states were declared for federal disaster aid as a result of the Midwest Floods in June 1994. Homes, businesses and personal property were all destroyed by the high flood levels; 168,340 people registered for federal assistance. (FEMA News Photo)

General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs where man-made development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

Flash flooding events usually occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by an ice jam. Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces. Flash flood waters move at very high speeds- "walls" of water can reach heights of 10 to 20 feet. Flash flood waters and the accompanying debris can

uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads.
The periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1 percent chance of occurring in any given year.

Table 4.1 shows flood damage values by fiscal year from a national perspective.

Table 4.1 - National Flood Damage by Fiscal Year (Oct.-Sept.) 1990 - 2014

Fiscal Year	Damage (Fiscal Year Dollars)	Inflation Adjustment	Damage (2014 Dollars)	U.S. Population (Millions)	Damage Per Capita (2014 Dollars)	Flood Fatalities
2014	$2,861,426,089.00	1.000	$2,861,426,089	317.68	$9.01	38
2013	$2,175,518,874.54	1.016	$2,210,809,876	315.18	$7.01	80
2012	$506,368,342.10	1.031	$522,119,985	312.86	$1.67	29
2011	$8,648,709,658.17	1.052	$9,102,294,087	310.50	$29.31	113
2010	$5,172,733,151.99	1.086	$5,615,860,859	308.11	$18.23	103
2009	$996,350,292.93	1.103	$1,099,446,636	306.77	$3.58	56
2008	$6,136,677,306.23	1.100	$6,747,571,742	304.09	$22.19	82
2007	$2,571,631,102.33	1.142	$2,936,200,387	301.23	$9.75	87
2006	$4,034,316,650.85	1.174	$4,737,440,410	298.38	$15.88	76
2005	$45,641,927,156.26	1.212	$55,325,587,646	295.52	$187.21	43
2004	$15,363,887,745.72	1.253	$19,254,554,417	292.81	$65.76	82
2003	$2,826,192,364.69	1.287	$3,636,203,672	290.11	$12.53	86
2002	$1,380,637,071.75	1.316	$1,816,823,223	287.63	$6.32	49
2001	$8,448,554,328.91	1.337	$11,299,869,817	284.97	$39.65	48
2000	$1,534,953,230.18	1.375	$2,110,213,054	282.16	$7.48	38
1999	$6,213,228,434.31	1.421	$8,828,900,640	279.04	$31.64	68
1998	$2,847,771,022.54	1.452	$4,136,011,784	275.85	$14.99	136
1997	$9,962,460,912.62	1.475	$14,694,536,739	272.65	$53.90	118
1996	$7,079,446,559.79	1.509	$10,681,707,207	269.39	$39.65	131
1995	$5,897,082,264.51	1.553	$9,160,444,009	266.28	$34.40	80
1994	$1,271,677,329.61	1.597	$2,031,388,693	263.13	$7.72	91
1993	$18,806,442,570.44	1.638	$30,810,809,608	259.92	$118.54	103
1992	$889,219,833.64	1.687	$1,500,430,125	256.51	$5.85	62
1991	$1,982,191,491.88	1.738	$3,445,345,705	252.98	$13.62	61
1990	$1,872,216,779.84	1.811	$3,391,133,218	249.62	$13.59	142

Source: Hydrologic Information Center, National Weather Service

Hurricanes and Coastal Storms

Hurricanes, tropical storms, nor'easters and typhoons, also classified as cyclones, are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves, and tidal flooding which can be more destructive than cyclone wind.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in this basin is about six (6).

Photo 4.2 Hurricane Lili Damage

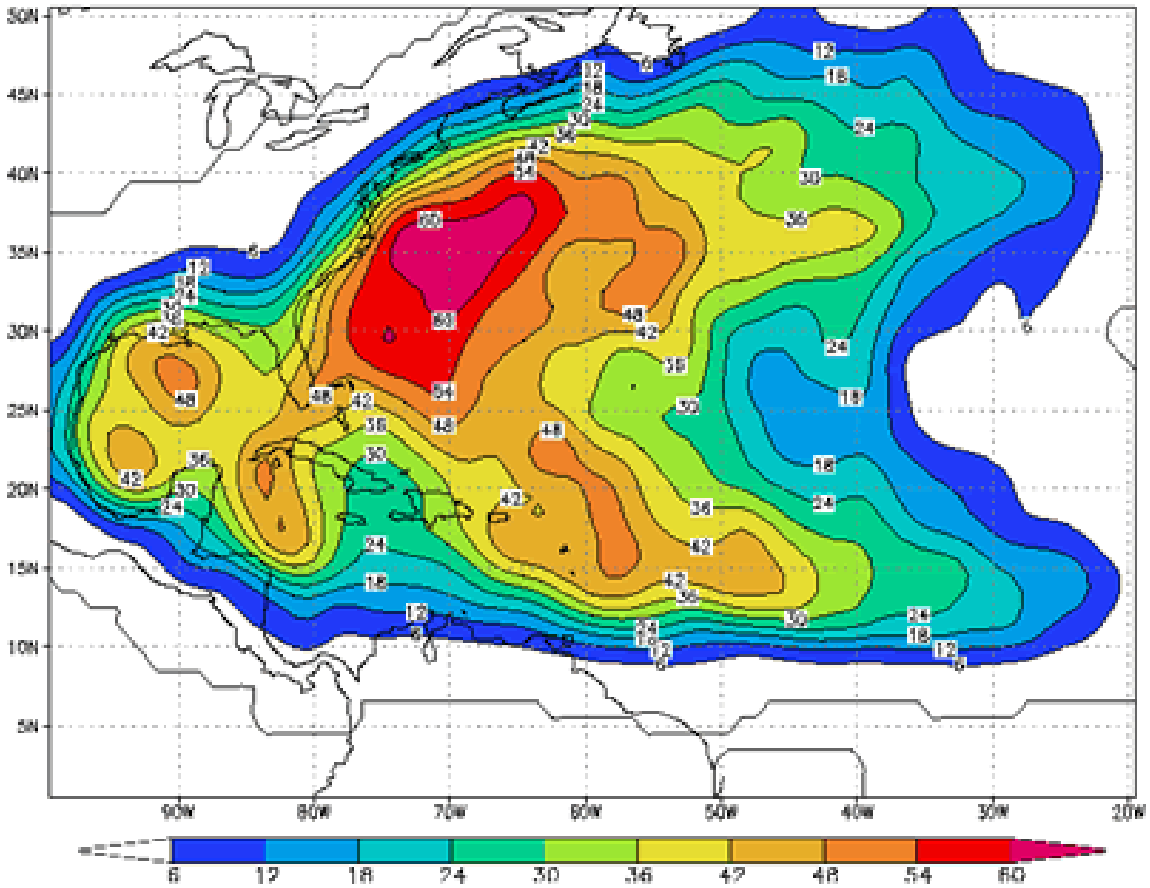
Wind and rain from Hurricane Lili damage road signs along I-10 in Louisiana October 3, 2002. (Photo by Lauren Hobart/FEMA News Photo)

Figure 4.1 shows for any particular location what the chance is that a tropical storm or hurricane will affect the area sometime during the whole June to November Atlantic hurricane season. The figure was created by the National Oceanic and Atmospheric Administration's Hurricane Research Division using data from 1944 to 1999 and counting hits when a storm or hurricane was within approximately 100 miles (165 km) of each location.

As an incipient hurricane develops, barometric pressure (measured in Millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach, or exceed, 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida.

When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale, which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense. The Saffir-Simpson Scale was slightly modified in 2012 in order to "resolve awkwardness with conversions among the various units used for wind speed in advisory products" (NHC). The Saffir-Simpson Scale is shown in **Table 4.2**.

Figure 4.1 - Empirical Probability of a Named Storm



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

Table 4.2
Saffir-Simpson Wind Scale

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States.

Category	Maximum Sustained Wind Speed (mph)
1	74-95 mph
2	96-110 mph
3	111-129 mph
4	130-156 mph
5	157 mph or higher

Table 4.3 describes the damage that could be expected for each category of hurricane as determined by the Saffir-Simpson Scale.

Table 4.3 - Hurricane Damage Classification

Category	Damage Level	Description
1	MINIMAL	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	MODERATE	**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.
3	EXTENSIVE	**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.
4	EXTREME	**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 possibly months. Most of the area will be uninhabitable for weeks or months.
5	CATASTROPHIC	**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 Hurricane Center

A storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to five feet in a Category 1 hurricane up to 20 feet in a Category 5 storm. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas.

A storm surge is a wave that has outrun its generating source and become a long period swell. The surge is always highest in the right-front quadrant of the direction in which the hurricane is moving. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast.

Storm surge heights, and associated waves, are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves.

Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms. Hurricane Floyd, as an example, was at one time a Category 4 hurricane racing towards the North Carolina coast. As far inland as Raleigh, the state capital located more than 100 miles from the coast, communities were preparing for extremely damaging winds exceeding 100 miles per hour. However, Floyd made landfall as a Category 2 hurricane and will be remembered for causing the worst inland flooding disaster in North Carolina's history. Rainfall amounts were as high as 20 inches in certain locales and 67 counties sustained damages.

Photo 4.3 Hurricane Floyd Storm Surge Damage

Hurricane Floyd brought a devastating 15 feet of storm surge that damaged or destroyed hundreds of houses along the ocean front of Long Beach on Oak Island, North Carolina in September 1999. A prime example of successful hazard mitigation, the elevated home (right) survived while the older, ground-level block foundation of the home on the left was crushed. (Photo by Dave Gatley/FEMA News Photo)

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

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

Table 4.4 shows an intensity scale proposed for nor'easters that is based upon levels of coastal degradation.

Table 4.4
Dolan-Davis Nor'easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: North Carolina Division of Emergency Management

Severe Thunderstorms

Photo 4.4 Lightning Strikes

Multiple cloud-to-ground and cloud-to-cloud lightning strikes observed during a nighttime thunderstorm. (Photo courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/ National Severe Storms Laboratory)

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as "severe." Although thunderstorms generally affect a small area when they occur, they are very dangerous because of their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in those regions are most ideal for generating these powerful storms.

Thunderstorms are caused when air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for thunderstorms. These storms can occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours.

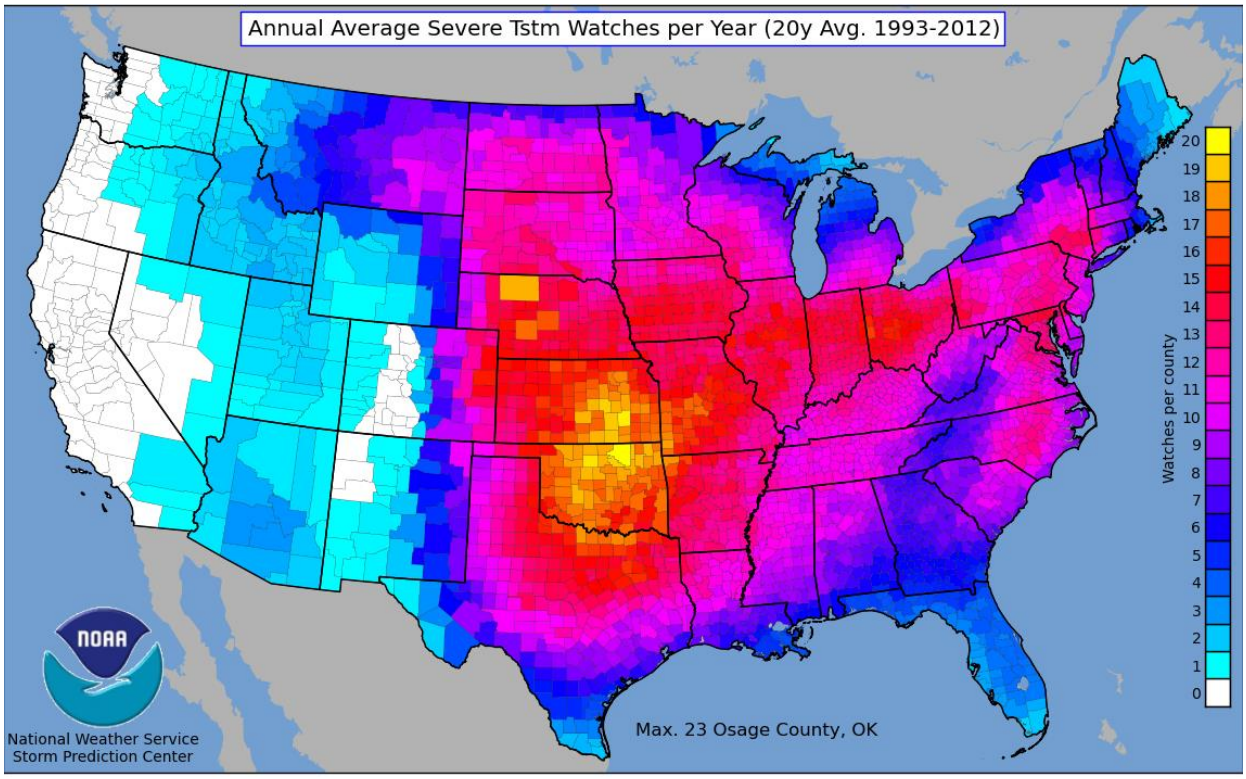
Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid

heating and cooling of the surrounding air causes thunder. On average, 89 people are killed each year by lightning strikes in the United States.

The National Weather Service has been collecting data for thunder days, number and duration of thunder events, and lightning strike density since 1948. A series of maps was generated showing the annual average thunder event duration, the annual average number of thunder events, and the mean annual density of lightning strikes. The figure below illustrates the most recent statistic on thunderstorm activity.

Figure 4.2 illustrates thunderstorm hazard activity based on the annual average number of thunderstorm watches from 1993 to 2012.

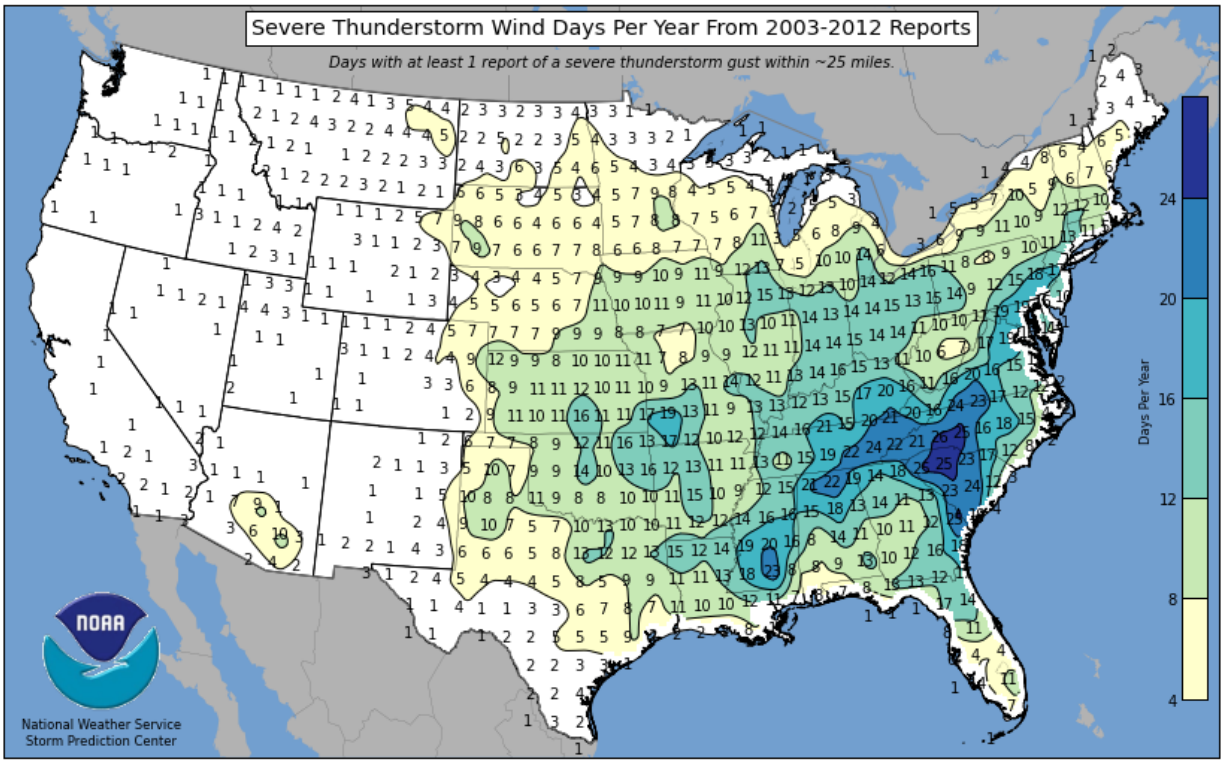
Figure 4.2
Annual Average Number of Thunder Events



Source: Federal Emergency Management Agency

The number of severe thunderstorm wind days per year in the conterminous United States is shown in **Figure 4.3**. These numbers represent the number of days where at least one report of a severe thunderstorm gust (greater than 40 mph) was recorded within 25 miles. Compared with Figure 4.2 above, this map shows that while severe thunderstorm watches are most common in the Plains, severe thunderstorm occurrences are actually centered on the Piedmont of North and South Carolina.

Figure 4.3 – Severe Thunderstorm Wind Days



Source: National Weather Service NOAA

Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other coastal storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 1200 tornadoes is reported nationwide, resulting in an average of 60 deaths and 1,500 injuries (NOAA, 2002). They are

Photo 4.5 Dimmitt, TX Tornado of June 1995

The most comprehensively observed tornado in history, this tornado south of Dimmitt, Texas developed June 2, 1995 curving northward across Texas Highway 86 where it entirely removed 300 feet of asphalt from the road tossing it more than 600 feet into an adjacent field. It also caused F4 damage at an isolated rural residence just north of the road. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

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

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light construction such as residential homes (particularly mobile homes), and tend to remain localized in impact. The Fujita-Pearson Scale for Tornadoes was updated to the Enhanced-Fujita scale on February 1, 2007. The Enhanced-Fujita (EF) Scale is still a set of wind estimates based on damage, however takes into account construction quality, provides damage indicators, and a definitive correlation between damage and wind speed. The EF-Scale (**Table 4.5**) consists of 28 damage indicators consisting of buildings, structures and trees. For each Damage Indicator (DI), several Degrees of Damage (DODs) are identified. The DODs are sequenced so each one requires a higher expected wind speed than the previous one. Damage ranges from the initiation of visible damage to complete destruction of the particular DI. A benefit of this approach is that, in the future, additional DIs can be added to the current list as new information becomes available.

Table 4.5
Enhanced Fujita Scale for Tornadoes

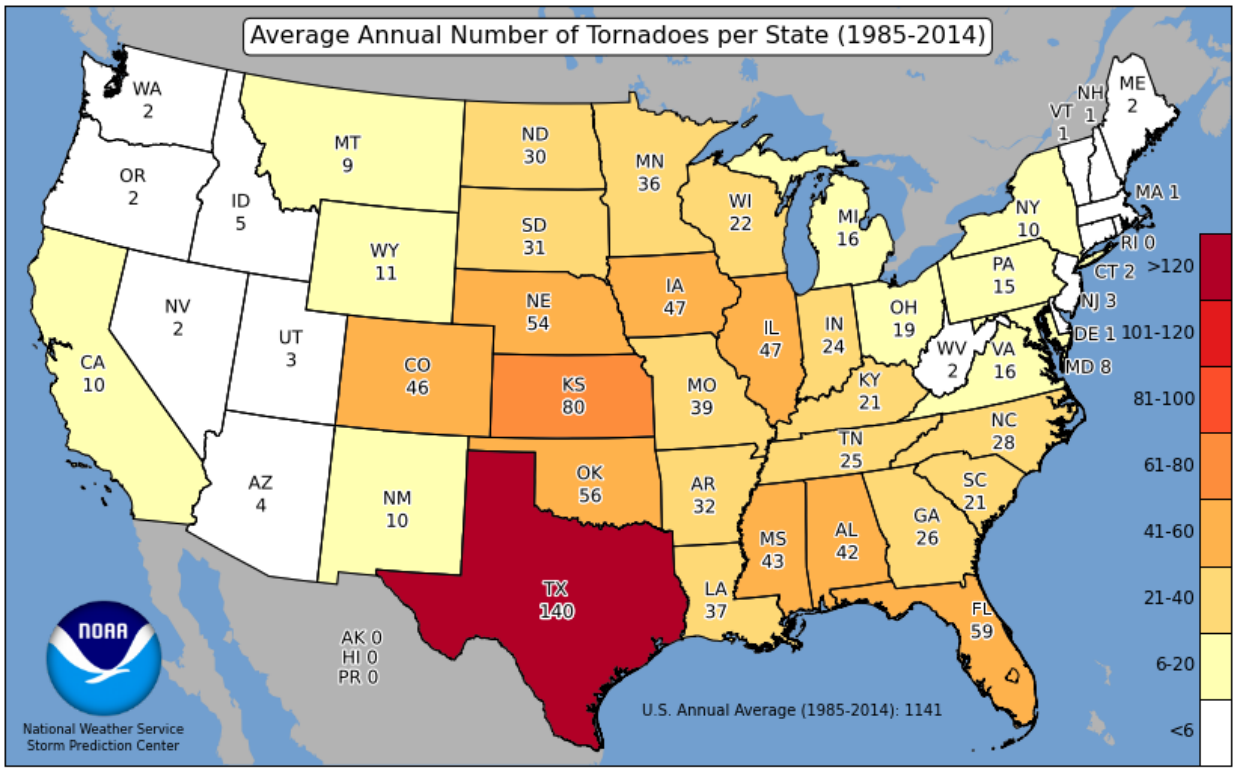
EF-Scale Number	3 Second Gust (mph)	Type of Damage Done
EF0	65-85	Light Damage: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	Moderate Damage: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	Considerable Damage: Roofs torn off well-constructed houses; mobile homes demolished; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	Severe Damage: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	Devastating Damage: Whole frame houses, well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	Incredible Damage: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100m (109 yd.); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA's NWS Storm Prediction Center

According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Texas, Kansas, Florida, and Oklahoma respectively. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), Florida experiences the greatest number of tornadoes per square mile of all U.S. states (SPC, 2002).

Figure 4.4 shows tornado activity in the United States based on the average number of tornadoes between 1985 and 2014.

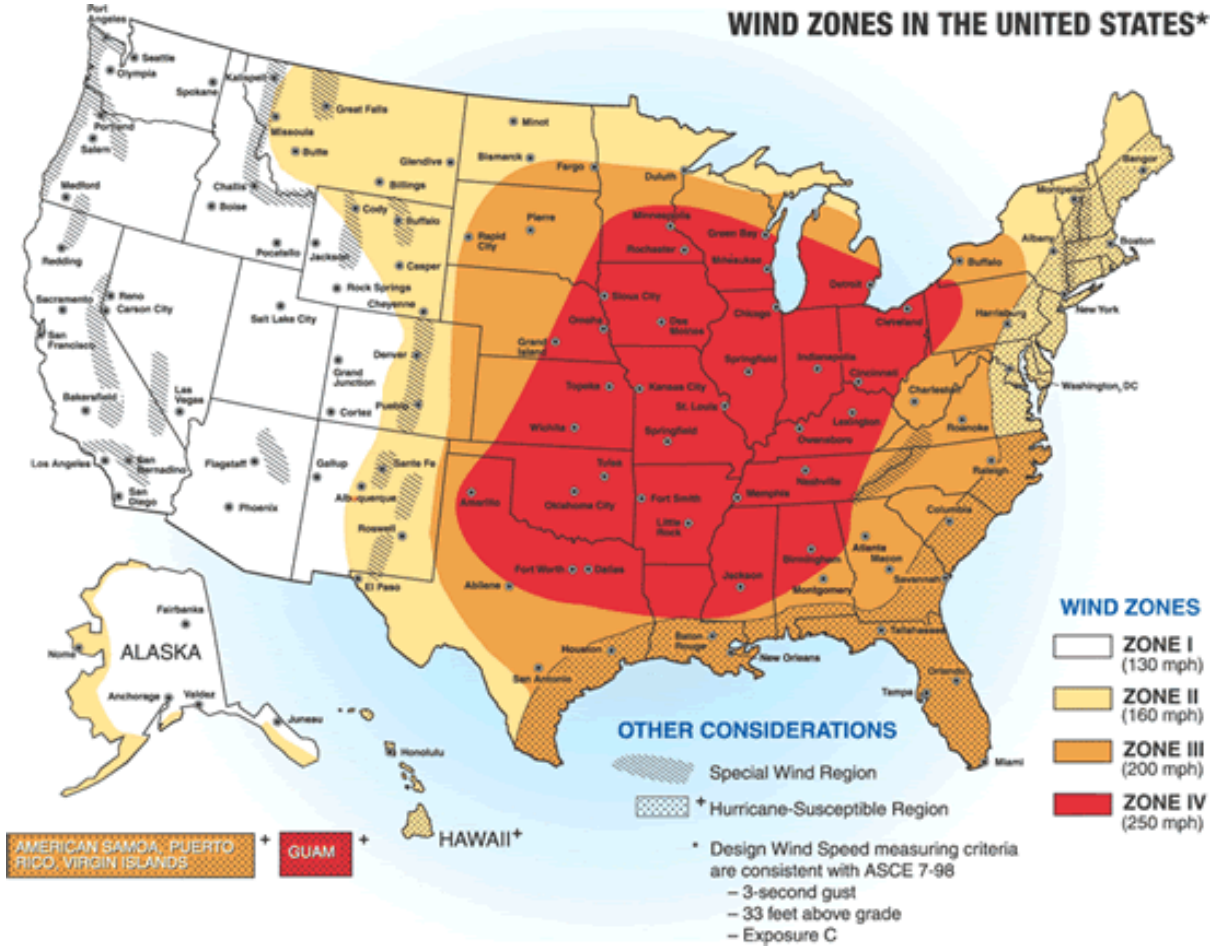
Figure 4.4
Tornado Activity in the United States



The tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest. This type of tornado usually occurs around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction.

Figure 4.5 shows how the frequency and strength of extreme windstorms vary across the United States. The map was produced by the Federal Emergency Management Agency and is based on 40 years of tornado history and over 100 years of hurricane history. Zone IV, the darkest area on the map, has experienced both the greatest number of tornadoes and the strongest tornadoes. As shown by the map key, wind speeds in Zone IV can be as high as 250 MPH.

Figure 4.5 - Wind Zones in the United States



Source: Federal Emergency Management Agency

Wildfire

A wildfire is any fire occurring in a wildland area (i.e. grassland, forest, brush land) except for fir under prescription.[9] Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

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

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

State and local governments can impose fire safety regulations on home sites and developments to help curb wildfire. Land treatment measures such as fire access roads, water storage, helipads, safety zones, buffers, firebreaks, fuel breaks, and fuel management can be designed as part of an overall fire defense system to aid in fire control. Fuel management, prescribed burning, and cooperative land management planning can also be encouraged to reduce fire hazards.

Photo 4.6 Wildfires in Montana in August 2000

On Sunday, August 6, 2000, several forest fires converged near Sula, Montana, forming a firestorm that overran 100,000 acres and destroyed 10 homes. Temperatures in the flame front were estimated at more than 800 degrees. Note the elk gathering near the East Fork of the Bitterroot River. (Photo by John McColgan/U.S. Forest Service Firefighter)

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

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high fire hazard areas. The increasing demand for outdoor recreation places more people in wildlands during holidays, weekends, and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for the inferno that can sweep through the brush and timber and destroy property in minutes.

Drought/Extreme Heat

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

Droughts are frequently classified as one of following four types:

- Meteorological
- Agricultural
- Hydrological
- Socio-economic.

Meteorological droughts are typically defined by the level of “dryness” when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels.

Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

While drought mostly impacts land and water resources, extreme heat can pose a significant risk to humans. Extreme heat can be defined as temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity. Under normal conditions, the human body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work much harder to maintain a normal temperature.

Elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight are more likely to become victims of extreme heat. Because men sweat more than women, they are more susceptible to heat-related illness because they become more quickly dehydrated.

Photo 4.7 Drought Conditions

A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July 2000 illustrates the drought conditions that can severely affect water supplies, agriculture, stream water quality, recreation, navigation, and forest resources. (Photo courtesy of the United States Geological Survey)

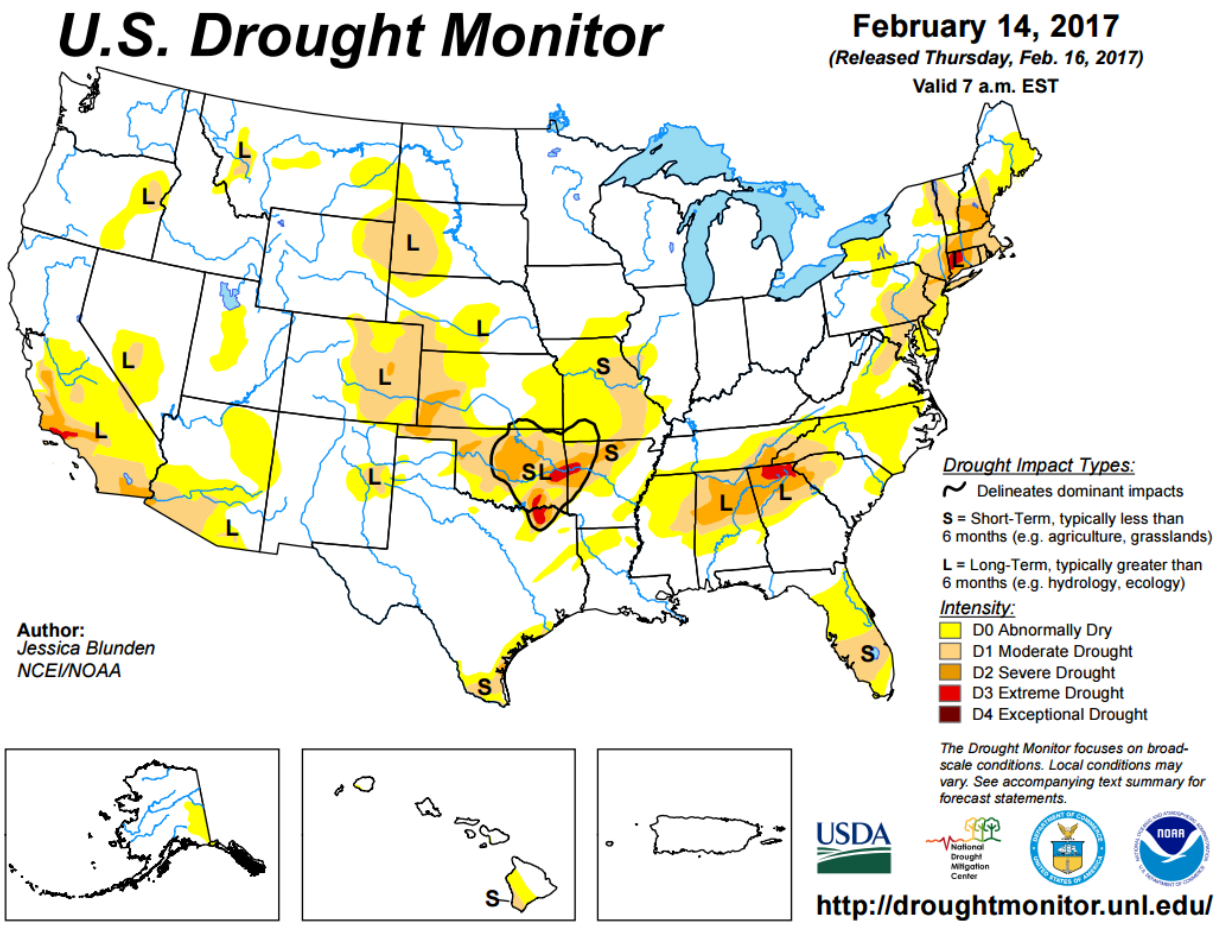
Studies have shown that a significant rise in heat-related illness occurs when excessive heat persists for more than two days. Spending at least two hours per day in air conditioning can significantly reduce the number of heat-related illnesses.

Extreme heat in urban areas can create health concerns when stagnant atmospheric conditions trap pollutants, thus adding unhealthy air to excessively hot temperatures. In addition, the "urban heat island effect" can produce significantly higher nighttime temperatures because asphalt and concrete (which store heat longer) gradually release heat at night.

Figure 4.6 shows a U.S. Drought Monitor summary map from the United States Department of Agriculture for February 14, 2017. Drought Monitor summary maps identify general drought areas and label droughts by intensity, with D1 being the least intense and D4 being the most intense.

Weekly-updated maps may be obtained online from The Drought Monitor Web site, maintained by the National Drought Mitigation Center, located at the following Web address: http://drought.unl.edu/dm.

Figure 4.6 - U.S. Drought Monitor



Hail

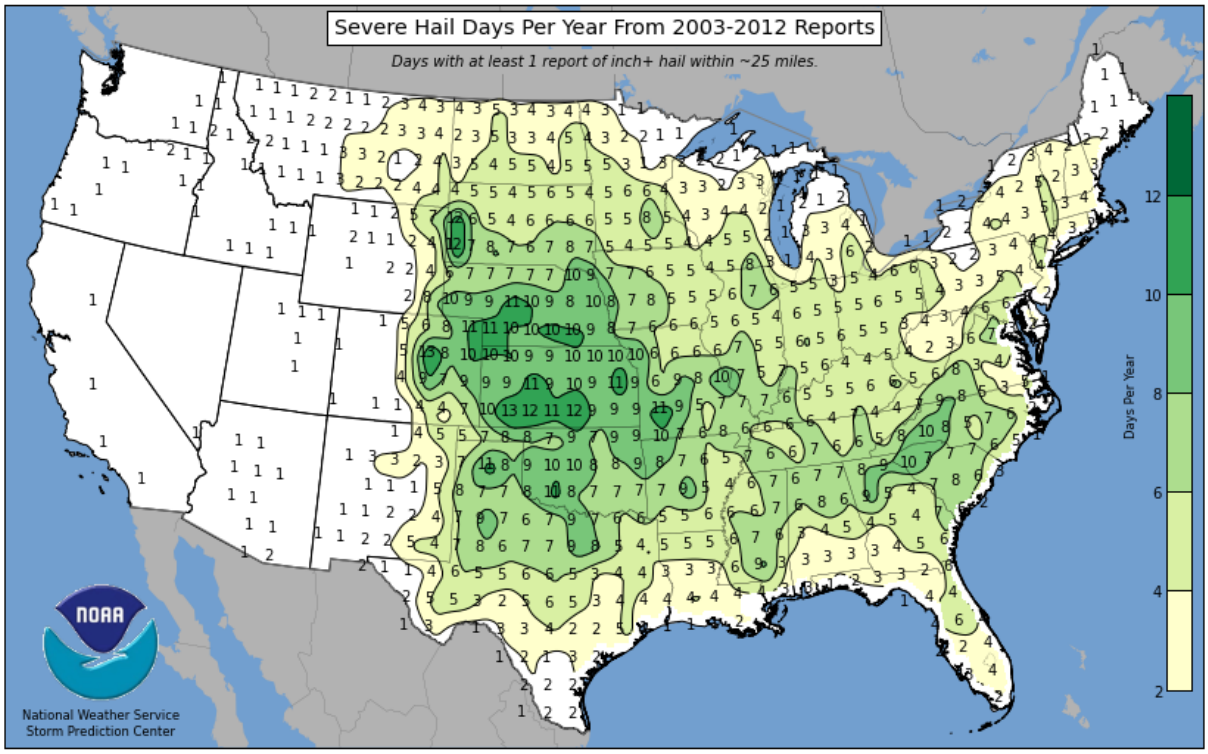
Photo 4.8 Hailstorm

Large hail collects on streets and grass during a severe thunderstorm. Larger stones appear to be nearly two to three inches in diameter. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Hailstorms are an outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation — as balls or irregularly shaped masses of ice greater than 0.75 in. (1.91 cm) in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size.

Figure 4.7 shows number of hailstorms days in the United States.

Figure 4.7
Average number of hailstorm days in the United States



Source: National Weather Service

Winter Storms and Freezes

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

Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Sleet – raindrops that freeze into ice pellets before reaching the ground – usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard, especially on power lines and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Photo 4.9 Winter Storm and Freeze Damage

A heavy layer of ice was more weight than this tree in Kansas City, Missouri could withstand during a January 2002 ice storm that swept through the region bringing down trees, power lines and telephone lines. (Photo by Heather Oliver/FEMA News Photo)

A freeze is weather marked by low temperatures, especially when below the freezing point (zero degrees Celsius or thirty-two degrees Fahrenheit). Agricultural production is seriously affected when temperatures remain below the freezing point.

Erosion

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year.

There are two types of soil erosion: wind erosion and water erosion. Wind erosion can cause significant soil loss. Winds blowing across sparsely vegetated or disturbed land can pick up soil particles and carry them through the air, thus displacing them. Water erosion can occur over land or in streams and channels. Water erosion that takes place over land may result from raindrops, shallow sheets of water flowing off the land, or shallow surface flow, which is concentrated in low spots. Stream channel erosion may occur as the volume and velocity of water flow increases enough to cause movement of the streambed and bank soils. Major storms such as hurricanes may cause significant erosion by combining high winds with heavy surf and storm surge to significantly impact the shoreline.

An area's potential for erosion is determined by four factors: soil characteristics, vegetative cover, topography climate or rainfall, and topography. Soils composed of a large percentage of silt and fine sand are most susceptible to erosion. As the content of these soils increases in the level of

clay and organic material, the potential for erosion decreases. Well-drained and well-graded gravels and gravel-sand mixtures are the least likely to erode. Coarse gravel soils are highly permeable and have a good capacity for absorption, which can prevent or delay the amount of surface runoff. Vegetative cover can be very helpful in controlling erosion by shielding the soil surface from falling rain, absorbing water from the soil, and slowing the velocity of runoff. Runoff is also affected by the topography of the area including size, shape and slope. The greater the slope length and gradient, the more potential an area has for erosion. Climate can affect the amount of runoff, especially the frequency, intensity and duration of rainfall and storms. When rainstorms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature and rainfall amounts define the period of highest erosion risk of the year.

During the past 20 years, the importance of erosion control has gained the increased attention of the public. Implementation of erosion control measures consistent with sound agricultural and construction operations is needed to minimize the adverse effects associated with increasing settling out of the soil particles due to water or wind. The increase in government regulatory programs and public concern has resulted in a wide range of erosion control products, techniques, and analytical methodologies in the United States. The preferred method of erosion control in recent years has been the restoration of vegetation.

Dam/Levee Failure

Worldwide interest in dam and levee safety has risen significantly in recent years. Aging infrastructure, new hydrologic information, and population growth in floodplain areas downstream from dams and near levees have resulted in an increased emphasis on safety, operation and maintenance.

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

Photo 4.10 Large Dam

Dam failure can result from natural events, human-induced events, or a combination of the two. Failures due to natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning. The most common cause of dam failure is prolonged rainfall that produces flooding. (Photo: Michael Baker Corporation)

Though dams have many benefits, they also can pose a risk to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. If a levee breaks, scores of properties are quickly submerged in floodwaters and residents may become trapped by this rapidly rising water. The failure of dams and levees has the potential to place large numbers of people and great amounts of property in harm's way.

Earthquakes, Sinkholes and Landslides

Earthquake

Photo 4.11 Earthquake Damage

Many roads, bridges and elevated highways, were damaged by the 6.7 magnitude earthquake that impacted Northridge, California January 17, 1994. Approximately 114,000 structures were damaged and 72 deaths were attributed to the event. Damage costs were estimated at $25 billion. (FEMA News Photo)

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

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses the ability to resist shear and flows much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's ten tectonic plates. These plate borders generally follow the outlines of the continents, with the North American plate following the continental border with the Pacific Ocean in the west, but following the mid-Atlantic trench in the east. As earthquakes occurring in the mid-Atlantic trench usually pose little danger to humans, the greatest earthquake threat in North America is along the Pacific Coast.

The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (see **Table 4.6**). Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with an I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity

and its correspondence to the Richter Scale is given in **Table 4.7**.

Table 4.6
Richter Scale

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

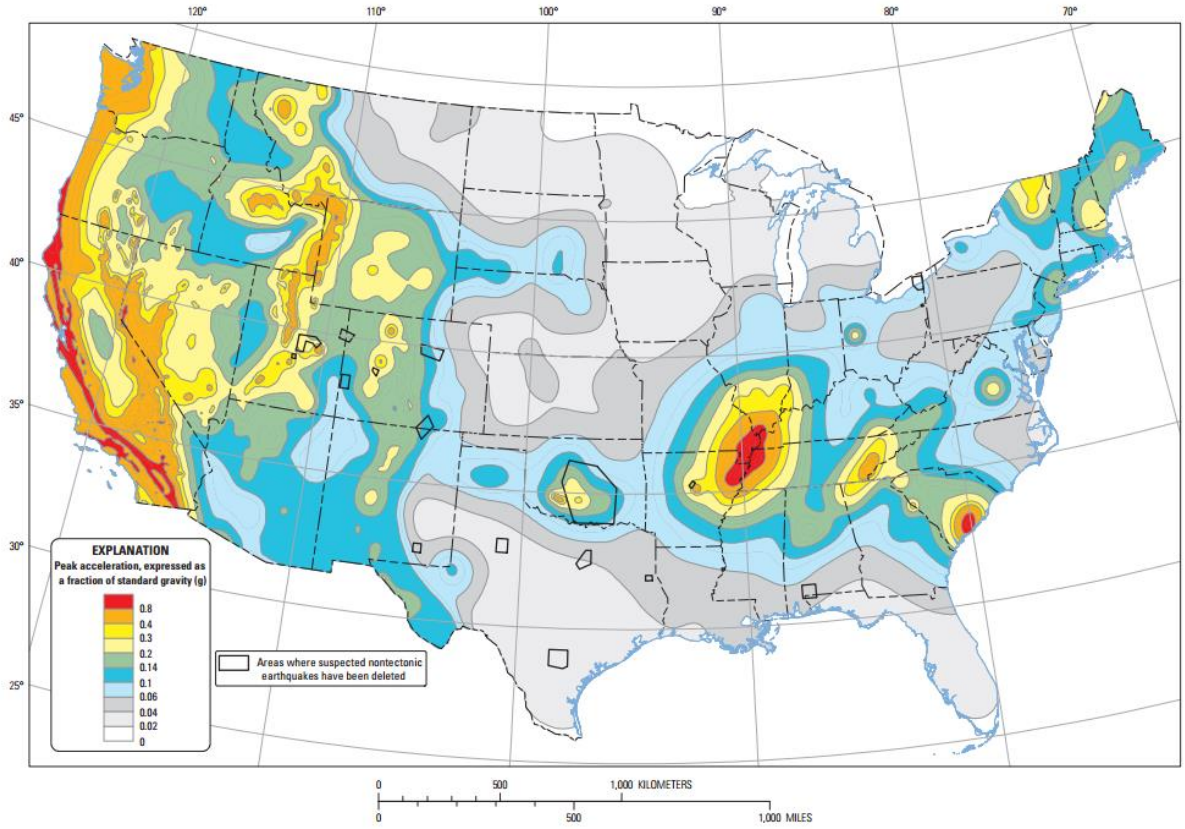
Table 4.7
Modified Mercalli Intensity Scale for Earthquakes

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

Source: North Carolina Division of Emergency Management

Figure 4.8 shows the probability that ground motion will reach a certain level during an earthquake in the Eastern US. The data show peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 2 percent probability of exceedance in 50 years. The map was compiled by the U.S. Geological Survey (USGS) Geologic Hazards Team, which conducts global investigations of earthquake, geomagnetic, and landslide hazards.

Figure 4.8
2% probability of exceedance in 50 years map of peak ground acceleration



Source: United States Geological Survey, 2014

Sinkholes

Sinkholes are a natural and common geologic feature in areas with underlying limestone and other rock types that are soluble in natural water. Most limestone is porous, allowing the acidic water of rain to percolate through their strata, dissolving some limestone and carrying it away in solution. Over time, this persistent erosional process can create extensive underground voids and drainage systems in much of the carbonate rocks. Collapse of overlying sediments into the underground cavities produces sinkholes.

The three general types of sinkholes are: subsidence, solution, and collapse. Collapse sinkholes are most common in areas where the overburden (the sediments and water contained in the unsaturated zone, surficial aquifer system, and the confining layer above an aquifer) is thick, but the confining layer is breached or absent. Collapse sinkholes can form with little warning and leave behind a deep, steep sided hole. Subsidence sinkholes form gradually where the overburden is thin and only a veneer of sediments is overlying the limestone. Solution sinkholes form where no overburden is present and the limestone is exposed at land surface.

Sinkholes occur in many shapes, from steep-walled holes to bowl or cone shaped depressions. Sinkholes are dramatic because the land generally stays intact for a while until the underground spaces get too big. If there is not enough support for the land above the spaces, then a sudden collapse of the land surface can occur. Under natural conditions, sinkholes form slowly and

expand gradually. However, human activities such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater can accelerate the rate of sinkhole expansions, resulting in the abrupt formation of collapse sinkholes.

Although a sinkhole can form without warning, specific signs can signal potential development:

- Slumping or falling fence posts, trees, or foundations
- Sudden formation of small ponds
- Wilting vegetation
- Discolored well water
- Structural cracks in walls, floors.

Sinkhole formation is aggravated and accelerated by urbanization. Development increases water usage, alters drainage pathways, overloads the ground surface, and redistributes soil. According to the United States Geological Survey (USGS), sinkhole damages over the last 15 years cost on average at least $300 million per year. However, there is no national tracking of sinkhole occurrence or damages, the actual damage is likely higher.

Photo 4.12 Sinkhole Collapse

Collapses, such as the sudden formation of sinkholes, may destroy buildings, roads, and utilities. (Photo: Bettmann)

Landslides

A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation, which is driven by gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, volcanic eruptions, and changes in groundwater levels.

There are several types of landslides: rock falls, rock topple, slides, and flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material.

Mudflows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as heavy rainfall or rapid snowmelt, changing the soil into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. As the flows reach flatter ground, the mudflow spreads over a broad area where it can accumulate in thick deposits.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

Among the most destructive types of debris flows are those that accompany volcanic eruptions. A spectacular example in the United States was a massive debris flow resulting from the 1980 eruptions of Mount St. Helens, Washington. Areas near the bases of many volcanoes in the Cascade Mountain Range of California, Oregon and Washington are at risk from the same types of flows during future volcanic eruptions.

Areas that are generally prone to landslide hazards include previous landslide areas; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used.

Areas that are typically considered safe from landslides include areas that have not moved in the past; relatively flat-lying areas away from sudden changes in slope; and areas at the top or along ridges, set back from the tops of slopes.

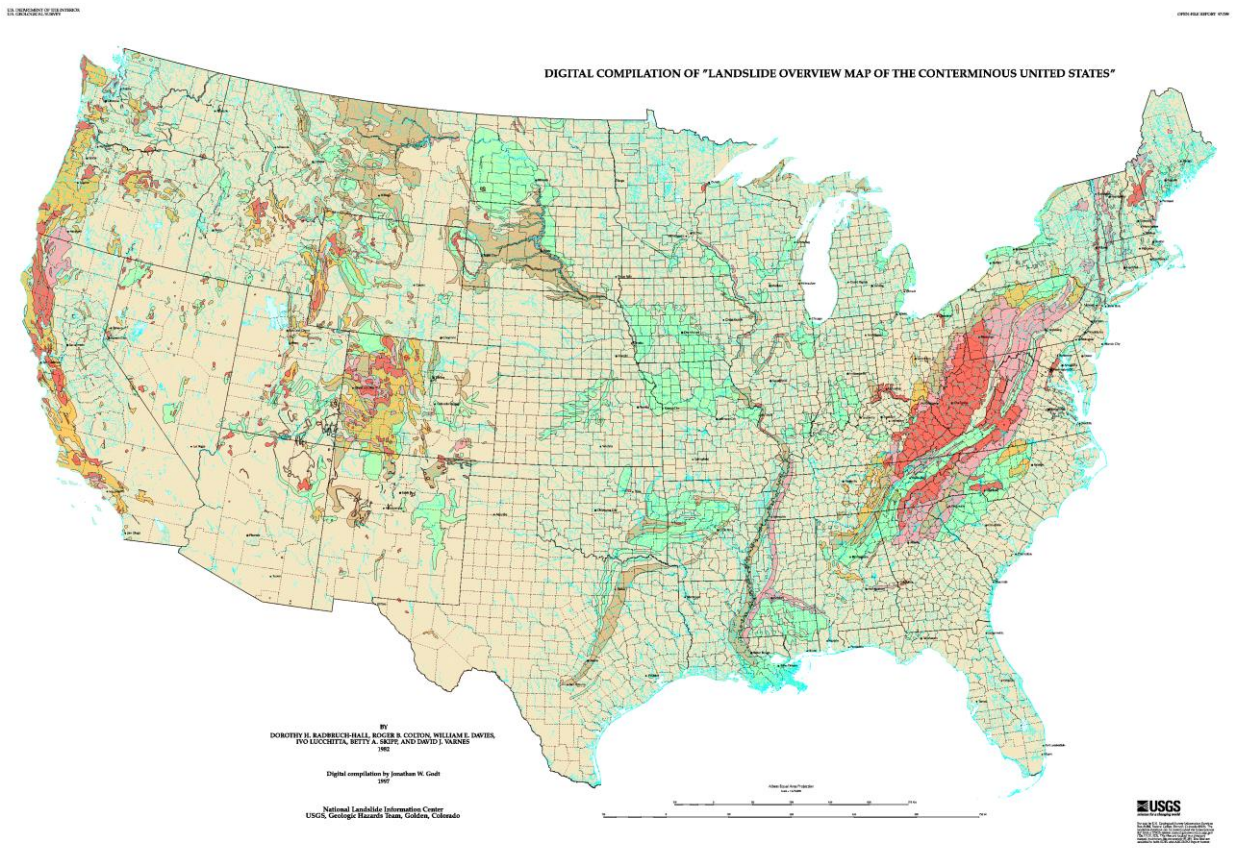
In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year.

Photo 4.13 Landslide Destruction

Landslides can damage or destroy roads, railroads, pipelines, electrical and telephone lines, mines, oil wells, buildings, canals, sewers, bridges, dams, seaports, airports, forests, parks, and farms. (Photo by Lynn Forman)

Figure 4.9 delineates areas where large numbers of landslides have occurred and areas, which are susceptible to landsliding in the conterminous United States. This map layer is provided in the U.S. Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States, available online at: https://landslides.usgs.gov/hazards/nationalmap/.

Figure 4.9 - Landslide Overview Map of the Conterminous United States



EXPLANATION

LANDSLIDE INCIDENCE

- Low (less than 1.5% of area involved)
- Moderate (1.5%-15% of area involved)
- High (greater than 15% of area involved)

LANDSLIDE SUSCEPTIBILITY/INCIDENCE

- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

Susceptibility not indicated where same or lower than incidence. Susceptibility to landsliding was defined as the probable degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated.

Source: United States Geological Survey

Human-Caused Hazards

Hazardous Materials (HazMat)

Hazardous materials (HazMat) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the Nation's highways and on the water. In 2016 alone, there were 24,194 HazMat incidents, 2, 892 of which are highway incidents, 2,850 are railroad incidents and 4,216 are from water-borne vessels. (National Response Center, 2017).

In essence, HazMat incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HazMat incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.

Photo 4.14 Hazardous Material(s) Spill

Propane tanks, gasoline, oil and other hazardous materials and debris in Princeville, North Carolina were cleaned up by Environmental Protection Agency crews following Hurricane Floyd in September 1999. The town remained off limits to residents for some time due to health-related concerns. (Photo by Dave Saville/FEMA News Photo)

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

Energy Pipeline Failures

The energy infrastructure of the United States is comprised of many components, including the physical network of pipes for oil and natural gas, electricity transmission lines, and other means for transporting energy to the Nation's consumers. This infrastructure also includes facilities that convert raw natural resources into energy products, as well as the rail network, trucking lines and marine transportation (U.S. Department of Energy, 2003). Much of this infrastructure is aging, and in addition to the challenges of keeping the infrastructure up-to-date with the latest technological advances and consumer needs, the potential for an energy pipeline failure to become a hazard in-and-of-itself must be considered.

Photo 4.15 Natural Gas Pipelines

Virtually all natural gas in the United States is moved via pipeline. (Photo courtesy of the Department of Energy)

The two million miles of oil pipelines in the United States are the principal mode for transporting oil and petroleum products such as gasoline, and virtually all natural gas in the United States is moved via pipeline as well (DOE, 2003). Much of this oil pipeline infrastructure is old, requiring regular safety and environmental reviews to ensure its safety and reliability. The potential risk of pipeline accidents is a significant national concern.

The energy infrastructure is vulnerable to physical and cyber disruption, either of which could threaten its integrity and safety (DOE, 2003). Disruptions could originate with natural events such as geomagnetic storms and earthquakes, or could result from accidents, equipment failures or deliberate interference. In addition, the Nation's transportation and power infrastructures have grown increasingly complex and interdependent—consequently, any disruption could have far-reaching consequences.

Terrorism

The Federal Emergency Management Agency, in its guidance on integrating human-caused hazards into state and local hazard mitigation plans (FEMA Publication 386-7), has established a set of categories that can be applied to the profiling of intentional acts of terrorism. These categories are: contamination; energy release (i.e., explosives, arson, etc.); and disruption of a service.

Data Sources

American Society of Civil Engineers (ASCE), "Facts About Windstorms."
Web site: www.windhazards.org/facts.cfm

Bureau of Reclamation, U.S. Department of the Interior
Web site: www.usbr.gov

Federal Emergency Management Agency (FEMA)
Web site: www.fema.gov

National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html

National Drought Mitigation Center, University of Nebraska-Lincoln
Web site: www.drought.unl.edu/index.htm

National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nssl.noaa.gov

National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nws.noaa.gov

Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
Web site: www.spc.noaa.gov

The Tornado Project, St. Johnsbury, Vermont
Web site: www.tornadoproject.com

United States Geological Survey (USGS), U.S. Department of the Interior
Web site: www.usgs.gov

Introduction – Risk Analysis

The ***Hazard Analysis*** Section provides information on historical hazard occurrences in Calvert County for the hazards listed below. This listing differs slightly in terminology, order and grouping from the ***Hazard Identification*** section as those hazards affecting Calvert County are more fully explored.

Natural
- Flood
  - Storm Surge/Tide
  - Coastal Flooding
- Severe Winds
  - Hurricanes
  - Coastal Storms
- Thunderstorms
- Tornadoes
- Wildfire
- Drought/Extreme Heat
- Hail
- Winter Storms
- Coastal Erosion
- Dam/Levee Failure
- Earthquakes

Human-Caused
- Hazardous Materials (HazMat)
- Energy Pipeline Failures
- Terrorism

Historical records, such as those available from the National Oceanic and Atmospheric Administration's National Climatic Data Center (NCDC), are used to identify the level of risk. The methodological assumption is that the data sources cited are the best data available, however not always complete. To the extent possible, other sources have been used to supplement NCDC records.

Natural Hazards

Flood

According to the National Climatic Data Center, 39 flood events were reported in Calvert County between January 1, 1996 and December 31, 2016. These 39 events included flash flooding, flood, coastal flood, and storm surge/tide events and resulted in zero (0) deaths, zero (0) injuries and a total of approximately $1.5 million in property damage (NCDC, 2017). Descriptions of major flooding events that have impacted people, property and the environment are below

Significant flood events that have impacted people, property and the environment:

Along Chesapeake Bay, September 6, 1996
Tropical Storm Fran tracked West of Maryland, bringing a storm surge of up to 6ft in the Chesapeake Bay, affecting coastal communities in Calvert County. $750,000 in damages were reported in Calvert County. (NCDC, 2017)

Coastal Zone, October 8, 1996
The same nor'easter which spawned wind gusts in excess of 60 mph also produced waves of 6 feet or greater in the Chesapeake Bay. Fortunately, the wind direction was from the north/northeast, limiting the pounding along the shore. Nevertheless, overwash created by the high waves caused minor damage to piers and bulkheads in Calvert and St Mary's Counties. $10,000 in damages were reported in Calvert County. (NCDC, 2017)

Coastal Zone, January 28, 1998
A fairly intense and slow-moving nor'easter produced a large area of moderate to heavy rains across central and lower southern Maryland beginning late on the 27th and continuing through late afternoon on the 28th. The heaviest rain fell while the storm was tracking along the South and North Carolina coastline. Storm totals ranged from 1 1/2 to 2 1/2 inches over the area, except between 3 and 4 inches across lower southern Maryland. (NCDC, 2017)

Countywide, February 4-5, 1998
A powerful nor'easter, carrying copious moisture from the Gulf of Mexico and Caribbean region, dumped between 2 and 4 inches of rain across much of Maryland between the foothills and the Chesapeake Bay. Highest totals, ranging from 3 to 5 inches, fell in lower southern Maryland, causing widespread flooding of low lying areas and small streams and creeks. The nor'easter, coming on the heels of one just a week earlier, caused tides of 3 to 4 feet above normal from the Calvert Co/Anne Arundel Co line south to Point Lookout in extreme southeastern St Mary's Co; and along the lower tidal Potomac River along the Charles and St Mary's shoreline, including Cobb Island and St George Island. $230,000 in damages were reported in Calvert County. (NCDC, 2017)

Countywide, September 16, 1999
Hurricane Floyd made landfall just east of Cape Fear, North Carolina in the early morning hours of the 16th and moved north-northeast across extreme southeast Virginia to near Ocean City, Maryland by evening on the 16th. Rainbands on the outer edge of the hurricane began to affect Maryland east of Washington County shortly after 8:00 AM EDT on the 15th and continued to cross the area through afternoon on the 16th. A total of 2 to 5 inches of rain fell in Frederick, Carroll, Montgomery, and Howard Counties. A total of 5 to 8 inches fell across Baltimore, Prince George's, and Charles Counties. Between 8 and 12 inches fell across St. Mary's, Anne Arundel,

and Harford Counties. The amount of damage Anne Arundel, Calvert, Charles, Harford, and St. Mary's Counties received from the storm qualified them for FEMA disaster assistance. $500,000 in damages were reported in Calvert County. (NCDC, 2017)

North Beach, July 1, 2016

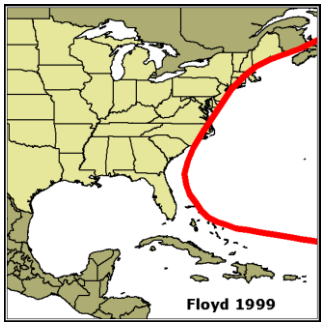
A cold front passed through the area on July 1st. A southerly flow ahead of the boundary caused warm and humid air in place, which led to an unstable atmosphere. The instability combined with lift from the cold front caused thunderstorms to develop. Some thunderstorms were severe due to stronger sheer profiles from an upper-level trough overhead along with the unstable atmosphere. Thunderstorms produced heavy rainfall.

There was a vehicle stuck in high water near Chesapeake Ave and Fourth Street. There were also reports of high water on Route 261. This area is a flood prone area. $5,000 in damages were reported in Calvert County. (NCDC, 2017)

Hurricanes and Tropical Storms

Severe wind events resulting from hurricanes, tropical storms and nor'easters can cause widespread damage and loss of life, as evidenced by the numerous coastal events that have impacted the State of Maryland. Although there has not been a direct strike from a major hurricane in more than two decades (a fact often attributed to the geographic position of North Carolina), Maryland has experienced the effects of as many as 56 tropical events from 1980 to 2015, including hurricanes, tropical depressions and tropical storms. Details of the most recent events are presented below. There has not yet been a direct landfall event in Calvert County, however the Chesapeake Bay plays a significant role in how the county is affected by tropical events.

Hurricane Floyd (1999)



Hurricane Floyd battered the Maryland Eastern Shore on September 16th and brought with it torrential rains and damaging winds. The hurricane caused widespread flash flooding as storm totals averaged around ten inches, most of which fell in a twelve-hour period from the early morning through the afternoon on the 16th. The highest verifiable storm total was 14.00 inches in Chestertown (Kent County). Based on Doppler Radar storm totals estimate similar amounts also fell across northern Queen Anne's County. Flooding along tidal sections of inland creeks and rivers were exacerbated during times of high tide. The torrential downpours associated with Hurricane Floyd exceeded the 100-year-flood return period for most of the Eastern Shore.

Hundreds of roads and bridges were closed. At one point, there were 225 roads closed throughout the state. About 450 people were evacuated from low lying areas, 300 in Calvert County. Five people were seriously injured. Dozens more were rescued from trapped vehicles. A 32-year-old man died on September 19th near Centreville (Queen Anne's County) when he was ejected from his motorcycle while attempting to jump over a washed-out bridge. While the highest wind gusts in most areas were less than 60 mph, the combination of the heavy rain that loosened the ground and the persistence of the strong winds uprooted hundreds of trees across the Eastern Shore. About 17,000 homes and businesses lost power. Power was restored by the 19th. A state of emergency was declared on the 16th and all schools were closed. The preliminary damage estimate was 15.25 million dollars. President Clinton declared all of the Maryland Eastern shore a disaster area.

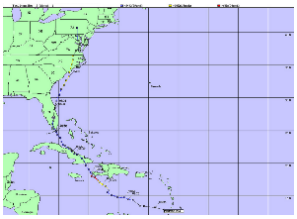
Hurricane Isabel (2003)

Tropical Storm Isabel caused a record-breaking tide and storm surge up the Chesapeake Bay, heavy rain and strong power outage producing winds. Isabel made landfall as a hurricane near Drum Inlet, North Carolina around 1:00 p.m. EDT on the 18th and weakened as it tracked farther inland. At one time in its life cycle, it was a powerful Category 5 hurricane when it was north of the Leewood Islands. Isabel's track took it west of the bay and was able to funnel water into the bay. The National Hurricane Center states that a 2 to 4-foot storm surge in Maryland was generated by Hurricane Isabel. This caused flooding along coastal areas into Calvert County. About 65,750 homes and businesses lost power with half of the outages in Calvert County.

Tropical Storm Cindy (2005)

Heavy rain associated with the remnants of Tropical Storm Cindy fell across Calvert County during the first half of the day on July 8th. The rain itself started during the evening of the 7th and ended during the afternoon of the 8th. Storm totals averaged two to three inches. The heavy rain caused some field and roadway flooding, but did not fall in a concentrated burst. Thus, no serious stream or river flooding was reported. Specific storm totals included 2.79 inches at the Conowingo Dam and 1.63 inches in Fair Hills. Lesser amounts fell farther south all the Eastern Shore through Talbot County. The remnants of Tropical Storm Cindy moved from near Atlanta, Georgia at 8 a.m. EDT on the 7th northeast to near Washington, D.C. at 8 a.m. EDT on the 8th, lower Delaware at 2 p.m. EDT on the 8th and about 100 miles east of Atlantic City at 8 p.m. EDT on the 8th.

Tropical Storm Ernesto (2006)



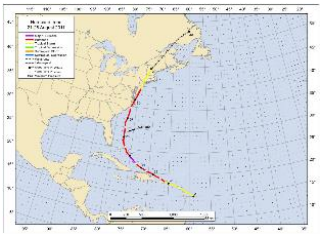
The combination of the remnants of Tropical Storm Ernesto and a large high-pressure system over eastern Canada produced heavy rain and strong winds along the Maryland Eastern Shore. Delmarva Power reported about 21,350 of its customers lost power on the 1st and 2nd of September. Businesses in Chestertown closed early because of the power outages on the first. The strong winds caused some minor damage to businesses on Chesapeake Bay in Talbot County. The county received about 50 calls about downed trees. Kent County responded to about 10 calls of downed trees.

Tropical Storm Hanna (2008)

Tropical Storm Hanna brought heavy rain, strong winds and tidal flooding to the Eastern Shore during the day and into the evening of the 6th. Rain moved into the region during the morning, fell heavy at times from the late morning into the afternoon and ended during the evening. Storm totals ranged from around 1 to about 4 inches with the highest amounts in Calvert County. The strongest winds occurred during the morning and afternoon with peak gusts as high as 56 mph. Siding was ripped from a restaurant in Tilghman (Talbot County). About 10,000 homes and businesses lost power on the Delmarva Peninsula. All power was restored by the 7th. Tidal flooding occurred during the early evening as the surge averaged two to three feet and affected Talbot and Caroline Counties. Many planned activities were cancelled. The Maryland Department of Natural Resources suspended camping at all Eastern Shore State Parks and Chesapeake College was closed.

A limited state of emergency was declared because of Hanna. The eastbound lanes of the William Preston Lane Junior Memorial Bridge (Queen Anne's County) were closed the morning of the 6th and reopened during the afternoon, but driving restrictions remained in place in both directions into the evening. The persistent strong winds knocked down several trees and limbs. This caused scattered power outages and a few road closures. The heavy rain caused a few road closures in Calvert County, although the majority of the closures were caused by tidal flooding farther south.

Hurricane Irene (2011)

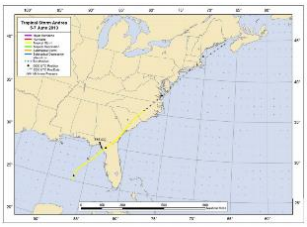


Hurricane Irene caused an estimated $4 million in damages across Maryland. Tropical storm force wind gusts overspread the Eastern Shore with peak wind gusts averaged 50 to 60 mph. Event precipitation totals averaged 6 to 12 inches and caused widespread field and roadway flooding. On August 25, Maryland Governor Martin O'Malley declared a state of emergency in preparation for Irene. The Chesapeake Bay Bridge was closed to vehicular traffic. In Calvert County, sections of Maryland State Routes 273, 213 and 272 were closed. About seventy-percent of all Delmarva Power customers lost power.

Hurricane Sandy (2012)

Post-Tropical Storm Sandy caused an estimated $5 million dollars in damage on the Eastern Shore of Maryland. Most of the damages were 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 Andrea (2013)



The remnants of Tropical Storm Andrea moving up the Eastern Seaboard, from the Southeast States to the Mid-Atlantic and Northeast Coasts, led to waves of heavy rain and thunderstorms from the early morning hours through late evening on June 7th. The initial burst of heavy precipitation arrived during the early morning on the 7th as moisture surged into the Mid-Atlantic Region ahead of Tropical Storm Andrea, with the center of its low pressure located near the coast of Georgia. Throughout the course of the day, the cyclone became post-tropical as it accelerated northeast along the East Coast of the United States, delivering another round of heavy rain with some strong thunderstorms to the Mid-Atlantic States during late afternoon and evening of the 7th.

Thunderstorms

According to the National Climatic Data Center, Calvert County experienced 130 thunderstorm events including high wind, lightning, strong wind, and thunderstorm wind for the period January 2006 through December 2016. These events resulted in Zero (0) deaths, four (4) injuries and a total of approximately $1.65 million in property damage (NCDC, 2017). **Table 4.8** provides a breakdown of this thunderstorm activity.

Table 4.8
Summary of Thunderstorm Activity in Calvert County (2006-2016)

LOCATION	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
St Leonard	7/16/2007	1532	Thunderstorm Wind	50	0	0	$1,000
Lusby	7/19/2007	1450	Thunderstorm Wind	52	0	0	$10,000
Dares Beach	3/8/2008	1645	Thunderstorm Wind	50	0	0	$10,000
Calvert (Zone)	5/11/2008	2200	High Wind	50	0	2	$100,000
North Beach	5/31/2008	1355	Thunderstorm Wind	78	0	0	$0
Huntingtown	5/31/2008	1405	Thunderstorm Wind	50	0	0	$2,000
Solomons	5/31/2008	1520	Thunderstorm Wind	50	0	0	$15,000
Appeal	5/31/2008	1520	Thunderstorm Wind	50	0	0	$15,000
Owings	6/4/2008	1433	Thunderstorm Wind	52	0	0	$10,000
Port Republic	6/4/2008	2041	Thunderstorm Wind	50	0	0	$10,000
Dunkirk	6/7/2008	2123	Thunderstorm Wind	50	0	0	$1,000
Chaneyville	6/7/2008	2123	Thunderstorm Wind	50	0	0	$1,000
Dunkirk	6/7/2008	2123	Thunderstorm Wind	50	0	0	$1,000
Dunkirk	6/7/2008	2125	Thunderstorm Wind	50	0	0	$15,000
Sunderland	6/7/2008	2128	Thunderstorm Wind	50	0	0	$1,000
Mt Harmony	6/7/2008	2128	Thunderstorm Wind	50	0	0	$5,000
Dunkirk	6/7/2008	2129	Thunderstorm Wind	50	0	0	$1,000
Wilson	6/7/2008	2145	Thunderstorm Wind	50	0	0	$1,000
Lusby	6/14/2008	1740	Thunderstorm Wind	50	0	0	$5,000
North Beach	6/16/2008	1550	Thunderstorm Wind	50	0	0	$5,000
Buena Vista	7/4/2008	1749	Thunderstorm Wind	50	0	0	$50,000
St Leonard	7/4/2008	1808	Thunderstorm Wind	50	0	0	$10,000
Lusby	7/4/2008	1812	Thunderstorm Wind	50	0	0	$10,000
Port Republic	7/4/2008	1825	Lightning		0	0	$20,000
Mutual	8/2/2008	2045	Thunderstorm Wind	50	0	0	$0
St Leonard	8/2/2008	2047	Thunderstorm Wind	50	0	0	$0
Mt Harmony	9/30/2008	2046	Thunderstorm Wind	50	0	0	$0
Stoakley	4/21/2009	1808	Thunderstorm Wind	50	0	0	$0
Island Creek	8/21/2009	1400	Thunderstorm Wind	56	0	0	$0
Calvert (Zone)	2/26/2010	700	Strong Wind	40	0	0	$500
Parran	6/3/2010	1712	Thunderstorm Wind	52	0	0	$500
Appeal	6/3/2010	1728	Thunderstorm Wind	52	0	0	$500
Dunkirk	7/13/2010	1957	Thunderstorm Wind	52	0	0	$2,000
Dunkirk	7/13/2010	1958	Thunderstorm Wind	52	0	0	$2,000
Chaney	7/13/2010	2000	Thunderstorm Wind	52	0	0	$2,000
Paris	7/13/2010	2010	Thunderstorm Wind	52	0	0	$2,000
Chaney	8/5/2010	1519	Thunderstorm Wind	52	0	0	$5,000
Dunkirk	8/5/2010	1519	Thunderstorm Wind	56	0	0	$10,000

LOCATION	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
Dunkirk	8/5/2010	1520	Thunderstorm Wind	61	0	0	$5,000
Calvert (Zone)	2/19/2011	600	High Wind	52	0	0	$1,000
Calvert (Zone)	2/25/2011	1600	High Wind	50	0	0	$0
Dunkirk	4/5/2011	401	Thunderstorm Wind	61	0	0	$1,000
Dunkirk	4/5/2011	401	Thunderstorm Wind	61	0	0	$2,000
Sunderland	4/5/2011	403	Thunderstorm Wind	56	0	0	$1,000
Cox	4/5/2011	405	Thunderstorm Wind	56	0	0	$1,000
Owings	4/5/2011	407	Thunderstorm Wind	61	0	0	$10,000
Sollers	4/5/2011	420	Thunderstorm Wind	52	0	0	$1,000
Huntingtown	4/16/2011	1753	Thunderstorm Wind	50	0	0	$2,000
Appeal	6/12/2011	1430	Thunderstorm Wind	50	0	0	$1,000
Drum Pt	6/16/2011	2158	Thunderstorm Wind	52	0	0	$5,000
Drum Pt	6/16/2011	2159	Thunderstorm Wind	52	0	0	$5,000
Cove Pt	6/16/2011	2200	Thunderstorm Wind	52	0	0	$5,000
Dunkirk	6/17/2011	1803	Thunderstorm Wind	61	0	0	$10,000
Chaney	6/17/2011	1805	Thunderstorm Wind	56	0	0	$2,000
Dunkirk	6/17/2011	1806	Thunderstorm Wind	52	0	0	$10,000
Dunkirk	6/17/2011	1806	Thunderstorm Wind	52	0	0	$2,000
Chaneyville	6/17/2011	1806	Thunderstorm Wind	61	0	0	$2,000
Owings	6/17/2011	1807	Thunderstorm Wind	61	0	0	$10,000
Chesapeake Beach	6/17/2011	1812	Thunderstorm Wind	56	0	0	$5,000
North Beach	6/17/2011	1815	Thunderstorm Wind	56	0	0	$1,000
North Beach	6/17/2011	1815	Thunderstorm Wind	61	0	0	$5,000
Mutual	7/11/2011	2052	Thunderstorm Wind	52	0	0	$1,000
St Leonard	7/11/2011	2054	Thunderstorm Wind	52	0	0	$1,000
Wallville	7/19/2011	1904	Thunderstorm Wind	56	0	0	$20,000
Wallville	7/19/2011	1904	Thunderstorm Wind	52	0	0	$1,000
North Beach	8/1/2011	1840	Thunderstorm Wind	61	0	0	$1,000
Chesapeake Beach	8/1/2011	1842	Thunderstorm Wind	61	0	2	$100,000
North Beach	8/1/2011	1843	Thunderstorm Wind	56	0	0	$2,000
North Beach	8/1/2011	1845	Thunderstorm Wind	63	0	0	$0
Huntingtown	8/21/2011	1555	Thunderstorm Wind	52	0	0	$0
Breezy Pt	8/21/2011	1607	Thunderstorm Wind	52	0	0	$0
Breezy Pt	8/21/2011	1607	Thunderstorm Wind	50	0	0	$0
Mt Harmony	6/29/2012	2213	Thunderstorm Wind	61	0	0	$1,000
North Beach	6/29/2012	2215	Thunderstorm Wind	51	0	0	$0
Huntingtown	6/29/2012	2215	Thunderstorm Wind	57	0	0	$1,000
Huntingtown	6/29/2012	2215	Thunderstorm Wind	52	0	0	$0
North Beach	6/29/2012	2218	Thunderstorm Wind	61	0	0	$0
Huntingtown	6/29/2012	2225	Thunderstorm Wind	52	0	0	$0
Wilson	7/8/2012	1710	Thunderstorm Wind	52	0	0	$1,000

LOCATION	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
Bowens	7/8/2012	1712	Thunderstorm Wind	52	0	0	$0
Chaneyville	7/28/2012	1738	Thunderstorm Wind	52	0	0	$1,000
Paris	7/28/2012	1739	Thunderstorm Wind	52	0	0	$1,000
Coster	9/18/2012	1551	Thunderstorm Wind	50	0	0	$500
Calvert (Zone)	10/29/2012	1553	High Wind	56	0	0	$812,880
Dunkirk	4/19/2013	1824	Thunderstorm Wind	56	0	0	$0
Chaney	4/19/2013	1824	Thunderstorm Wind	56	0	0	$0
Huntingtown	4/19/2013	1827	Thunderstorm Wind	56	0	0	$0
Appeal	4/19/2013	1854	Thunderstorm Wind	56	0	0	$10,000
Dunkirk	6/28/2013	1530	Thunderstorm Wind	52	0	0	$0
Dowell	5/22/2014	1645	Thunderstorm Wind	52	0	0	$0
Solomons	5/22/2014	1646	Thunderstorm Wind	52	0	0	$0
Drum Pt	5/22/2014	1648	Thunderstorm Wind	52	0	0	$1,000
Cox	5/27/2014	1858	Thunderstorm Wind	52	0	0	$0
Chaney	6/18/2014	2356	Thunderstorm Wind	52	0	0	$0
Chaney	6/18/2014	2357	Thunderstorm Wind	52	0	0	$0
St Leonard	7/14/2014	1755	Thunderstorm Wind	52	0	0	$3,000
Calvert (Zone)	2/14/2015	1114	High Wind	50	0	0	$0
Chaney	6/18/2015	1633	Thunderstorm Wind	52	0	0	$1,000
Chaney	6/18/2015	1634	Thunderstorm Wind	52	0	0	$1,000
Chaney	6/18/2015	1636	Thunderstorm Wind	52	0	0	$1,000
Chaney	6/18/2015	1637	Thunderstorm Wind	52	0	0	$1,000
Chaney	6/18/2015	1638	Thunderstorm Wind	52	0	0	$1,000
Owings	6/18/2015	1639	Thunderstorm Wind	52	0	0	$1,000
Chaneyville	6/18/2015	1640	Thunderstorm Wind	52	0	0	$1,000
Chaneyville	6/18/2015	1641	Thunderstorm Wind	52	0	0	$1,000
Sunderland	6/18/2015	1642	Thunderstorm Wind	52	0	0	$1,000
Huntingtown	6/18/2015	1645	Thunderstorm Wind	52	0	0	$1,000
Sunderland	6/18/2015	1645	Thunderstorm Wind	52	0	0	$1,000
Parran	6/18/2015	1650	Thunderstorm Wind	52	0	0	$1,000
Parran	6/18/2015	1651	Thunderstorm Wind	52	0	0	$1,000
Dares Beach	6/18/2015	1656	Thunderstorm Wind	52	0	0	$3,000
Adelina	6/18/2015	1719	Thunderstorm Wind	52	0	0	$1,000
Stoakley	6/20/2015	2032	Thunderstorm Wind	52	0	0	$1,000
Dares Beach	6/20/2015	2033	Thunderstorm Wind	52	0	0	$1,000
Stoakley	6/23/2015	1939	Thunderstorm Wind	52	0	0	$1,000
Bertha	6/30/2015	1527	Thunderstorm Wind	52	0	0	$1,000
Dunkirk	6/30/2015	2328	Thunderstorm Wind	52	0	0	$3,000
Parran	2/24/2016	1610	Thunderstorm Wind	52	0	0	$0
Willows	2/24/2016	1800	Thunderstorm Wind	61	0	0	$0
Calvert (Zone)	4/3/2016	55	High Wind	50	0	0	$0

LOCATION	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
Chaneyville	4/7/2016	1621	Thunderstorm Wind	43	0	0	$1,000
Chaney	4/7/2016	1626	Thunderstorm Wind	43	0	0	$1,000
Barstow	7/18/2016	1610	Thunderstorm Wind	50	0	0	$0
Huntingtown	7/19/2016	2332	Thunderstorm Wind	52	0	0	$0
TOTAL:							$1,394,880

Source: National Climatic Data Center

Tornadoes

In an assessment conducted by the National Weather Service Storm Prediction Center covering the 30-year period from 1980 to 2009, the State of Maryland ranked #33 in the Nation for number of tornadoes (213), #27 in number of fatalities (6), #29 in number of F2 or greater tornadoes (23), and #24 in number of F4 & F5 tornadoes (2).

Independent of the Storm Prediction Center state-ranking project, the National Climatic Data Center indicates that the geographic area of the State of Maryland experienced 95 tornado events from January 1, 2006 through December 31, 2016. NCDC data supports the statistics for the State of Maryland of (0) deaths and (7) injuries, and reflects a total of approximately $11.111 million in property damage, with an additional $43,500 in crop damage. As for Calvert County, there were four (4) tornado events between the dates of January 1, 2006 through December 31, 2016. The NCDC indicates that these events were responsible for $407,000 in property damages, with an additional $5,000 in crop damages. According to the NCDC, Calvert County experienced 16 tornadoes from January 1, 1950 through December 31, 2016.

Table 4.9 lists all 16 tornadoes that were reported to the National Climatic Data Center as having touched down in Calvert County. These events are responsible for two deaths, two injuries and $11,352,500 in property damages in the county.

Table 4.9
Summary of Tornado Activity in the Calvert County (1950-2015)

LOCATION	DATE	TIME	TYPE	SCALE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Calvert Co.	6/27/1978	1800	Tornado	F2	0	0	$250,000	$0
Calvert Co.	9/5/1979	1715	Tornado	F1	0	1	$250,000	$0
Calvert Co.	10/13/1983	1853	Tornado	F2	0	0	$25,000	$0
Calvert Co.	5/8/1984	1555	Tornado	F0	0	0	$25,000	$0
Calvert Co.	8/17/1994	1005	Tornado	F0	0	0	$500	$0
Dunkirk	7/13/1996	235	Tornado	F1	0	0	$120,000	$0
Dunkirk	4/21/2000	1440	Tornado	F1	0	0	$210,000	$0
Chaney	5/13/2000	1903	Tornado	F1	0	1	$20,000	$0
Solomons	5/22/2001	1855	Tornado	F0	0	0	$0	$0
Bowens	4/28/2002	1831	Tornado	F2	2	0	$10,000,000	$0
Long Beach	4/28/2002	1842	Tornado	F1	0	0	$5,000	$0
Solomons	9/28/2004	1500	Tornado	F0	0	0	$40,000	$0
Paris	6/4/2008	1440	Tornado	EF0	0	0	$400,000	$0

LOCATION	DATE	TIME	TYPE	SCALE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Appeal	4/28/2011	1041	Tornado	EF0	0	0	$7,000	$0
Buena Vista	8/7/2012	1655	Tornado	EF0	0	0	$0	$0
Coster	2/21/2014	1233	Tornado	EF0	0	0	$0	$5,000
TOTAL:					2	2	$11,352,500	$5,000

Source: National Climatic Data Center

Figure 4.10 illustrates graphically historical tornado occurrences within Calvert County.

Figure 4.10
Historical Tornado Occurrences

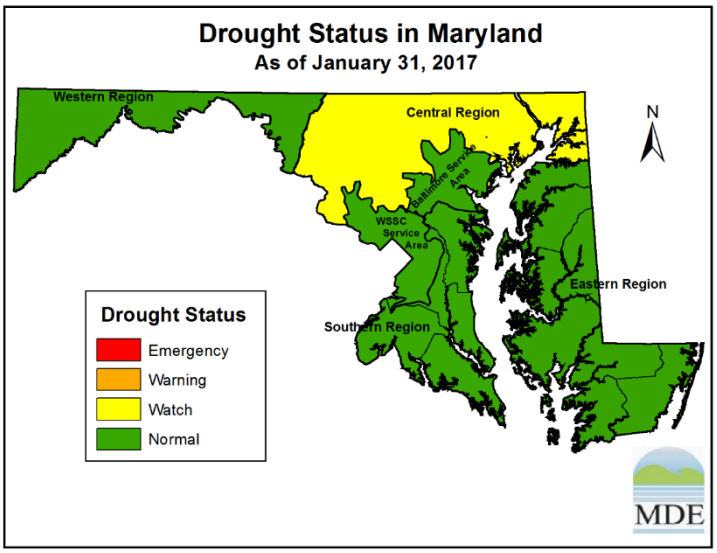
Wildfire

According to the Maryland Department of Natural Resources, the busiest wildfires seasons typically occur in the spring and the fall of the year. These are the transition times for natural cover fuels. In spring, with the absence of moist deciduous vegetation and forest canopy shade, the sun warms the forest floor pre-heating the fuels. In fall, an abundance of new fuel accumulates with leaf fall. Given adequate rainfall amounts throughout the state, wildfires are mostly suppressed on initial attack and can be intense but of short duration. However, unusually hot and dry conditions or drought can turn a mild fire season into a serious problem that often requires extended attack operations to completely suppress wildfires.

The NCDC has 0 reported wildfires for Calvert County between the dates of January 1, 2006 through December 31, 2016.

Drought

Figure 4.11 Drought Status in Maryland



According to the National Climatic Data Center, the State of Maryland has experienced 450 reported droughts and/or periods of unseasonably dry weather from 1996 through December 2016.

All crop damage reported for this period totals $99.72 million. Of these 450 events, Calvert County was reportedly affected by 12 events, however there no deaths, injuries, or damages associated.

The droughts of 1999 were the worst agricultural droughts in Maryland; devastating farmers. 55% of pasture land, 45% of corn, 39% of sorghum, 29% of tobacco, and 34% of soybeans across the state were reported in poor or very poor condition by month's end. 42% of topsoil and 84% of subsoil were reported as short or very short of moisture. Frederick County expected to lose 90% of their corn and soybean crop, and $9 million in lost revenues. Montgomery County expected a 50% loss of soybean and sweet corn and a 60% loss of hay and corn for a loss of $11 million. Washington County reported a corn crop loss of 60% and $10 million in lost revenue. St. Mary's County reported a 60% loss of corn and soybean crops.

Calvert County farmers reported 30% losses in corn, soybeans, and hay. Statewide, crop losses were expected to exceed $100 million. In addition to agricultural lands, forests and rural vegetation were also dangerously dry. The Maryland DNR responded to 600 fires that burned over 2500 acres from January to July, a 100% increase from the previous year. The Cumulative Severity Index (CSI), a measure of fire danger which ranges from 1 to 800, ranged from 503 in Allegany County to 629 in Prince Georges County on August 12th.

Extreme Temperature

According to the National Climatic Data Center, Calvert County experienced 35 extreme temperature events, including cold/wind chill, extreme cold/wind chill, freezing fog, frost/freeze, heat, and excessive heat from January 2006 through December 2016. These heat waves and cold snaps have caused one (1) death and zero (0) injuries.

In 2008, a hot and very humid air mass seeped into the Mid Atlantic on July 17 and July 18. The heat index value climbed to around 105 degrees both afternoons. Emergency response officials reported sporadic incidents of heat-related illness, such as shortness of breath and heat exhaustion, around the Washington/Baltimore Metropolitan region. Three deaths were attributed directly to this heat wave. The deaths occurred in the Maryland suburbs of Washington DC in the counties of Prince Georges, Calvert, and Carroll. Two additional deaths, also in the Maryland suburbs, were indirectly attributed to this heat wave, since they were related to pre-existing health conditions. (NCDC, 2017)

Hail

According to the National Climatic Data Center, Calvert County experienced 17 hail events from 2006 through December 2016 (see **Table 4.10**), with some hail stones reaching 1.75 inches in diameter; these events total (0) deaths, (0) injuries, and no reported damages.

Table 4.10
Hail Activity in Calvert County (2006-2016)

LOCATION	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
St Leonard	7/16/2007	1532	Hail	1	0	0	$0
Huntingtown	5/31/2008	1405	Hail	1	0	0	$0
Stoakley	5/31/2008	1442	Hail	0.75	0	0	$0
Kenwood Beach	6/22/2008	1747	Hail	0.75	0	0	$0
Dunkirk	6/22/2008	1834	Hail	0.75	0	0	$0
Barstow	7/4/2008	1756	Hail	0.75	0	0	$0
Island Creek	6/2/2009	1713	Hail	0.88	0	0	$0
St Leonard	6/2/2009	1719	Hail	0.75	0	0	$0
St Leonard	6/2/2009	1720	Hail	0.75	0	0	$0
Lusby	6/2/2009	1727	Hail	0.75	0	0	$0
Bowens	6/26/2009	1959	Hail	0.75	0	0	$0
Barstow	5/14/2010	1845	Hail	1	0	0	$0
Breezy Pt	8/21/2011	1607	Hail	1	0	0	$0
Dares Beach	6/22/2012	1543	Hail	1	0	0	$0
Solomons	5/22/2014	1650	Hail	1.75	0	0	$0
Chaneyville	5/2/2016	1905	Hail	1.75	0	0	$0
Chesapeake Beach	5/23/2016	1654	Hail	1	0	0	$0

Source: National Climatic Data Center

A detailed map illustrating historical occurrences is presented in the *Vulnerability Assessment* Chapter along with indicators of countywide vulnerability.

Winter Storms

According to the National Climatic Data Center, Calvert County experienced 80 distinct winter storm events, including blizzards, heavy snow, ice storm, sleet, winter storm, and winter weather, from 2006 through December 2016 (see **Table 4.11**). These storm events resulted in a total of (0) deaths, (0) injuries, and $0 in property damage.

Table 4.11
Winter Storm Activity in Calvert County (2005-2015)

LOCATION	DATE	TIME	TYPE	DEATHS	INJURIES	DAMAGE
CALVERT (ZONE)	1/17/2008	800	Winter Weather	0	0	$0
CALVERT (ZONE)	2/20/2008	600	Winter Weather	0	0	$0
CALVERT (ZONE)	2/22/2008	0	Winter Weather	0	0	$0
CALVERT (ZONE)	1/27/2009	500	Winter Storm	0	0	$0
CALVERT (ZONE)	3/1/2009	1700	Winter Storm	0	0	$0
CALVERT (ZONE)	12/5/2009	1000	Winter Weather	0	0	$0
CALVERT (ZONE)	12/18/2009	1900	Winter Storm	0	0	$0
CALVERT (ZONE)	1/7/2010	2100	Winter Weather	0	0	$0
CALVERT (ZONE)	1/30/2010	1000	Winter Storm	0	0	$0
CALVERT (ZONE)	2/2/2010	1700	Winter Weather	0	0	$0
CALVERT (ZONE)	2/5/2010	1100	Winter Storm	0	0	$0
CALVERT (ZONE)	2/6/2010	1100	Blizzard	0	0	$0
CALVERT (ZONE)	2/9/2010	1700	Winter Storm	0	0	$0
CALVERT (ZONE)	2/10/2010	800	Blizzard	0	0	$0
CALVERT (ZONE)	12/16/2010	1000	Winter Weather	0	0	$0
CALVERT (ZONE)	12/25/2010	1700	Winter Weather	0	0	$0
CALVERT (ZONE)	1/11/2011	1700	Winter Weather	0	0	$0
CALVERT (ZONE)	1/17/2011	2000	Winter Weather	0	0	$0
CALVERT (ZONE)	1/26/2011	1600	Winter Weather	0	0	$0
CALVERT (ZONE)	1/31/2011	1600	Winter Weather	0	0	$0
CALVERT (ZONE)	2/1/2011	500	Winter Weather	0	0	$0
CALVERT (ZONE)	3/27/2011	300	Winter Weather	0	0	$0
CALVERT (ZONE)	1/20/2012	2000	Winter Weather	0	0	$0
CALVERT (ZONE)	1/22/2012	1800	Winter Weather	0	0	$0
CALVERT (ZONE)	1/23/2013	2200	Winter Weather	0	0	$0
CALVERT (ZONE)	1/25/2013	1400	Winter Weather	0	0	$0
CALVERT (ZONE)	1/28/2013	400	Winter Weather	0	0	$0
CALVERT (ZONE)	3/25/2013	100	Winter Weather	0	0	$0
CALVERT (ZONE)	12/8/2013	600	Winter Weather	0	0	$0
CALVERT (ZONE)	1/2/2014	1600	Winter Weather	0	0	$0
CALVERT (ZONE)	1/10/2014	500	Winter Weather	0	0	$0
CALVERT (ZONE)	1/21/2014	1100	Winter Weather	0	0	$0
CALVERT (ZONE)	1/28/2014	1900	Winter Weather	0	0	$0

LOCATION	DATE	TIME	TYPE	DEATHS	INJURIES	DAMAGE
CALVERT (ZONE)	2/4/2014	2000	Winter Weather	0	0	$0
CALVERT (ZONE)	2/12/2014	1900	Winter Weather	0	0	$0
CALVERT (ZONE)	2/13/2014	1600	Winter Weather	0	0	$0
CALVERT (ZONE)	2/25/2014	800	Winter Weather	0	0	$0
CALVERT (ZONE)	2/26/2014	300	Winter Weather	0	0	$0
CALVERT (ZONE)	3/3/2014	400	Winter Storm	0	0	$0
CALVERT (ZONE)	3/16/2014	1800	Winter Storm	0	0	$0
CALVERT (ZONE)	1/14/2015	300	Winter Weather	0	0	$0
CALVERT (ZONE)	2/9/2015	2100	Winter Weather	0	0	$0
CALVERT (ZONE)	2/16/2015	1400	Winter Storm	0	0	$0
CALVERT (ZONE)	2/21/2015	800	Winter Weather	0	0	$0
CALVERT (ZONE)	2/25/2015	2300	Winter Weather	0	0	$0
CALVERT (ZONE)	3/1/2015	800	Ice Storm	0	0	$0
CALVERT (ZONE)	3/3/2015	1300	Winter Weather	0	0	$0
CALVERT (ZONE)	3/5/2015	1000	Winter Storm	0	0	$0
CALVERT (ZONE)	1/23/2016	700	Blizzard	0	0	$0
CALVERT (ZONE)	2/14/2016	2300	Winter Storm	0	0	$0
CALVERT (ZONE)	3/3/2016	1900	Winter Weather	0	0	$0

Source: National Climatic Data Center

Coastal Erosion

An evaluation of erosion hazards in the United States was conducted as a collaborative project of The H. John Heinz III Center for Science, Economics and the Environment in April 2000, a study prepared for the Federal Emergency Management Agency (www.heinzcenter.org). The Heinz Center evaluation provides an assessment of coastal erosion and the potential loss of property along U.S. shorelines.

In 1990, the State of Maryland had an estimated 1,000 people living within 500 feet of the Atlantic shoreline, according to data derived from analyzing U.S. Census Block Groups. According to the study, an estimated 25 percent of those homes within 500 feet of U.S. coastlines and Great Lakes coastlines are likely to be lost to erosion by 2060.

Calvert County is not adjacent to the Atlantic Ocean. However, according to the Development of the Maryland Shoreline Inventory Methods and Guidelines for Calvert County (August, 2006), the county resides within the Atlantic Coastal Plain. Calvert County is a peninsula surrounded by the Patuxent River and the Chesapeake Bay. The data inventory developed for the Shoreline Situation Report, designed to assist with management and planning of tidal shorelines, is based on a three-tiered shoreline assessment approach;

- The immediate riparian zone, evaluated for land use;
- The bank, evaluated for height, stability, cover and natural protection; and
- The shoreline, describing the presence of shoreline structures for shore protection and recreational access.

Dam/Levee Failure

According to the Maryland's Department of the Environment Dam Safety Program, there are 439 dams in Maryland ranging in height from 6 feet to 296 feet. There are (81) high hazard dams, (114) significant hazard dams and (244) low hazard dams. (MDE, February 2015)

The data below (**Table 4.12**) was provided by MDE Dam Safety Division. Calvert County has 17 dams, (2) of which are classified as high hazard, (9) significant hazard and (6) low hazard.
Dam hazard definitions, as accepted by the National Interagency Committee on Dam Safety, are as follows:

1. Low Hazard Potential — Unlikely loss of life, minor increases to existing flood levels at road and buildings

2. Significant Hazard Potential — Possible loss of life, significant increased flood risks to roads and buildings with no more than 2 houses

3. High Hazard Potential — Probably loss of life, major increases in existing flood levels at houses, buildings, major interstates and state roads

Figure 4.12 illustrates hazard ratings per dam within Calvert County.

Figure 4.12
Dam Hazard Ratings

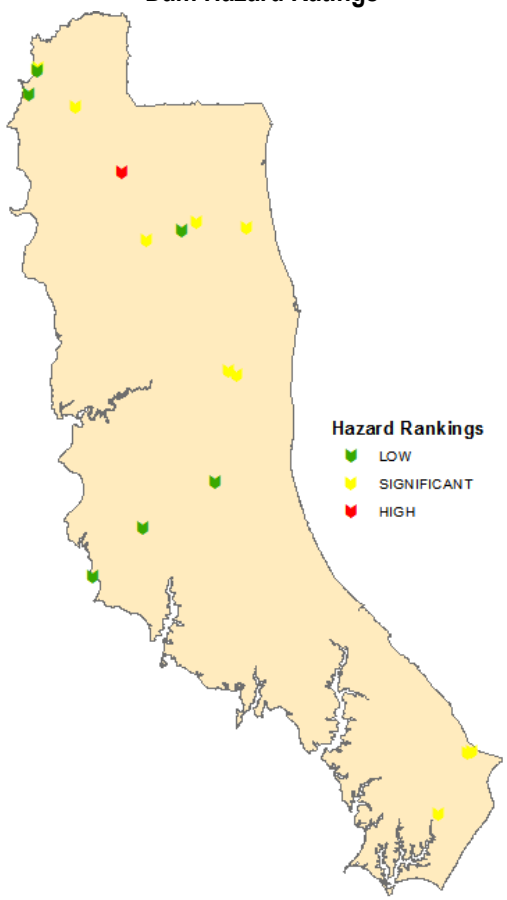


Table 4.12
County Dam Hazard Data

Dam Name	Owner Name	Hazard	River or Stream	Built
Ferry Landing Woods Pond	Ferry Landing Woods Civic Association	Low	Patuxent River - Tr	1981
Calvert Gateway	Penwick Village Ltd Partnership	Significant	Hall Creek-Tr	2000
Shores of Calvert Upper Dam	Shores of Calvert Assn	Significant	Patuxent River-Tr	1972
Shores of Calvert Lower Dam	Shores of Calvert Assn	Low	Patuxent River-Tr	1972
Victoria Station Community Lake	Victoria Station Homeowners Assoc	High	Graham Creek	1986
Sunderland Railroad Embankment Pond	John Ireland	Low	Fishing Creek-Tr	N/A
Lake Ridge Community Pond Dam	Edward B. Howlin, Inc.	Significant	Fishing Creek-Tr	1969
Lake Karylbrook Community Pond	Calvert County Department of Public Works – Roads	Significant	Fishing Creek-Tr	N/A
Queensberry Drive Swm	Queensberry Community Association, Inc.	Significant	Hunting Creek-Tr	2001
Prince Frederick Wwtp Pond 2	Calvert County Department of Public Works	Low	Offstream-Parker Creek	2002
Bowens Farm Pond	Mike and Barb Scarborough	Low	Cypress Swamp-Tr	1970
Starkey Pond	Tom Starkey	Low	Morsell Creek	N/A
Cove Point Lng Secondary Dam	Dominion Cove Point Lng, Lp	Significant	Wilbur Creek	1974
Cove Point Lng Main Dam	Dominion Cove Point Lng, Lp	Significant	Wilbur Creek	1974
Chesapeake Ranch Estates Dam	Chesapeake Ranch Estates	High	Mill Creek	1965
Queensberry Drive Playground Dam	Queensberry Community Association, Inc.	Significant	Hunting Creek-Tr	2001
Twin Lakes Upper Pond (Hoile Lane)	Calvert County Department of Public Works – Roads	Significant	Cocktown Creek-Tr	1970

Source: Dam Safety Division, MDE

Earthquakes

According to the Maryland Geological Survey, 54 earthquakes have been impacted the State of Maryland during a period from 1758 through 2015. One notable was the Virginia earthquake in 2011. Measured at a magnitude 5.8 and a MMI of VII, this earthquake's epicenter was located about 60 miles northeast of Richmond, Virginia, however it was felt as far as Calvert County.

Table 4.13 lists all recorded earthquakes in the State of Maryland for the period 1962 through 2015, along with their intensity.

Table 4.13
Recorded Earthquakes in the State of Maryland (1962-2015)

DATE	LOCATION	MODIFIED MERCALLI INTENSITY
9/7/1962	Hancock	IV
4/26/1978	Hancock	...
5/23/1986	Accoceek – Piscataway	...
1/13/1990	Randallstown (V), Eldersburg (IV), Ellicott City (IV), Granite (IV), Owings Mills (III)	V
4/4/1990	Granite - Randallstown – Baltimore	II
9/28/1991	Granite – Randallstown	III
3/10/1993	Columbia (IV) - Ellicott City (II) - Fulton (II)	II-IV
3/12/1993	Columbia - Allview Estates	II-III
3/15/1993	Columbia - Allview Estates – Laurel	III-V
3/16/1993	Columbia - Allview Estates	II-III
3/16/1993	Columbia - Allview Estates	II-III
3/17/1993	Columbia - Allview Estates	I-II
3/19/1993	Columbia - Allview Estates	I-II
3/19/1993	Columbia - Allview Estates	I
3/21/1993	Aberdeen - Bel Air	I-II
3/22/1993	Columbia - Allview Estates	not felt
3/26/1993	Ellicott City near jct US40 & 29	I-II
4/4/1993	Columbia - Allview Estates	I-III
4/4/1993	Columbia - Allview Estates	I-II
4/8/1993	Columbia - Allview Estates	I-II
7/9/1993	Columbia - Allview Estates	II-III
7/12/1993	Columbia - Allview Estates	III-IV
10/28/1993	Ilchester - Ellicott City	IV
10/28/1993	Ilchester - Ellicott City	IV
11/17/1993	Columbia - Allview Estates	III
11/27/1993	Columbia - Allview Estates	I-II
11/27/1993	Columbia - Allview Estates	I-II
10/28/1994	Glen Burnie - Pasadena -Gambrills -Millersville	IV
8/2/1996	Perryville	II-III
10/17/1996	Rising Sun (epicenter may be in Pennsylvania)	IV
12/6/1996	Columbia - Allview Estates	II
12/14/1996	Columbia - Allview Estates	II
12/16/1996	Ilchester - Ellicott City	I
12/22/1996	Columbia - Allview Estates	III
12/18/2001	Columbia nr US29-Md32	II
3/22/2002	Columbia nr US29-Md32	I
12/9/2003	28 miles west of the Richmond in rural Powhatan County, VA	VI

DATE	LOCATION	MODIFIED MERCALLI INTENSITY
2/23/2005	SE Baltimore near Fort McHenry, Dundalk, Glen Burnie, Pasadena, Gambrills	VI
12/27/2008	9 km (6 miles) W of Lancaster, PA.	IV
7/1/2009	Southwestern New Jersey	III
9/29/2009	7 km (4 miles) NNE (15°) from Bel Air North, MD	II
7/16/2010	Potomac-Shenandoah Region, MD	V
8/23/2011	8 km (5 miles) SSW (195°) from Mineral, VA	V-VI

Source: Maryland Geological Survey

Landslides and Sinkholes

Landslides and sinkholes, discussed in the *Hazard Identification* section, were not analyzed in detail due to extremely low probability of occurrence within the State of Maryland.

Human-Caused Hazards

Hazardous Materials (HazMat)

Located in Calvert County, MD., Calvert Cliffs Nuclear Power Plant began operating in 1975; fully operational in 1977. The power plant is built on a 1,500-acre site on the western shore of the Chesapeake Bay, about 50 miles SE of Washington, D.C. (Exelon Corp, 2017)

According to the United States Nuclear Regulatory Commission, Calvert Cliffs Nuclear Power Plant has reported 22 events between 2011 and 2016. These reported events are summarized below in **Table 4.14**

Table 4.14
Calvert Cliffs Nuclear Power Plant Incident Summary (2011 - 2016)

Accession Number	Date	Document	Report Number
ML11297A113	10/20/2011	LER 11-001-00, for Calvert Cliffs, Unit 1, Regarding Reactor Trip Due to a Phase-to-Phase Short Circuit on Main Transformer.	LER 11-001-00
ML11340A030	12/2/2011	LER 11-002-00, for Calvert Cliffs Nuclear Power Plant, Unit 1, regarding Technical Specification 3.0.3 Entry for Inoperable 125 VDC Channels.	LER 11-002-00
ML11354A244	12/16/2011	LER 11-003-00 for Calvert Cliffs, Unit 1, Regarding 1A Emergency Diesel Generator Inoperability Due to Water Intrusion.	LER 11-003-00
ML12201A068	7/17/2012	LER 12-001-00 for Calvert Cliffs Nuclear Power Plant, Unit 1, "Valve Surveillance Requirement Not Met Due to Legacy Issues".	LER 12-001-00
ML12256A988	9/11/2012	LER 12-002-00 for Calvert Cliffs, Unit 1 Regarding Reactor Coolant Pressure Boundary Leakage Due to Tubing High Cyclic Fatigue.	LER 12-002-00
ML12285A380	10/10/2012	LER 12-003-00 for Calvert Cliffs Nuclear Power Plant, "Plant Shutdown Completed due to Control Element Assembly Misalignment".	LER 12-003-00
ML13175A358	6/21/2013	LER 12-003-01 for Calvert Cliffs, Unit 1 Regarding Plant Shutdown Completed due to Control Element Assembly Misalignment.	LER 12-003-01
ML13353A171	12/17/2013	LER 13-002-00 from Calvert Cliffs Nuclear Power Plant Regarding Unfused Ammeter Circuits Result in Appendix R Unanalyzed Condition.	LER 13-002-00
ML14080A308	3/20/2014	LER 14-001-00 for Calvert Cliffs Nuclear Power Plant, Unit 1, Regarding Reactor Trip Due to Turbine Control System Reboot.	LER 14-001-00

Accession Number	Date	Document	Report Number
ML14097A071	4/3/2014	LER 14-002-00 for Calvert Cliffs, Unit 1 Regarding Condition Prohibited by Technical Specifications Due to Auxiliary Feedwater Train Inoperable Due to Human Performance Error.	LER 14-002-00
ML14119A438	4/24/2014	LER 14-003-00 for Calvert Cliffs Nuclear Power Plant Regarding Pressurizer Safety Valves As-Found Settings (Low) Outside Technical Specification Limits Due to Inadequate Lift Spring Performance.	LER 14-003-00
ML14126A603	5/1/2014	LER 14-004-00 for Calvert Cliffs, Unit 1, Regarding Unfused 250 VDC Circuits Result in 10 CFR Part 50 Appendix R Unanalyzed Condition Due to Original Design did not Adequately Address Fire Protection Requirements.	LER 14-004-00
ML14139A417	5/12/2014	LER 14-005-00 for Calvert Cliffs Nuclear Power Plant Regarding Condition Prohibited by Technical Specifications Due to Human Performance Error.	LER 14-005-00
ML14182A662	7/26/2014	LER 14-006-00 for Calvert Cliffs Nuclear Power Plant, Unit 1 Regarding Reactor Trip Due to Reactor Protective System Matrix Relay Testing Pushbutton Failure.	LER 14-006-00
ML14265A416	9/19/2014	LER 14-007-00 for Calvert Cliffs, Unit 1 Regarding Reactor Coolant System Pressure Boundary Leakage in Reactor Coolant Pump Differential Pressure Transmitter Tubing.	LER 14-007-00
ML15084A008	3/20/2015	LER 15-001-00 for Calvert Cliffs Nuclear Power Plant, Unit 1, Regarding Component Cooling and Shutdown Heat Exchanger Lineup Potential to Exceed Design Basis Temperatures.	LER 15-001-00
ML15160A321	7/5/2015	LER 15-002-00 for Calvert Cliffs, Units 1 and 2, Regarding Automatic Reactor Trips Due to Transmission System Disturbance.	LER 15-002-00
ML15317A007	11/9/2015	LER 15-003-00 for Calvert Cliffs, Unit 1, Regarding Diesel Generator Inoperable Due to Lube Oil Filter Fouling Due to Coolant Leakby on a Cylinder Liner.	LER 15-003-00
ML16083A363	3/21/2016	LER 16-001-00 for Calvert Cliffs Nuclear Power Plant Unit 1, Regarding Manual Reactor Trip Due to High Secondary Side Sodium Levels Due to a Condenser Tube Leak.	LER 16-001-00
ML16106A304	4/14/2016	LER 16-002-00 for Calvert Cliffs, Unit 1, Regarding Pressurizer Safety Relief Nozzle Dissimilar Metal Weld Flaw Exceeded American Society of Mechanical Engineers Code Allowable Limit.	LER 16-002-00
ML16204A377	7/20/2016	LER 16-004-00 for Calvert Cliffs, Unit 1 Regarding High Energy Line Break Barrier Breeched Due to Human Performance Error Causing Both Service Water Trains to be Inoperable.	LER 16-004-00
ML16216A148	7/29/2016	LER 16-003-00 for Calvert Cliffs Nuclear Power Plant, Unit No. 1 Regarding Automatic Trip on Loss of Load due to Spurious Steam Generator High Level Turbine Trip.	LER 16-003-00

Source: NRC: Nuclear Regulatory Commission

Table 4.15 shows Nuclear Regulatory Commission (NRC) data for Calvert County with regard to number of incidents, injuries, deaths and damages incurred as the result of hazardous materials incidents.

Table 4.15 NRC HazMat Data for Calvert County

Year	Type of Incident							Injuries	Fatalities	Damages
	Fixed	Mobile	Rail	Tank	Vessel	Pipeline	Other			
2010	0	1	0	1	1	0	2	0	0	0
2011	1	1	0	1	2	0	3	0	0	0
2012	5	1	0	2	1	0	0	0	0	0
2013	0	0	0	2	0	0	6	0	0	0
2014	2	2	0	0	3	0	2	0	0	0
Total	**8**	**5**	**0**	**6**	**7**	**0**	**13**	**0**	**0**	**0**

Source: NRC: Nuclear Regulatory Commission

Energy Pipeline Failures

A history of hazards is not currently available for energy pipeline failures in Calvert County.

Terrorism

Because of the relatively recent, or heightened, focus being placed on managing terrorism and consequences of terrorism in the United States, no historical database is currently available for cataloging acts of terrorism. However, at the time of this Plan's development, no significant historical occurrences of terrorism were known to have taken place within the Calvert County planning area. Under a DHS Terrorism Preparedness Grant, Calvert County and others participate in the State's Preparedness Report and the Threat Identification and Risk Assessment (THIRA) prepared for US Dept. of Homeland Security. This information is sensitive in nature and not included in this Plan.

Probability of Future Events in Calvert County

The final step of any hazard analysis is calculating the likelihood of future events. Given the number of events that have occurred in the past and the time period over which those events have occurred, one can calculate the number of events that occur per year. This gives a sense of the probability of future occurrences. The results of this calculation for Calvert County are presented in **Table 4.16**. For floods, the events that are tallied are generally nuisance events without a great deal of damage. The probability of a 100-year flood (and its predicted extent) is 1% in any given year. Earthquakes require a similar explanation. While 58 total events have taken place according to the historical record, only one of those was capable of causing any damage at all, however slight. Finally, there is no historical record of occurrence for several hazards.

Table 4.16 - Probability of Future Events (All Hazards)

Hazard	Number of Events	Time Period	Events per Year	Probability of Future Occurrence
Flood	39	1996 – 2016	1.95/0.0100	Medium
Tropical Storm	3	1996 - 2016	0.15	Low
Severe Thunderstorm	130	2006 - 2016	13	High
Tornado	16	1950 - 2016	0.24	Low
Wildfire	2	2005 - 2015	0.18	Low
Drought	12	1996 - 2016	0.6	Low
Extreme Temperature	35	2006 - 2016	3.5	High
Hail	17	2006 - 2016	1.7	Medium
Winter Storm	80	2006 - 2016	8	High
Coastal Erosion	Unknown	N/A	Unknown	Low
Dam Failure	Unknown	N/A	Unknown	Low
Earthquake	54 (1 MMI >= VI)	1758 – 2015	0.21/0.003	Low
Sinkhole/Landslide	Unknown	N/A	Unknown	Low
Hazardous Material Release	3	2006 - 2016	0.3	Low
Energy Pipeline Failure	Unknown	N/A	Unknown	Low

Hazard Profiles for Towns in Calvert County

Hazard profiles have been provided for the following two municipalities in Calvert County: North Beach and Chesapeake Beach.

North Beach
Hazards of greatest concern include flooding, thunderstorms and winter storms. Hazards of moderate consideration include fires, and hazardous material accidents. Terrorism in North Beach is the hazard of least concern in this vulnerability assessment.

There are 111 parcels within the floodplain in North Beach; a flood occurrence could cause potential damage near $19,253,000.

Chesapeake Beach
Hazards of greatest concern include fires, hazardous materials, winter storms, drought/water supply, and flooding in the Chesapeake Beach. Hazards of moderate consideration include transportation accidents, while terrorism in Chesapeake Beach is of least concern.

The loss estimate in Chesapeake Beach could potentially reach $277,388,000 for the 860 parcels within the floodplain.

Data Sources

Photos courtesy of the National Aeronautics and Space Administration (NASA).
Historic hurricane track graphics courtesy of the National Hurricane Center.

American Society of Civil Engineers (ASCE), "Facts About Windstorms."
Web site: www.windhazards.org/facts.cfm

Bureau of Reclamation, U.S. Department of the Interior
Web site: www.usbr.gov

Federal Emergency Management Agency (FEMA)
Web site: www.fema.gov

National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html

National Geophysical Data Center, "Tsunamis and Tsunami-Like Waves of the Eastern United States"
Web site: http://www.ngdc.noaa.gov/seg/hazard/tsu.shtml

National Inventory of Dams, U.S. Department of the Interior
Web site: http://crunch.tec.army.mil/nid/webpages/nid.cfm

National Hurricane Center, National Oceanic & Atmospheric Administration (NOAA)
Web site: http://www.nhc.noaa.gov/http://www.nhc.noaa.gov/HAW2/english/history/opal_1995_map.gif

National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nssl.noaa.gov

National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nws.noaa.gov

Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
Web site: www.spc.noaa.gov

The Tornado Project, St. Johnsbury, Vermont
Web site: www.tornadoproject.com

Exelon Corporation
Web site: www.exeloncorp.com

United States Geological Survey (USGS), U.S. Department of the Interior
Web site: www.usgs.gov

Dam Safety Division, Maryland Department of the Environment
Web site: www.mde.maryland.gov/damsafety

CHAPTER 5: VULNERABILITY ASSESSMENT

Introduction

High-level, detailed vulnerability assessments were completed for Calvert County for flood (riverine and coastal), severe winds (hurricanes and coastal storms), thunderstorms, tornadoes, drought, hail, winter storms, dam/levee failure, earthquakes, hazardous materials and energy pipeline failures, due to the higher level of risk for these hazards compared to others. It is important to note that the risk assessments for the county are based on best available data and represent a base-level assessment for the planning area. Additional work will be needed on an ongoing basis to enhance, expand and further improve the accuracy of the baseline established here.

The loss estimates provided in this section have resulted in an *approximation* of risk. These estimates should be used to understand relative risk from hazards and potential losses. However, it is important to understand that uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (such as abbreviated inventories, demographics or economic parameters).

To conduct the risk assessment effort, two distinct hazard risk assessment methodologies were applied; utilizing both HAZUS-MH® version 2.2 (FEMA's loss estimation software) and a statistical risk assessment methodology. Both approaches provide estimates for the potential impact by using a common, systematic framework for evaluation.

The HAZUS-MH risk assessment methodology is parametric, in that distinct hazard and inventory

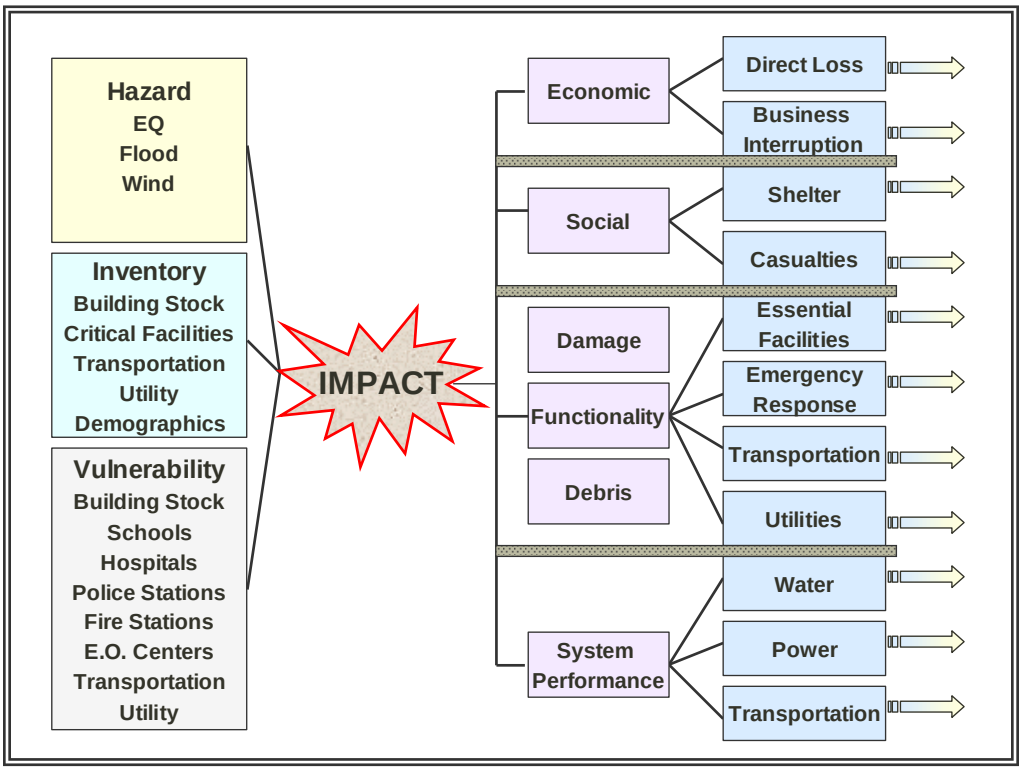
parameters (for example, wind speed and building types) were modeled using the HAZUS-MH software to determine the impact (damages and losses) on the built environment. The HAZUS-MH software was used to estimate losses from wind (hurricane and tornado) and flood hazards.

The second methodology, a statistical risk assessment methodology, was applied to analyze hazards of concern that are outside the scope of the HAZUS-MH software. The HAZUS-driven methodology uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information.

Explanation of HAZUS-MH Risk Assessment Methodology

HAZUS-MH is FEMA's standardized loss estimation software program, built upon an integrated geographic information system (GIS) platform (**Figure 5.1**). This risk assessment applied HAZUS-MH to produce regional profiles and estimate losses for three of the seven hazards addressed in this section: flood, hurricane winds and earthquake.

Figure 5.1 Conceptual Model of HAZUS-MH Methodology



Explanation of Regional Vulnerability Assessment Methodology

Vulnerabilities associated with other natural hazards were analyzed using a regional assessment methodology developed and used specifically for this effort. This approach is based on the principal that any spatially-nonspecific hazard event is essentially a random occurrence within a region and had just as much chance of occurring within the study area as outside. Historical data for each hazard are used and statistical evaluations are performed using manual calculations. The general steps used in

the statistical vulnerability assessment methodology are summarized below:

- Buffer the study area to determine the regional assessment area;
- Compile hazard occurrence data for the regional area from national and local sources;
- Categorize hazard parameters for each hazard to be modeled (e.g., tornado);
- Calculate the annualized occurrence and loss estimates for each regional subdivision;
- Normalize the annualized occurrence and loss estimates by land area and number of housing units respectively; and
- Determine the overall regional average of annualized occurrence and loss

The economic loss results are presented here using two interrelated risk indicators:

1) The Annualized Loss (AL), which is the estimated long-term value of losses to the general building stock in any single year in a specified geographic area (i.e., county)

2) The Annualized Loss Ratio (ALR), which expresses estimated annualized loss as a fraction of the building inventory replacement value, also referred to as the total exposure to the hazard.

The estimated Annualized Loss (AL) addresses the two key components of risk: the probability of the hazard occurring in the study area and the consequences of the hazard, largely a function of building construction type and quality, and of the intensity of the hazard event. By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced presentation of the risk.

The Annualized Loss Ratio (ALR) represents the AL as a fraction of the replacement value of the local building inventory. This ratio is calculated using the following formula:

"ALR = ANNUALIZED LOSSES / TOTAL EXPOSURE AT RISK"

The annualized loss ratio gauges the relationship between average annualized loss and building replacement value. This ratio can be used as a measure of relative risk between areas and, since it is normalized by replacement value, it can be directly compared across different geographic units such as metropolitan areas or counties.

It is important to note that HAZUS-MH was used to produce "worst case scenario" results. The outputs in this document are considered to be the result of a worst-case scenario event for each hazard, and it is understood that any smaller events which could occur would most likely create fewer losses than those calculated here.

Figure 5.2 Census Tracts

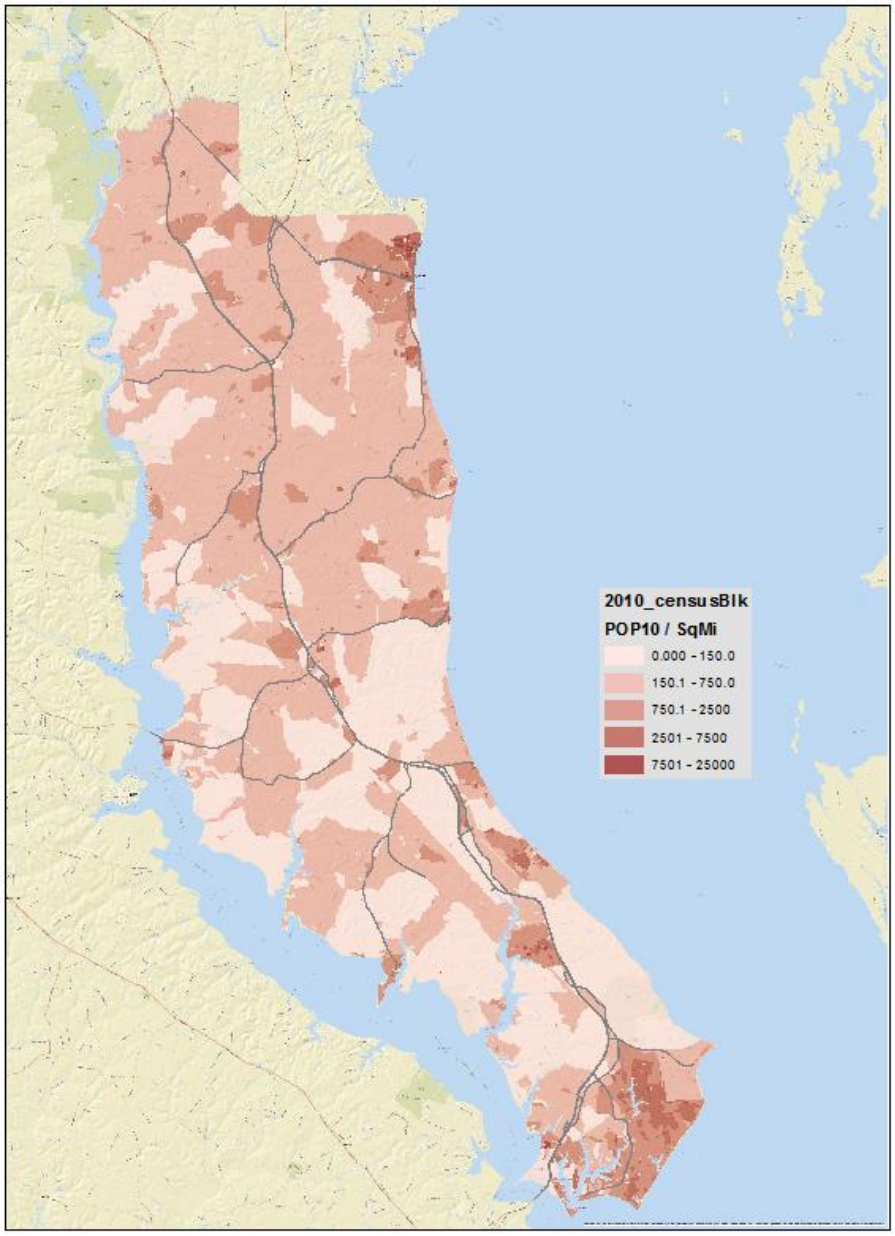
Census Tracts

Many of the tables presented in the Vulnerability Assessment use Census Tracts, which are semi-permanent statistical subdivisions used by the United Census Bureau. Census Tracts provide a stable set of geographic units for presenting statistical data; the map to the right depicts the 18 census tracts within Calvert County.

Calvert County Overview

According to the U.S. Census Bureau, the total population of Calvert County in 2010 was 88,737. (The total population in 2010 for the entire state of Maryland was 5,773,552.) Although 2015 population estimates have been released, the counts for 2010 are the latest available at the census block scale, as is necessary for a detailed analysis. The population of Calvert County grew 19% from 2000. The most densely populated areas of the county are in the southern tip of Solomons Island, and the towns located in the North East corner of the county – North Beach and Chesapeake Beach. (**Figure 5.3**).

Figure 5.3 Population Distribution by Census Tracts (U.S. Census 2010)



The latest value from HAZUS-MH of total dollar exposure within Calvert County is estimated to be approximately $214,202,000. This modeled estimate consists of single-family residential buildings, multi-family residential buildings and commercial facilities. Fortunately, for the flood vulnerability analysis, actual tax parcel boundaries and their assessed valuations were available to be used. Using the data from the Calvert County Government, the actual total dollar exposure in the county is $214,202,145.

Development Trends

The resident population of the State of Maryland is projected to increase from 5,772,717 in 2010 to approximately 7,835,975 by 2060 (Census Bureau; Proximity One, June 2015). From April 1, 2000 to July 1, 2014, Maryland's rate of population change was 3.5% (U.S. Census Bureau). These trends demonstrate that Maryland's population is increasing, and consequently the number of residential structures and the associated exposure of residential buildings will increase as well. Assuming a multiplier of 1.456[10], the total residential exposure of Calvert County could reach an estimated dollar value of $311,878,000 by 2025. This estimate does not of course take into account many other development factors, such as available land for new residential construction. Future Plan updates will address development trends in more detail, in particular for hazards with a physical hazard boundary (i.e., flood, storm surge, etc.)

Critical Facilities

For the purposes of this risk assessment, the label "critical facility" refers to five categories of locations that will be very important during the response and recovery phase of a hazard event. Those categories are: Medical Care Facilities, Emergency Operations Centers, Fire Departments, Police Departments and Schools. According to HAZUS-MH 2.2, there are a total of 73 critical facilities in Calvert County, Maryland.

Flood

In November 2014, FEMA released a new National Flood Hazard Layer for Calvert County, complete with a 1% chance per year depth grid that was created with state-of-the-art methods. Because this data was available and determined by the Hazard Mitigation Plan Update Steering Committee to be authoritative, it was directed to be used as the basis for the flood vulnerability assessment. Because only coastal flooding depths were predicted in the November 2014 study, additional analysis was conducted, using the HAZUS-MH Flood Information Tool and the Digital Flood Insurance Rate Maps, to calculate the predicted depths from a 1% chance per year riverine flooding event. Unfortunately, only a 1% chance per year flood depth grid was available, rather than the typical range of various return periods.

Because the actual property parcels with assessed values were available from Calvert County, there was an opportunity to examine the potential damage from flooding at the parcel level, rather than the census tract level available in HAZUS-MH. The GIS process used to accomplish this is:

1. Select all of the property parcels in Calvert County that intersect the 1% chance per year flood extent.
2. Reduce the assessed value of the parcel's structures by the percentage that the parcel is flooded. This assumes that the impact of a flood would be even across a parcel. This is a best practice in GIS analysis generally when the specific configuration of buildings on a parcel is not known.
3. Convert the raster flood depth grid into polygons for every 6" of flood depth.

[10] Based on the percent change in housing units for a two-year period and weighted for Calvert County.

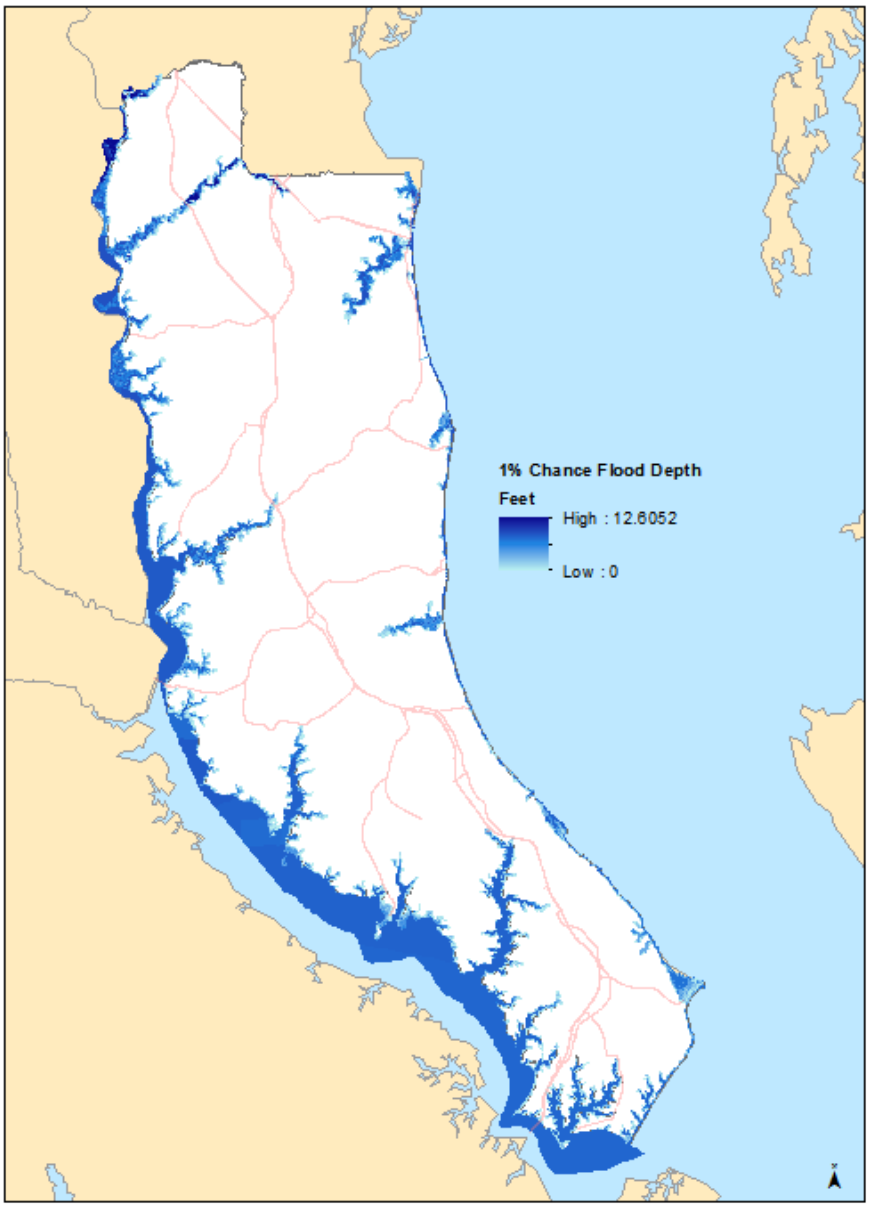
4. For each property parcel, determine the flood depth polygon with the greatest intersecting area. In other words, pick the flood depth polygon value that intersects each property parcel the most.
5. Using the type of property, assume the height of the building foundation and remove this value from the flood depth. For example, if a parcel is predicted to be flooded by 3 ft. of water in a 1% chance per year scenario, and the primary structure is assumed to have an 18-inch foundation (crawl space), then one can assume 1.5 ft. of flood water impacting the structure.
6. Finally, use the depth-damage curves from HAZUS-MH to relate the depth of the floodwater to the percent damaged. This damage percent, for both the building and its content, is multiplied by the reduced assessed value to calculate the estimated damage amount.

The result of this process is parcel-based map of the potential flood damage in Calvert County. This parcel-based vulnerability map may now be used to identify which properties are the most at risk from flooding in the County, what are their characteristics, and whom to contact to discuss potential mitigation options. It could also now be used to track the change in vulnerability over time as either the data regarding individual properties improves, or more up-to-date assessment valuations are considered.

Approximately 5% of Calvert County land area falls within the 1% chance per year flood zone (**Figure 5.4**). Also, 6,417 out of 48,704 property parcels (13.17%) intersect the flood zone. The predicted depth of flood water is between 0 and 12.6 feet (**Figure 5.5**).

Figure 5.4
FEMA 1% chance per year Flood Zone in Calvert County

Figure 5.5
FEMA 1% chance per year Flood Depth in Calvert County

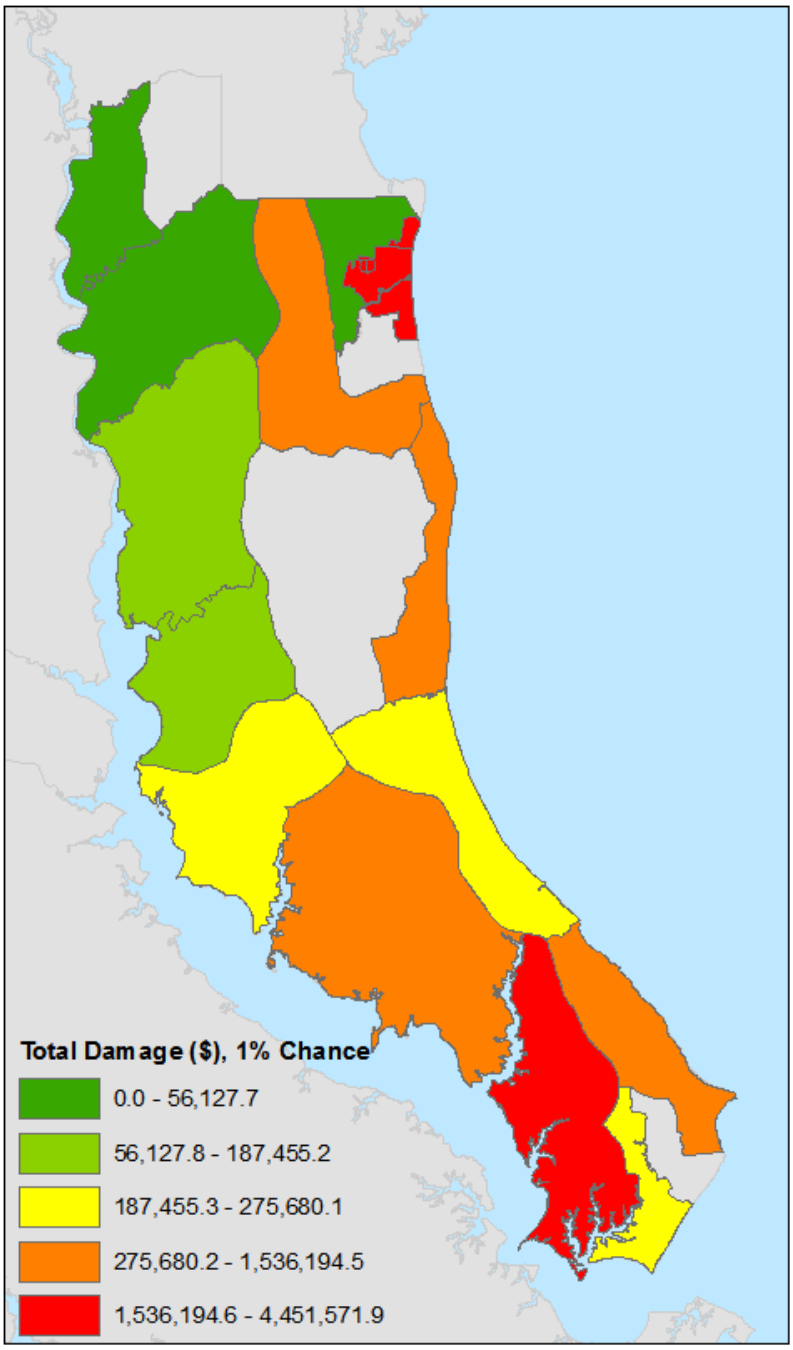


The total built property exposure (both building and contents) in the county is $214,202,000 (**Table 5.1**). The total estimated annualized losses equal $1,717,700, yielding a loss ratio of 0.00081. Again, this analysis has only used a 1% chance per year flood; including the 10%, 4%, 2%, and 0.2% chance per year flood depths would increase the loss ratio significantly.

Table 5.1
Potential Annualized Losses from Flood by Jurisdiction

Jurisdiction	Total Exposure	Estimated Losses	Loss Ratio
Tract # 860101	$0	$0	0.0000
Tract # 860102	-	-	-
Tract # 860200	$1,194,000	$561	0.00046
Tract # 860300	$3,119,000	$8,417	0.00269
Tract # 860401	$849,000	$237	0.00027
Tract # 860402	-	-	-
Tract # 860501	-	-	-
Tract # 860502	$14,352,000	$11,462	0.00079
Tract # 860600	$1,104,000	$1,874	0.00169
Tract # 860701	$1,308,000	$1,663	0.00127
Tract # 860702	-	-	-
Tract # 860703	$7,345,000	$2,716	0.00036
Tract # 860801	$18,232,000	$14,700	0.00080
Tract # 860802	$6,555,000	$2,550	0.00038
Tract # 860900	$50,202,000	$44,516	0.00088
Tract # 861001	$25,372,000	$15,362	0.00060
Tract # 861003	$5,294,000	$2,757	0.00052
Tract # 861004	-	-	-
North Beach	$26,723,000	$23,562	0.00088
Chesapeake Beach	$52,553,000	$41,391	0.00078
TOTAL	**$214,202,000**	**$171,770**	0.00081

Figure 5.6 - Losses per Tract from 1% chance per year Flood in Calvert County



Another means of gauging the vulnerability within Calvert County to flooding was determined to be the vulnerability of critical facilities to the 1% chance per year flood return periods. Within the county, 44 critical facilities were assessed with regard to flood risk (**Table 5.2**). Although the North Beach Volunteer Fire Department parking lot does show evidence of flooding in the 1% flood event, the building remains untouched. Additionally, the Calvert County Sheriff's Substation shows a similar pattern with the parking lot being flooded, while the building itself remains out of the flood zone. In Summary, no facilities in Calvert County fall completely within the 1% chance per year floodplain.

Table 5.2
Potential Damage to Critical Facilities from Flood by Type*

Type	Number of Critical Facilities	1% chance per year Flood			0.2% chance per year Flood		
		> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	> 50% Chance of Severe Damage	> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	> 50% Chance of Severe Damage
EOCs	1	0	0	0	0	0	0
Fire Stations	5	0	0	0	0	0	0
Hospitals	1	0	0	0	0	0	0
Police Stations	2	0	0	0	0	0	0
Schools	35	0	0	0	0	0	0
TOTAL	44	0	0	0	0	0	0

*Moderate: 5 to 30 percent damage, Slight: 1 to 5 percent damage, Negligible: less than 1 percent damage

Repetitive Loss Properties

A repetitive loss property is an NFIP-insured property that has had at least four paid flood losses of more than $1,000, or has had two paid flood losses within 10 years that, in aggregate, equal or exceed the value of the property, or has had three or more paid losses that, in aggregate, equal or exceed the value of the property.

Repetitive loss properties not only increase the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the repetitive loss problem because residents' lives are disrupted and may be threatened by the continual flooding. Addressing repetitive loss properties through the implementation of specific mitigation projects represent one of the most effective ways to reduce future flood losses.

According to According to FEMA as of October 2016, Calvert County has 41 unmitigated repetitive loss properties. According to their property address, the following communities contain these repetitive loss properties:

- Lusby (Cove Point)– 16 properties
- Saint Leonard (Long Beach) – 6 properties
- Saint Leonard (J Llowd Bowen Road) – 1 property
- Huntingtown (Neeld Estate) – 5 properties
- Town of North Beach – 5 properties
- Town of Chesapeake Beach – 3 properties
- Broomes Island – 2 properties
- Owings – 2 properties
- Solomons – 1 property

The loss and policy statistics for Calvert County have been included in **Tables 5.3 and 5.4** and are accurate as of October 31, 2016. The loss statistics are totals from January 1, 1978 to October 31, 2016. Calvert County incurs 2.63 percent of the total losses for the State of Maryland and 1.215 percent of the total policies

Table 5.3 Losses and total payments for Calvert County and Municipalities

Area	Losses	Total Payments
Maryland	18,136	$287,257,099.64
Calvert County	313	$4,470,955.17
Town of Chesapeake Beach	70	$1,550,673.09
City of North Beach	95	$2,624,714.48

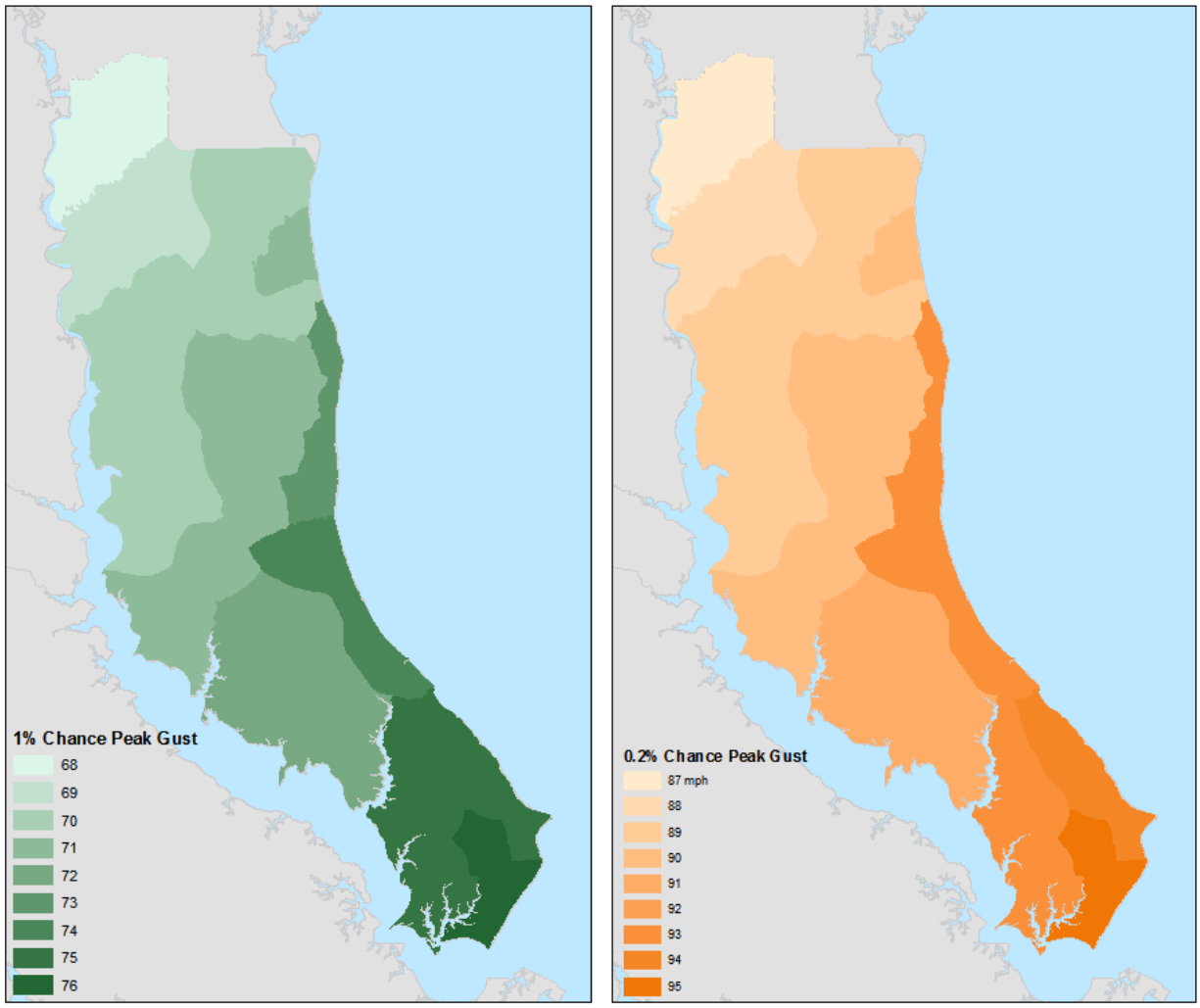
Table 5.4 Number of Insurance Policies in Force for Calvert County and Municipalities

Area	Policies in Force	Insurance in Force	Whole Written Premiums in Force
Maryland	67,139	$15,576,282,400	$39,555,407
Calvert County	533	$152,661,700	$481,319
Town of Chesapeake Beach	173	$52,423,000	$123,043
City of North Beach	110	$25,950,600	$129,039

Coastal Wind

Historical evidence shows that the State of Maryland is vulnerable to severe, hurricane and tropical storm-force winds. The approach for determining vulnerability to coastal winds included a number of factors. HAZUS-MH was used for wind speed data as well as an inventory and in-house damage functions, which were used in estimating losses. The potential hurricane wind gusts that could affect the area range from 68 to 75 mph for a 1% chance per year event to 87 to 95 mph for a 0.2% chance per year event, with the stronger winds being in the southern and eastern quadrants of the county (**Figure 5.7**).

Figure 5.7 - Potential Hurricane Wind Gusts for 1% and 0.2% per year Wind Events



Modeled from HAZUS-MH, the total built property exposure to coastal winds (both building and contents) in the county is $19,652,598 (**Table 5.5**).

Table 5.5
Potential Annualized Losses from Hurricane Winds by Jurisdiction

Jurisdiction	Total Exposure	Estimated Losses	Loss Ratio
Tract # 860101	$817,641,000	$3,224	0.0000039
Tract # 860102	$777,814,000	$768	0.0000009
Tract # 860200	$1,441,435,000	$2,519	0.0000017
Tract # 860300	$966,690,000	$1,773	0.0000018
Tract # 860401	$1,347,643,000	$4,064	0.0000030
Tract # 860402	$557,201,000	$1,606	0.0000028
Tract # 860501	$1,303,107,000	$3,157	0.0000024
Tract # 860502	$734,435,000	$3,280	0.0000044
Tract # 860600	$1,673,133,000	$3,075	0.0000018

Tract # 860701	$730,734,000	$3,768	0.0000051
Tract # 860702	$892,065,000	$1,177	0.0000013
Tract # 860703	$656,391,000	$6,947	0.0000105
Tract # 860801	$1,621,833,000	$28,836	0.0000177
Tract # 860802	$1,019,027,000	$23,243	0.0000228
Tract # 860900	$1,709,975,000	$41,805	0.0000244
Tract # 861001	$325,264,000	$9,772	0.0000300
Tract # 861003	$1,277,882,000	$43,732	0.0000342
Tract # 861004	$1,239,594,000	$46,031	0.0000371
North Beach	$97,076,000	$293	0.0000030
Chesapeake Beach	$646,451,000	$1,925	0.0000029
TOTAL	**$19,835,391,000**	**$230,995**	**0.0000116**

Another means of gauging the vulnerability within Calvert County to coastal wind was the vulnerability of critical facilities to the 1% chance per year and 0.2% chance per year wind return periods. During a 1% chance per year wind event, no critical facilities had more than a 50% chance of sustaining minor, moderate, or severe damage. In a 0.2% chance per year wind event, 1 facility has a better than 50% chance of sustaining severe (10 to 50% damage, (**Table 5.6**).

Table 5.6
Potential Damage to Critical Facilities from Hurricane Winds by Type[11]

Type	Number of Critical Facilities	1% chance per year Wind			0.2% chance per year Wind		
		> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	> 50% Chance of Severe Damage	> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	> 50% Chance of Severe Damage
EOCs	1	0	0	0	0	0	0
Fire Stations	5	0	0	0	0	0	0
Hospitals	1	0	0	0	0	0	0
Police Stations	2	0	0	0	0	0	0
Schools	35	0	0	0	0	0	0
TOTAL	**44**	**0**	**0**	**0**	**0**	**0**	**0**

Tornado

Historical evidence shows that Calvert County is vulnerable to tornadic activity. This particular hazard may result from severe thunderstorm activity or may occur during a tropical storm or hurricane. Because it cannot be predicted where a tornado may touch down, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. It is also not possible to estimate the number of residential, commercial, and other buildings or facilities that may experience losses.

[11] The definitions used are as follows. Minor: less than 2 percent damage. Moderate: 3 to 10 percent damage. Severe: 10 to 50 percent damage.

Therefore, the approach to determining the County's vulnerability to a tornado is to examine not just tornado events in the County boundary, but to look at all of the events of the neighboring counties within 25 miles of the boundary of the County as well. A tornado that impacts Charles County, MD (to the west of Calvert County) could have just as easily impacted Calvert County instead. The actual location of the tornado at this scale of analysis is simply a matter of luck rather than any of the County's unique geographical factors.

Because the neighboring jurisdictions are of differing sizes and densities, the results for must be scaled appropriately. For example, Dorchester County had 0.44 tornado events per year, the same as Calvert County's 0.44 events per year. But, Dorchester County is bigger than Calvert – one would expect the larger county to have more tornado events. In fact, Calvert County is 35% the size of Dorchester County. Therefore, a county the size of Dorchester would have been impacted by 0.154 events per year if the county had been the same size as Calvert. The annualized losses are scaled similarly, but use numbers of housing units as a proxy for differences in building exposure.

Table 5.7 shows the number of events in Calvert County and those counties bordering Calvert County. **Table 5.8** shows the number of annual events and the amount of annual loss in Calvert County and bordering counties after the appropriate scale factor has been applied. **Table 5.9** shows annualized potential losses from tornado events by jurisdiction within Calvert County. The total estimated annualized losses for the county equal $315,347.22.

Table 5.7
Potential Annualized Losses from Tornadoes

Jurisdiction	Events	Losses	Years	Annual Events	Annual Losses
Calvert County, MD	16	$11,352,500.00	36	0.444	**$315,347.22**
St. Mary's County, MD	28	$4,138,500.00	37	0.757	**$111,851.35**
Charles County, MD	23	$116,437,000.00	37	0.622	**$3,146,945.95**
Prince George's County, MD	22	$110,930,000.00	23	0.957	**$4,823,043.48**
Anne Arundel County, MD	14	$6,506,000.00	33	0.424	**$197,151.52**
Talbot County, MD	3	$26,000.00	22	0.136	**$1,181.82**
Dorchester County, MD	11	$5,722,000.00	25	0.440	**$228,880.00**
Average	**16.7**	**$36,444,571.43**	**30.4**	**0.540**	**$1,260,628.76**

Table 5.8
Normalized Occurrences and Losses from Tornadoes

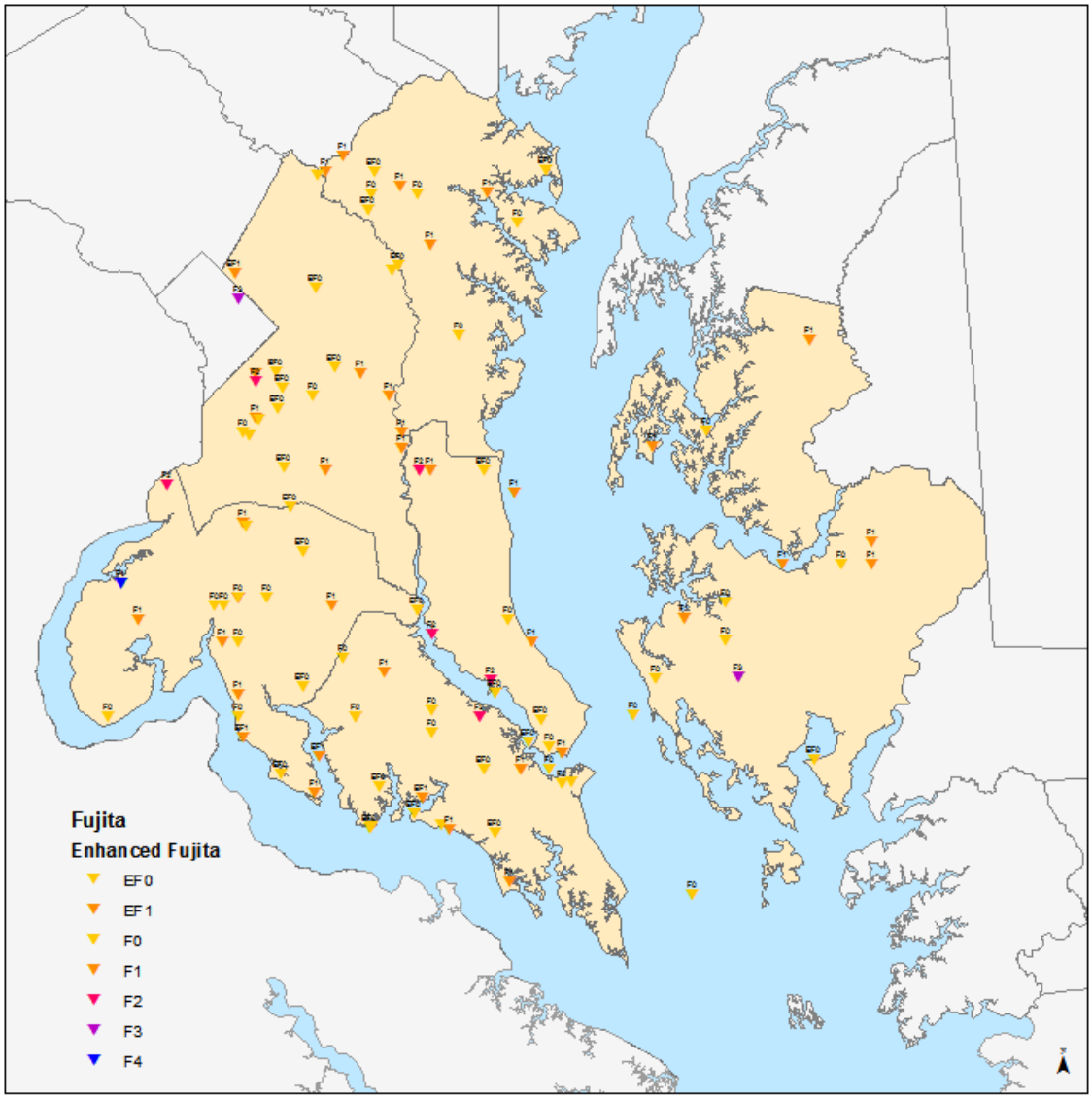
Jurisdiction	Annual Events	Area Scale Factor	Scaled Events	Annual Loss	HU Scale	Scaled Annual Loss
Calvert County, MD	0.444	1.000	0.444	$315,347.22	1.000	**$315,347.22**
St. Mary's County, MD	0.757	2.214	0.342	$111,851.35	1.242	**$90,057.45**
Charles County, MD	0.622	1.864	0.334	$3,146,945.95	1.662	**$1,893,469.28**
Prince George's County, MD	0.957	1.446	0.662	$4,823,043.48	9.594	**$502,714.56**
Anne Arundel County, MD	0.424	1.704	0.249	$197,151.52	6.327	**$31,160.35**
Talbot County, MD	0.136	1.382	0.098	$1,181.82	0.582	**$2,030.62**
Dorchester County, MD	0.440	2.849	0.154	$228,880.00	0.485	**$471,917.53**
Normalized Average	**0.540**	**0.887**	**0.450**	**$1,260,628.71**	**1.092**	**$570,437.19**

The location and magnitude of past tornado events within 25 miles of the county is presented in **Figure 5.8**.

Table 5.9
Potential Annualized Losses from Tornadoes by Jurisdiction

Jurisdiction	Total Exposure	% of Total Exposure	Estimated Loss
Tract # 860101	$817,641,000	4.1%	$23,388
Tract # 860102	$777,814,000	3.9%	$22,247
Tract # 860200	$1,441,435,000	7.3%	$41,642
Tract # 860300	$966,690,000	4.9%	$27,951
Tract # 860401	$1,347,643,000	6.8%	$38,790
Tract # 860402	$557,201,000	2.8%	$15,972
Tract # 860501	$1,303,107,000	6.6%	$37,649
Tract # 860502	$734,435,000	3.7%	$21,106
Tract # 860600	$1,673,133,000	8.4%	$47,917
Tract # 860701	$730,734,000	3.7%	$21,106
Tract # 860702	$892,065,000	4.5%	$25,670
Tract # 860703	$656,391,000	3.3%	$18,824
Tract # 860801	$1,621,833,000	8.2%	$46,776
Tract # 860802	$1,019,027,000	5.1%	$29,092
Tract # 860900	$1,709,975,000	8.6%	$49,058
Tract # 861001	$325,264,000	1.6%	$9,127
Tract # 861003	$1,277,882,000	6.4%	$36,508
Tract # 861004	$1,239,594,000	6.2%	$35,367
North Beach	$97,076,000	0.5%	$2,852
Chesapeake Beach	$646,451,000	3.3%	$18,824
TOTAL	$19,835,391,000	100%	$570,437.19

Figure 5.8 Location and Magnitude of Past Tornado Events within 25 miles



Drought

Although the State of Maryland as a whole is vulnerable to drought, estimated potential losses are somewhat difficult to calculate because drought causes little damage to the built environment, mostly affecting crops and farmland. Therefore, it is assumed that all buildings and facilities are exposed to drought but would experience negligible damage in the occurrence of a drought event.

The approach used to determine vulnerability within Calvert County consisted of a number of factors. Statistical data for the past 100 years from the University of Nebraska, developed based on Palmer Drought and Crop Severity Indices, was analyzed. Drought event frequency/impact was then determined for Calvert County. Also used was USDA agriculture data from 1997. Drought impact on the non-irrigated agriculture products profile was then determined. **Table 5.10** shows the number of events in Calvert County and those counties bordering Calvert County.

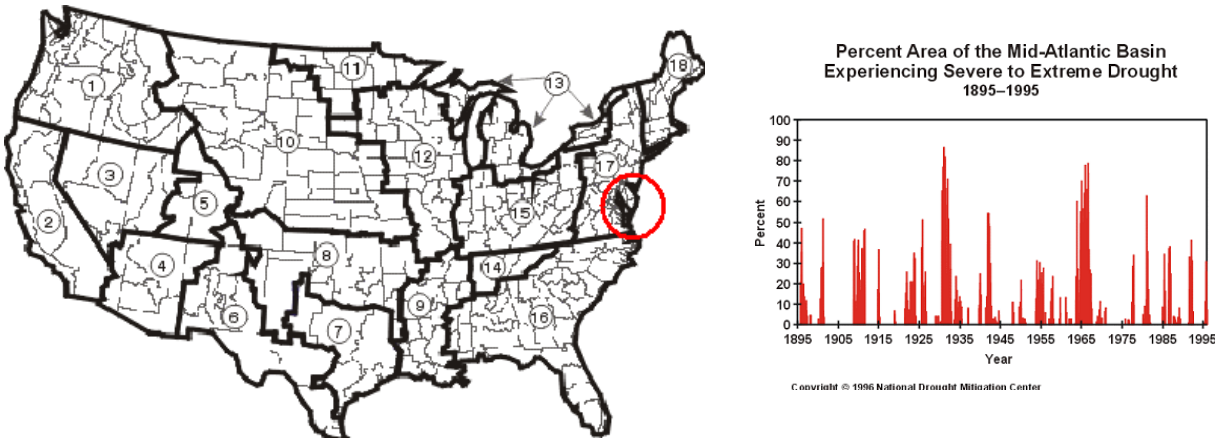
Table 5.10
Annualized Losses from Drought

Jurisdiction	Events	Losses	Years	Annual Events	Annual Losses
Calvert County, MD	16	$334,000	18	0.889	$18,555.56
St. Mary's County, MD	12	$334,000	18	0.667	$18,555.56
Charles County, MD	12	$334,000	18	0.667	$18,555.56
Prince George's County, MD	11	$334,000	19	0.579	$17,578.95
Anne Arundel County, MD	12	$334,000	19	0.632	$17,578.95
Talbot County, MD	59	-	19	3.105	$0.00
Dorchester County, MD	1	$2,000,000	18	0.056	$111,111.11
Average	17.571	$524,285.71	18.429	0.942	$28,847.95

There was one notable drought event that occurred on November 1, 1998. This event is the sole cause of the damaged notes above in each county. This event was caused by abnormally low rainfall totals over a 5-month period. This drought event contributed to $40 million in damage to the fall harvest as well as 303 reported fires across the state of Maryland.

Figure 5.9 shows the hazard profile for drought in the geographic area surrounding Calvert County[12].

Figure 5.9
Hazard Profile for Drought in and Around Calvert County



Hail

The State of Maryland is minimally vulnerable to hail storms. Hail does occur in the Mid-Atlantic but is usually not large enough nor widespread enough to cause any significant damage to the built environment. It does, however, have the potential of harming crops in the agricultural areas of Calvert County.

[12] This information was obtained from the National Drought Mitigation Center (www.drought.unl.edu), which helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management.

The approach to determining vulnerability to hail is similar to that used for severe thunderstorm wind. Historical hail loss data from the National Oceanic and Atmospheric Administration (NOAA) was gathered for Calvert County and the neighboring counties. All historical losses were scaled to account for inflation, and average historic losses were calculated (**Table 5.11**). As with tornadoes (above), because the neighboring jurisdictions are of differing sizes and densities, the results must be normalized appropriately using the method described previously (**Table 5.12**).

Because the total estimated annualized losses for the county is negligible ($2,640.37), annualized expected losses from hail events by jurisdiction were not calculated. The annualized loss ratio is 0.00000018.

Table 5.11
Potential Annualized Losses from Hail

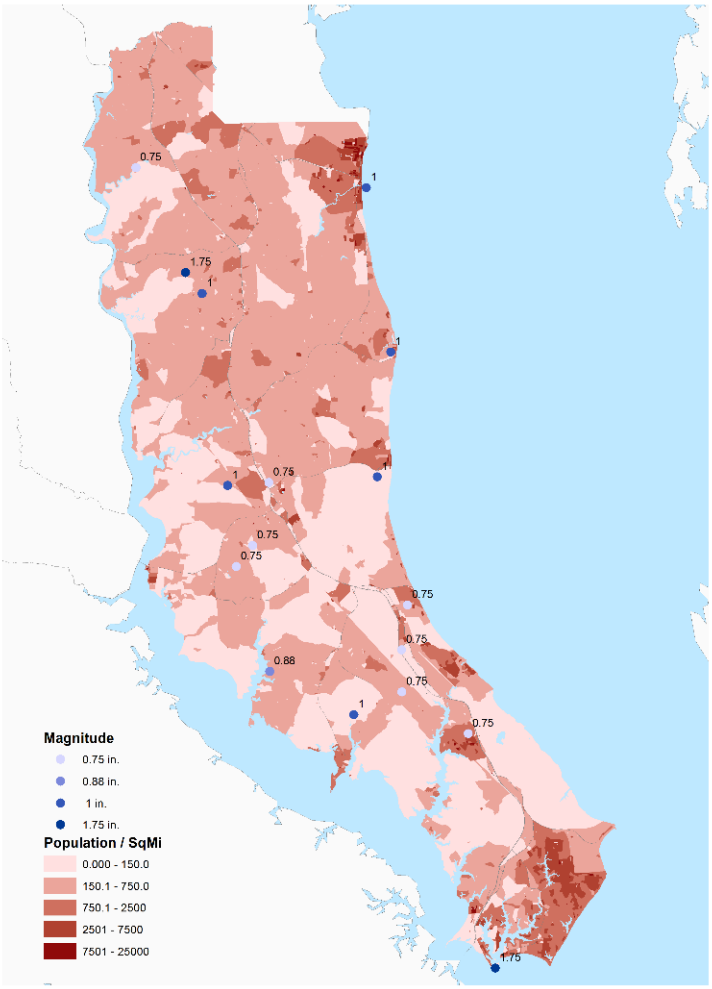
Jurisdiction	Events	Losses	Years	Annual Events	Annual Losses
Calvert County, MD	36	$6,050.00	23	1.565	$263.04
St. Mary's County, MD	49	$12,000.00	35	1.400	$342.86
Charles County, MD	76	$806,500.00	34	2.235	$23,720.59
Prince George's County, MD	85	$12,000.00	38	2.237	$315.79
Anne Arundel County, MD	68	$17,000.00	33	2.061	$515.15
Talbot County, MD	14	$0.00	19	0.737	$0.00
Dorchester County, MD	24	$0.00	22	1.091	$0.00
Normalized Average	50.286	$121,935.71	29.143	1.618	$3,593.92

Table 5.12
Normalized Occurrences and Losses from Hail

Jurisdiction	Annual Events	Area Scale Factor	Scaled Events	Annual Loss	HU Scale	Scaled Annual Loss
Calvert	1.57	1.00	1.57	$263	1.00	$263
St. Mary's	1.40	0.98	1.37	$343	1.00	$341
Charles	2.24	0.76	1.70	$23,721	0.75	$17,739
Prince George's	2.24	0.71	1.60	$316	0.13	$40
Anne Arundel	2.06	0.85	1.75	$515	0.19	$100
Talbot	0.74	1.29	0.95	$0	2.10	$0
Dorchester	1.09	0.61	0.67	$0	2.48	$0
Normalized Average	1.62	0.89	1.37	$3,593.92	1.09	$2,640.37

Figure 5.10 shows recorded hail activity by hailstone size, relative to population distribution within the county.

Figure 5.9 - Recorded Hail Activity by Hailstone Size in Relation to Population Distribution



Winter Storms

Historical evidence shows that Calvert County is quite vulnerable to winter storms, with several occurring each year. Because winter storms generally impact large areas, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. It is also not possible to estimate the number of residential, commercial, and other buildings or facilities that may experience losses. Additionally, it is important to note that for winter storms, some factors that contribute to a community's actual and perceived losses are not reflected in this analysis, such as removal of snow from roadways, debris clean-up, some indirect losses from power outages, etc.

The approach to determining vulnerability to winter storms is similar to that used for tornadoes. Historical winter storm loss data from the National Oceanic and Atmospheric Administration (NOAA) was gathered for Calvert County and the neighboring counties. All historical losses were scaled to account for inflation, and average historic losses were calculated (**Table 5.13**). As with tornadoes (above), because the neighboring jurisdictions are of differing sizes and densities, the results must be normalized appropriately using the method described previously (**Table 5.14**). **Table 5.15** shows annualized expected losses from winter storm events by jurisdiction within Calvert County. The total estimated annualized losses for the county equal $500 and an annualized loss ratio of 0.0000013.

Table 5.13
Potential Annualized Losses from Winter Storms

Jurisdiction	Events	Losses	Years	Annual Events	Annual Losses
Calvert County, MD	81	$10,000.00	20	4.050	$500.00
St. Mary's County, MD	78	$15,000.00	20	3.900	$750.00
Charles County, MD	93	$5,000.00	20	4.650	$250.00
Prince George's County, MD	108	$1,090,000.00	20	5.400	$54,500.00
Anne Arundel County, MD	111	$2,172,000.00	20	5.550	$108,600.00
Talbot County, MD	110	$400,000.00	20	5.500	$20,000.00
Dorchester County, MD	67	$0.00	20	3.350	$0.00
Average	92.571	$527,428.57	20.000	4.629	$26,371.43

Table 5.14
Normalized Occurrences and Losses from Winter Storms

Jurisdiction	Annual Events	Area Scale Factor	Scaled Events	Annual Loss	AL Scale	Scaled Annual Loss
Calvert County, MD	4.05	1.00	4.05	$500	1.00	**$500**
St. Mary's County, MD	3.90	0.98	3.82	$750	1.00	$747
Charles County, MD	4.65	0.76	3.53	$250	0.75	$187
Prince George's County, MD	5.40	0.71	3.86	$54,500	0.13	$6,826
Anne Arundel County, MD	5.55	0.85	4.72	$108,600	0.19	$21,000
Talbot County, MD	5.50	1.29	7.10	$20,000	2.10	$41,991
Dorchester County, MD	3.35	0.61	2.05	$0	2.48	$0
Normalized Average	4.63	0.89	4.16	$26,371.43	1.09	$10,178.65

Table 5.15
Potential Annualized Losses from Winter Storms by Jurisdiction

Jurisdiction	Total Exposure	% of Total Exposure	Estimated Losses
Tract # 860101	$817,641,000	4.1%	$417.32
Tract # 860102	$777,814,000	3.9%	$396.97
Tract # 860200	$1,441,435,000	7.3%	$743.04
Tract # 860300	$966,690,000	4.9%	$498.75
Tract # 860401	$1,347,643,000	6.8%	$692.15
Tract # 860402	$557,201,000	2.8%	$285.00
Tract # 860501	$1,303,107,000	6.6%	$671.79
Tract # 860502	$734,435,000	3.7%	$376.61
Tract # 860600	$1,673,133,000	8.4%	$855.01
Tract # 860701	$730,734,000	3.7%	$376.61
Tract # 860702	$892,065,000	4.5%	$458.04
Tract # 860703	$656,391,000	3.3%	$335.90
Tract # 860801	$1,621,833,000	8.2%	$834.65

Tract # 860802	$1,019,027,000	5.1%	$519.11
Tract # 860900	$1,709,975,000	8.6%	$875.36
Tract # 861001	$325,264,000	1.6%	$162.86
Tract # 861003	$1,277,882,000	6.4%	$651.43
Tract # 861004	$1,239,594,000	6.2%	$631.08
North Beach	$97,076,000	0.5%	$50.89
Chesapeake Beach	$646,451,000	3.3%	$335.90
TOTAL	**$19,835,391,000**	**100%**	**$10,178.65**

Thunderstorm Wind

Calvert County, according to historical records, is affected by severe thunderstorms several times a year. The strong winds and lightning generated from severe thunderstorms pose a threat to the residents, the built environment, and particularly the trees within the County. However, because severe thunderstorms are not spatially-constrained, one must consider the entire County at risk. In addition, the extent of damage from severe thunderstorm wind may be either localized or widespread but it is rarely consistent across space. Therefore, it is impossible to predict if certain areas of the county may be more vulnerable than others and even to estimate the number of buildings that may suffer loss from a severe thunderstorm wind.

The approach to determining vulnerability to severe thunderstorms is similar to that used for tornadoes. Historical severe thunderstorm loss data from the National Oceanic and Atmospheric Administration (NOAA) was gathered for Calvert County and the neighboring counties. All historical losses were scaled to account for inflation, and average historic losses were calculated (**Table 5.16**). As with tornadoes (above), because the neighboring jurisdictions are of differing sizes and densities, the results must be normalized appropriately using the method described previously (**Table 5.17**). **Table 5.18** shows annualized expected losses from severe thunderstorm events by jurisdiction within Calvert County. The total estimated annualized losses for the county equal $129,507 and an annualized loss ratio of 0.0000065.

Table 5.16
Potential Annualized Losses from Severe Thunderstorms

Jurisdiction	Events	Losses	Years	Annual Events	Annual Losses
Calvert County, MD	220	$2,850,000.00	36	6.111	**$79,166.67**
St. Mary's County, MD	242	$6,840,600.00	39	6.205	**$175,400.00**
Charles County, MD	294	$2,404,000.00	39	7.538	**$61,641.03**
Prince George's County, MD	381	$8,760,750.00	37	10.297	**$236,777.03**
Anne Arundel County, MD	439	$8,582,250.00	39	11.256	**$220,057.69**
Talbot County, MD	218	$1,811,010.00	38	5.737	**$47,658.16**
Dorchester County, MD	87	$2,833,000.00	33	2.636	**$85,848.48**
Average	**268.714**	**$4,868,801.43**	**37.286**	**7.112**	**$129,507.01**

Table 5.17

Normalized Occurrences and Losses from Severe Thunderstorms

Jurisdiction	Annual Events	Area Scale Factor	Scaled Events	Annual Loss	AL Scale	Scaled Annual Loss
Calvert County, MD	6.11	1.00	6.11	$79,167	1.00	$79,167
St. Mary's County, MD	6.21	0.98	6.08	$175,400	1.00	$174,639
Charles County, MD	7.54	0.76	5.73	$61,641	0.75	$46,097
Prince George's County, MD	10.30	0.71	7.36	$236,777	0.13	$29,655
Anne Arundel County, MD	11.26	0.85	9.57	$220,058	0.19	$42,552
Talbot County, MD	5.74	1.29	7.41	$47,658	2.10	$100,061
Dorchester County, MD	2.64	0.61	1.61	$85,848	2.48	$213,159
Normalized Average	7.11	0.89	6.27	$129,507.01	1.09	$97,904.33

Table 5.18
Potential Annualized Losses from Thunderstorms by Jurisdiction

Jurisdiction	Total Exposure	% of Total Exposure	Estimated Losses
Tract # 860101	$817,641,000	4.1%	$4,014
Tract # 860102	$777,814,000	3.9%	$3,818
Tract # 860200	$1,441,435,000	7.3%	$7,147
Tract # 860300	$966,690,000	4.9%	$4,797
Tract # 860401	$1,347,643,000	6.8%	$6,657
Tract # 860402	$557,201,000	2.8%	$2,741
Tract # 860501	$1,303,107,000	6.6%	$6,462
Tract # 860502	$734,435,000	3.7%	$3,622
Tract # 860600	$1,673,133,000	8.4%	$8,224
Tract # 860701	$730,734,000	3.7%	$3,622
Tract # 860702	$892,065,000	4.5%	$4,406
Tract # 860703	$656,391,000	3.3%	$3,231
Tract # 860801	$1,621,833,000	8.2%	$8,028
Tract # 860802	$1,019,027,000	5.1%	$4,993
Tract # 860900	$1,709,975,000	8.6%	$8,420
Tract # 861001	$325,264,000	1.6%	$1,566
Tract # 861003	$1,277,882,000	6.4%	$6,266
Tract # 861004	$1,239,594,000	6.2%	$6,070
North Beach	$97,076,000	0.5%	$490
Chesapeake Beach	$646,451,000	3.3%	$3,231
TOTAL	$19,835,391,000	100.0%	$97,904.33

Earthquake

Figure 5.10 shows the potential ground motion for a 1% chance per year and 0.2% chance per year earthquake. While Calvert County has felt earthquakes every so often, none have been significant enough to cause any damage for well over 100 years. The coastal plain of the Mid-Atlantic is notorious for being a seismically quiet zone. However, if a serious earthquake were to occur, the losses would likely be significant.

This explains the amount of potential annualized losses for the county of $530,180 (**Table 5.19**) or an annualized loss ratio of 0.0000267. **Table 5.20** shows potential damage to critical facilities from earthquake events by jurisdiction within Calvert County. None are predicted to suffer more than negligible damage in either a 1% or 0.2% chance per year earthquake.

Figure 5.11

Peak Ground Acceleration (Ground Motion) for 1% and 0.2% chance per year Events

1% chance per year Ground Motion **0.2% chance per year Ground Motion**

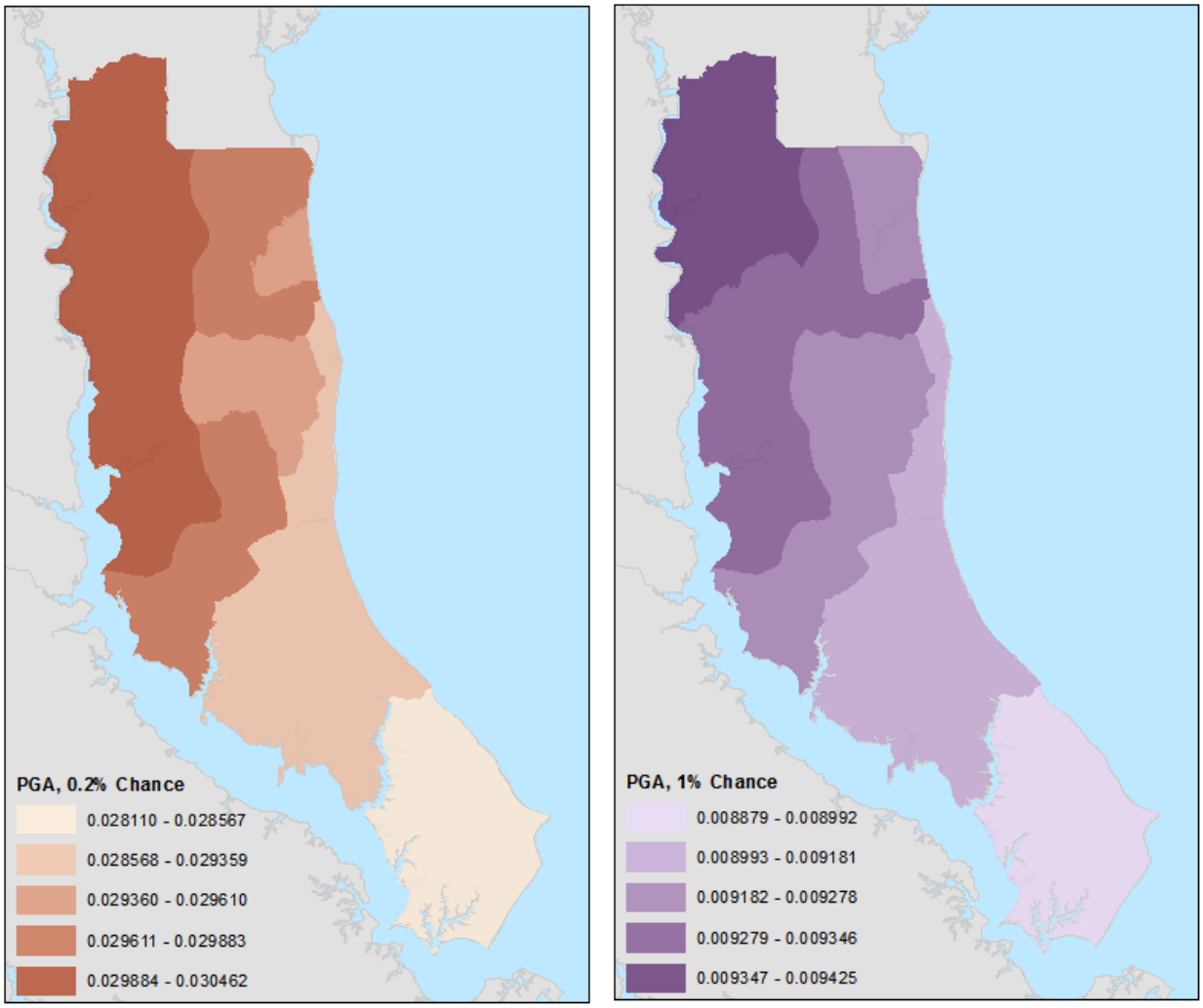


Table 5.19

Potential Annualized Losses from Earthquake per Jurisdiction

Jurisdiction	Total Exposure	Estimated Losses	Loss Ratio
Tract # 860101	$817,641,000	$23,480	0.0000011
Tract # 860102	$777,814,000	$23,290	0.0000011
Tract # 860200	$1,441,435,000	$40,660	0.0000020
Tract # 860300	$966,690,000	$25,900	0.0000013
Tract # 860401	$1,347,643,000	$36,200	0.0000018
Tract # 860402	$557,201,000	$15,070	0.0000007
Tract # 860501	$1,303,107,000	$33,950	0.0000017
Tract # 860502	$734,435,000	$18,450	0.0000009
Tract # 860600	$1,673,133,000	$45,400	0.0000022
Tract # 860701	$730,734,000	$23,030	0.0000011
Tract # 860702	$892,065,000	$27,920	0.0000014
Tract # 860703	$656,391,000	$18,060	0.0000009
Tract # 860801	$1,621,833,000	$41,220	0.0000020
Tract # 860802	$1,019,027,000	$25,690	0.0000012
Tract # 860900	$1,709,975,000	$43,970	0.0000022
Tract # 861001	$325,264,000	$8,360	0.0000004
Tract # 861003	$1,277,882,000	$30,940	0.0000015
Tract # 861004	$1,239,594,000	$28,580	0.0000014
North Beach	$97,076,000	$2,610	0.0000001
Chesapeake Beach	$646,451,000	$17,400	0.0000008
TOTAL	**$19,835,391,000**	**$530,180**	**0.0000267**

Table 5.20
Potential Damage to Critical Facilities from Earthquake per Type[13]

Type	Number of Critical Facilities	1% chance per year Earthquake			0.2% chance per year Earthquake		
		> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	> 50% Chance of Severe Damage	> 50% Chance of Minor Damage	> 50% Chance of Moderate Damage	**> 50% Chance of Severe Damage**
EOCs	1	0	0	0	0	0	0
Fire Stations	5	0	0	0	0	0	0
Hospitals	1	0	0	0	0	0	0
Police Stations	2	0	0	0	0	0	0
Schools	35	0	0	0	0	0	0
TOTAL	**44**	**0**	**0**	**0**	**0**	**0**	**0**

[13] The definitions used are as follows. Negligible: less than 1 percent damage. Slight: 1 to 5 percent damage. Moderate: 5 to 30 percent damage. Extensive (where applicable): 30 to 60 percent damage.

Dam/Levee Failure

The approach for determining vulnerability to dam and/or levee failure consists of a number of factors. Data from the USACE National Inventory of Dams (NID)[14] in addition to the HAZUS-MH demographic inventory was used, with an assumption that dam breaks most likely will occur at the time of maximum capacity. **Table 5.21** shows dams in Calvert County and their associated Hazard Risk Levels, along with the year build and structure height in feet.

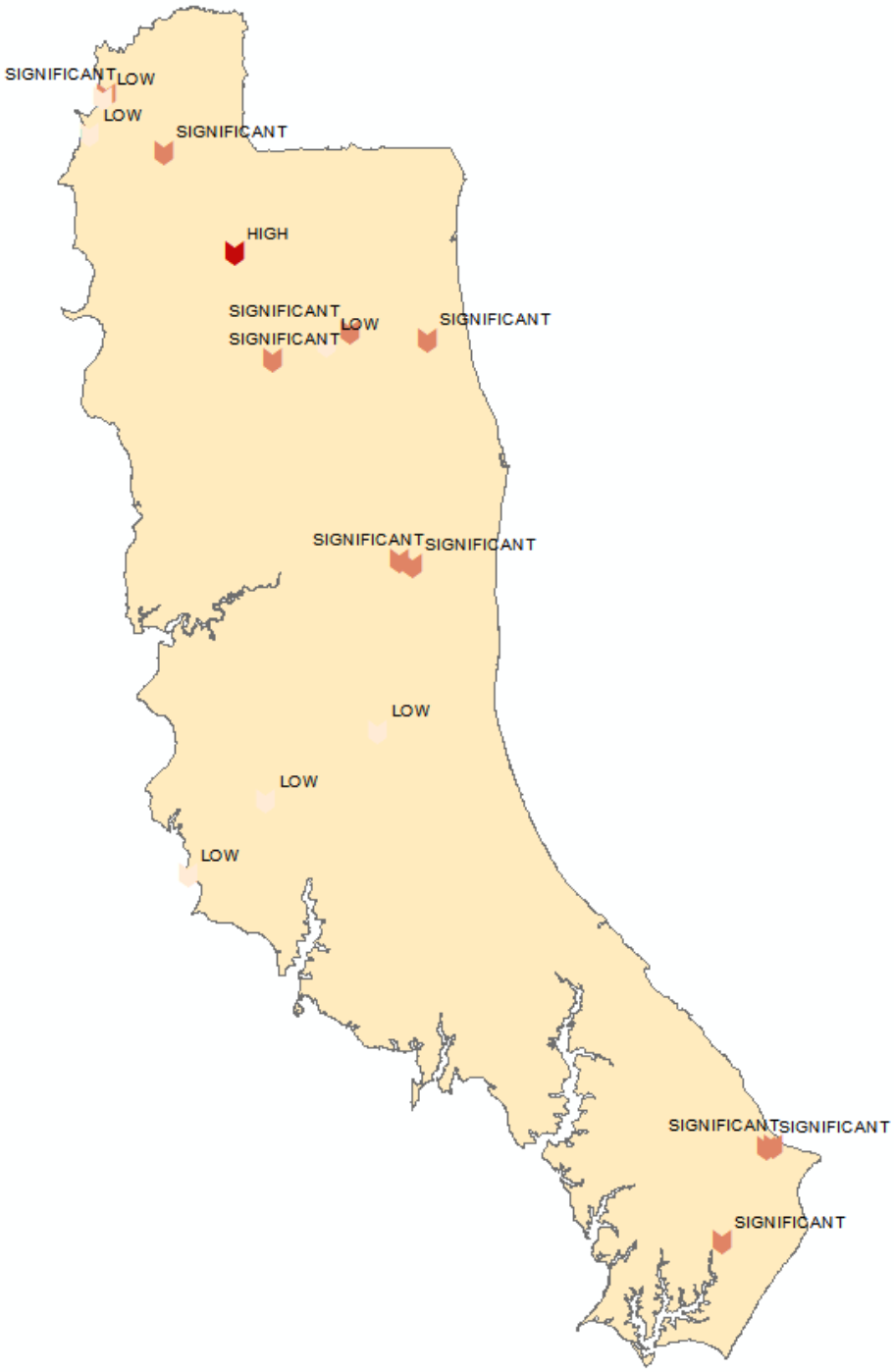
Table 5.21
Estimated Exposure of People to Dam Failure

Dam Name	Hazard	Ht(feet)	Built
Ferry Landing Woods Pond	Low	11	1981
Calvert Gateway	Significant	10	2000
Shores of Calvert Upper Dam	Significant	5	1972
Shores of Calvert Lower Dam	Low	15	1972
Victoria Station Community Lake	High	105	1986
Sunderland Railroad Embankment Pond	Low	25	N/A
Lake Ridge Community Pond Dam	Significant	10	1969
Lake Karylbrook Community Pond	Significant	67	N/A
Queensberry Drive Swm	Significant	52	2001
Prince Frederick Wwtp Pond 2	Low	15	2002
Bowens Farm Pond	Low	40	1970
Starkey Pond	Low	42	N/A
Cove Point Lng Secondary Dam	Significant	7	1974
Cove Point Lng Main Dam	Significant	20	1974
Chesapeake Ranch Estates Dam	High	27	1965
Queensberry Drive Playground Dam	Significant	42	2001
Twin Lakes Upper Pond (Hoile Lane)	Significant	31	1970

Figure 5.11 shows the location of dams within Calvert County, along with their hazard ranking (high, significant or low), in relation to population density.

[14] With the National Dam Inspection Act of 1972, the U.S. Congress authorized the U.S. Army Corps of Engineers (USACE) to inventory dams located in the United States. The Water Resources Development Act of 1986 authorized USACE to maintain and periodically publish an updated National Inventory of Dams (NID).

Figure 5.11
Location of Dams with Hazard Ranking within Calvert County



Other Hazards

Though communities in the State of Maryland recognize that the state is vulnerable to other hazards such as wildfire, erosion, sinkholes, landslides, tsunamis, or terrorism, a high-level detailed risk assessment was not completed for Calvert County due to the low level of risk and/or vulnerability for these hazards within the area as a whole as compared with other hazards.

Conclusions on Hazard Risk

Table 5.22 summarizes the annualized expected losses presented for each natural hazard in this section. Based upon the methodologies described in the beginning of this section, the risk from natural hazards in Calvert County can be rated on a scale of Low, Moderate or High for each identified natural hazard based upon these annualized losses and an annualized loss ratio (**Table 5.23**). Because of the nature of human-caused hazards and the nature in which risk and vulnerability is presented for human-caused hazards, it is not possible to rank them fairly in direct comparison with natural hazards. In summary, all human-caused hazards addressed in this section—terrorism (chemical, radiological and biological agents), hazardous materials incidents (HazMat), and energy pipeline failures—warrant an overall rating of low risk for Calvert County.

Table 5.22
Potential Annualized Loss Rates per Jurisdiction

Jurisdiction	Flooding	Coastal Wind	Tornado	Drought	Hail	Winter Storm	Thunder -storm	Earthquake
Tract # 860101	0.0000000	0.0000039	0.0000237	---	---	0.0000013	0.0000065	**0.0000011**
Tract # 860102	-	0.0000009	0.0000237	---	---	0.0000013	0.0000065	**0.0000011**
Tract # 860200	0.0004600	0.0000017	0.0000239	---	---	0.0000013	0.0000066	**0.0000020**
Tract # 860300	0.0026900	0.0000018	0.0000239	---	---	0.0000013	0.0000066	**0.0000013**
Tract # 860401	0.0002700	0.0000030	0.0000238	---	---	0.0000013	0.0000065	**0.0000018**
Tract # 860402	-	0.0000028	0.0000237	---	---	0.0000013	0.0000065	**0.0000007**
Tract # 860501	-	0.0000024	0.0000239	---	---	0.0000013	0.0000066	**0.0000017**
Tract # 860502	0.0007900	0.0000044	0.0000238	---	---	0.0000013	0.0000065	**0.0000009**
Tract # 860600	0.0016900	0.0000018	0.0000237	---	---	0.0000013	0.0000065	**0.0000022**
Tract # 860701	0.0012700	0.0000051	0.0000239	---	---	0.0000013	0.0000066	**0.0000011**
Tract # 860702	-	0.0000013	0.0000238	---	---	0.0000013	0.0000065	**0.0000014**
Tract # 860703	0.0003600	0.0000105	0.0000237	---	---	0.0000013	0.0000065	**0.0000009**
Tract # 860801	0.0008000	0.0000177	0.0000239	---	---	0.0000013	0.0000065	**0.0000020**
Tract # 860802	0.0003800	0.0000228	0.0000236	---	---	0.0000013	0.0000065	**0.0000012**
Tract # 860900	0.0008800	0.0000244	0.0000238	---	---	0.0000013	0.0000065	**0.0000022**
Tract # 861001	0.0006000	0.0000300	0.0000232	---	---	0.0000013	0.0000064	**0.0000004**
Tract # 861003	0.0005200	0.0000342	0.0000237	---	---	0.0000013	0.0000065	**0.0000015**
Tract # 861004	-	0.0000371	0.0000236	---	---	0.0000013	0.0000065	**0.0000014**
North Beach	0.0008800	0.0000030	0.0000243	---	---	0.0000014	0.0000067	**0.0000001**
Chesapeake Beach	0.0007800	0.0000029	0.0000300	---	---	0.0000017	0.0000066	**0.0000008**
TOTAL	**0.00081**	**0.0000116**	**0.0000238**	**0.0000015**	**0.0000002**	**0.0000013**	**0.0000065**	**0.0000267**

* Both Drought and Hail loss ratios were calculated from the amount of assessed value of farm properties in the county and therefore are not directly comparable to the other hazards

Table 5.23
Estimated Level of Risk by Hazard for Calvert County (High, Moderate, Low)

Flood	Coastal Wind	Tornado	Drought	Hail	Winter Storm	Thunder-storm	Earthquake
High	High	Moderate	Low	Low	Moderate	Moderate	Moderate

It should be noted that although some hazards may show Medium or Low risk, hazard occurrence is still possible. Also, any hazard occurrence could potentially cause a great impact and losses could be extremely high (e.g. an F5 tornado or a Category 5 hurricane).

Table 5.24 provides an overall ranking of risk by hazard for Calvert County.

Table 5.24
Overall Risk Ranking for Calvert County

Hazard	Rank
Flood	1
Coastal Storm Wind	2
Tornado	3
Severe Thunderstorm	4
Lightning	5
Earthquake	6
Winter Storm	7
Extreme Temperatures	8
Hail	9
Drought	10

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CHAPTER 6: CAPABILITY ASSESSMENT

Introduction

Performing a mitigation capability assessment is an integral component to developing a comprehensive and implementable mitigation strategy. The capability assessment identifies existing gaps, conflicts, and/or shortcomings, between various county plans, that may need to be addressed through future mitigation actions and helps to ensure that proposed mitigation actions are practical, while considering the municipalities' capacity for implementation. This assessment also examines completed or in-progress actions that merit continued support and enhancement through future efforts.

This mitigation capability assessment comprises three components:

1. Plan Integration and Document Review - an inventory of the County's existing planning and regulatory tools and a review and incorporation of existing plans and other technical information as appropriate,
2. Emergency Response Capabilities and Responsibilities
3. Municipal Capability Assessment - an analysis of municipal capacity from a planning, policy, staffing, and training standpoint.

Plan Integration and Document Review

Requirement §201.6(b)*: Review and incorporate, if appropriate, existing plans, studies, reports, and technical information.*

The purpose of a plan/ordinance review as part of this planning process is tri-fold:

- To identify existing county and municipal initiatives;
- To provide an inventory and review of sample plans and ordinances and identify sections in these documents that address hazard mitigation-related issues; and

- To provide a platform to integrate plans and other documents so recommendations and strategies do not contradict one another (e.g., between the hazard mitigation plan and comprehensive plan).

A Document Review comprises an inventory of the County's existing planning and regulatory tools and a review and incorporation of existing plans and other technical information as appropriate. The purpose of a plan/ordinance review is tri-fold:

- To identify existing county standards and mandates
- To provide an inventory and review of sample plans and ordinances and identify sections in these documents that address hazard mitigation-related issues
- To provide a platform to integrate plans and other documents so recommendations and strategies are not in contradiction with one another (e.g., between the hazard mitigation plan and comprehensive plan).

At the time this Plan was written, the Calvert County Comprehensive Plan Update 2017 was under development and was not available for review, and will be incorporated once it is adopted. The seven documents reviewed and listed below were the plans and ordinances selected and provided to VPC by the County.

VPC reviewed updates to existing road ordinances, stormwater management plans, sediment and erosion control plans, and community flood mitigation plans, among others, and summarized their connections with hazard mitigation.

County and Local Documents Reviewed

County Plans and Ordinances

- Calvert County Floodplain Regulations
- Calvert County Road Ordinance
- Calvert County Soil and Erosion Control Regulations
- Calvert County Stormwater Management Ordinance

Community Plans and Ordinances

- Breezy Point/Neeld Estate Flood Mitigation Plan
- Broomes Island Flood Mitigation Plan
- Cove Point Community Flood Mitigation Plan

Breezy Point/Neeld Estate – 2017 (draft)

At the time this Plan was written, the Breezy Point/Neeld Estate Flood Mitigation Plan was under development and was not available for review. The draft plan is currently available online at http://www.co.cal.md.us/DocumentCenter/View/14875.

Cove Point Community Flood Mitigation Plan – 2014

The Cove Point Community Flood Mitigation Plan is designed to identify community specific flooding issues; recommend mitigation actions; and suggest funding sources for the mitigation efforts.

Recommendations from the Cove Point Community Flood Mitigation Plan are detailed in Chapter

9 of this document: Goals and Mitigation Strategy.

Observations: No reference is made to elevating or floodproofing properties, restricting development, planting vegetation, or potential retreat from the area.
Recommendations: Five "standard" mitigation actions have been identified in the Calvert County Flood Mitigation Plan and are reiterated below. These actions should be included in the Cove Point plan to fortify the communities limited mitigation efforts.

- Conduct extensive educational outreach. Encourage residents outside of the current floodplain to prepare for sea level rise and floodplain creep.
- Increasing freeboard and elevating buildings even in areas above base flood elevation to prepare for sea level rise and the potential for floodplain creep.
- Wet floodproofing basements or crawlspace areas. Encouraging wet floodproofing even in areas above base flood elevation to prepare for the potential of floodplain creep.
- Elevating utilities and using water-safe/waterproof paints, compounds, and flooring in all first-floor enclosures.
- Encourage planting of mature trees and vegetation to stabilize the soil and prohibit clearing of new land for development, especially within 30 meters of the current floodplain.

Broomes Island Flood Mitigation Plan - 2016

The purpose of the Broomes Island Flood Mitigation Plan is "To develop a flood mitigation plan to improve the Broomes Island community's resistance to flooding by identifying actions that reduce flood impacts to residents, structures, and infrastructure; reviewing and modifying, if necessary, the emergency response plan for Broomes Island; and by identifying projected impacts of sea level rise scenarios at 2050 and 2100."

Recommendations from the Broomes Island Plan are detailed in Chapter 9 of this document: Goals and Mitigation Strategy.

Observations: This Plan is robust in nature and addresses pertinent issues.

Recommendations: No additional recommendations at this time.

Calvert County Floodplain Ordin*ance - Amended in 2011 and 2014*

The Calvert County Floodplain Ordinance was established to protect residents and properties in areas that suffer from periodic flooding from; loss of life, use, or property. Flood hazard areas can interrupt business, day to day operations, and even government services. As such, Calvert County has adhered to NFIP regulations since September 28th, 1984. All development or new construction from that date forward is compliant.

Table 6.1. Floodplain Coordinators

Municipality	Name	Address	Telephone Number
North Beach	John Hoffman	Town of North Beach, Town Hall, North Beach, MD	410-535-5940
Chesapeake Beach	Bill Watson	Town of Chesapeake Beach, Town Hall, Chesapeake Beach, MD	410-286-5222

Calvert County	John Swartz, Certified Floodplain Manager	Department of Community Planning and Building, 150 Main Street, 3rd Floor, Prince Frederick, MD 20678	410-535-1600 X2238

The following sections of the Ordinance relate directly to mitigation and are acceptable standards and echoed in this document;

8-2.03 – I.2 - Subdivision Proposals and Development Proposals

a.i. Subdivision proposals and *development* proposals shall have utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage.

8-2.03 – I.3 - Protection of Water Supply and Sanitary Sewage Systems

a. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems.
b. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into systems and discharges from systems into floodwaters.
c. On-site waste disposal systems shall be located to avoid impairment to or contamination from them during conditions of *flooding*

8-2.03 – I.4 - Buildings and Structures

Photo 6.1 – Elevated Utilities

d. Have electrical systems, equipment and components, and mechanical, heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment located at or above the elevation of the *lowest floor* required in Section 8-2.03.J.4.a or J.5.a (A Zones) or Section 8-2.03.K.3.b *(V Zones and Coastal A Zones).* Electrical wiring systems are permitted to be located below elevation of the *lowest floor* provided they conform to the provisions of the electrical part of the *building code* for wet locations. If replaced as part of a *substantial improvement,* electrical systems, equipment and components, and heating, ventilation, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall meet the requirements of this section.

8-2.03 I.6 – Historic Features

Repair, alteration, addition, rehabilitation, or other improvement of *historic features* shall be subject to the requirements of these regulations if the proposed work is determined to be a *substantial improvement,* unless a determination is made that the proposed work will not preclude the *feature's* continued designation as a *historic feature.* The Floodplain Administrator may require documentation of a *structure's* continued eligibility and designation as a *historic feature.*

8-2.03 I.7 – Manufactured Homes

a. New *manufactured homes* shall not be placed or installed in *floodways* or *coastal high hazard areas* (V Zones).
b. For the purpose of these regulations, the *lowest floor* of a *manufactured home* is the bottom of the lowest horizontal supporting member (longitudinal chassis frame beam).

8-2.03 I.9 – Critical and Essential Facilities

a. Not be located in *coastal high hazard areas* (V Zones), Coastal A Zones or floodways.
b. If located in flood hazard areas other than *coastal high hazard areas*, Coastal A Zones and floodways, be elevated to the higher of elevation required by these regulations plus one foot (3 foot above the *base flood elevation*), the elevation required by the *building code*, or the elevation of the 0.2 percent chance (500-year) flood.

8-2.03 I.11 – Gas or Liquid Storage Tanks

a. Underground tanks in flood hazard areas shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the *base flood.*
b. Above-ground tanks in flood hazard areas shall be anchored to a supporting structure and elevated to or above the *base flood elevation,* or shall be anchored or otherwise designed and constructed to prevent flotation, collapse, or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, during conditions of the *base flood.*
c. In flood hazard areas, tank inlets, fill openings, outlets and vents shall be:
i. At or above the *base flood elevation* or fitted with covers designed to prevent the inflow of floodwater or outflow of the contents of the tanks during conditions of the *base flood;* and
ii. Anchored to prevent lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, during conditions of the *base flood.*

8-2.03 J.3 -Residential Structures and Residential Portions of Mixed Use Structures

a.i - Lowest floors shall be elevated to or above the *flood protection elevation* (2 foot above the Base Flood Elevation).

Photo 6.2 – Elevated Structure

Recommendations:

Consider removing:

8-2.03 – I.4.e - As an alternative to paragraph (d), electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment are permitted to be located below the elevation of the *lowest floor* provided they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to that elevation.

Remove the caveat entirely to curb new development in flood prone areas.

Consider modifying to read:

8-2.03 – I.4.f - Have the electric panelboard elevated at least four (4) feet above the BFE. Increase the requirements to match the new BFEs.

8-2.03 – I.7.c.ii – Be installed in accordance with the anchor and tie-down requirements of the *building code* or the manufacturer's written installation instructions and specifications Specifically include the suggestion of Hurricane Straps for tie downs.

8-2.03 J.3 - *a.i - Lowest floors* shall be elevated to or above the *flood protection elevation* (2 foot above the Base Flood Elevation).

Consider increasing to 3 feet above BFE.

Calvert County Grading, Erosion and Sediment Control Ordinance – 2016

The purpose of the Calvert County Grading, Erosion and Sediment Control Ordinance is to protect, maintain, and enhance the safety, and welfare in the County by establishing minimum to review and approve Erosion and Sediment Control Plans. The proper erosion and sediment control practices will reduce the amount of off-site sedimentation caused by soil erosion, and will assist in the maintenance of stream, river and bay water quality standards.

The Ordinance is applicable to the "disturbance, development and use of all land within the unincorporated County, unless expressly and specifically exempted, "grandfathered" or provided (for) otherwise." The provisions of this Plan apply to the development and use of all land within the County, and the incorporated areas of the County once adopted by the municipality, and an agreement with Public Works.

The following sections of the plan relate directly to flood mitigation and planning and are acceptable standards.

§38-6 Vesting and Grandfathering

Calvert County honors the "vested" rights provided by Maryland Case Law. This allows for the continuance of certain development standards that were enacted prior to the enactment of the Ordinance.

B.1 - Any plans that receive final approval after January 9, 2013 must be in compliance with the requirements of this Ordinance and the Standards and Specifications.
B.4 - If a plan was approved prior to January 9, 2013, the site can proceed under the stands under which it was approved.

§38-7 Exemptions for Activities Located Outside the Critical Area and Buffer

2.a **-** Clearing or grading activities that disturb less than 5,000 square feet of land area and disturb less than 100 cubic yards of earth that do not direct runoff to highly erodible soils and do not disturb or discharge toward steep slopes and not related to new construction of a single-family dwelling.

3 - Any surface mining operation and the affected land covered by a surface mining permit issued

by the State of Maryland, Department of Natural Resources, under the authority of the Maryland Annotated Code, Natural Resources Article, Title 7, Subtitle 6A

§38-8 Variance
B. Any variance granted must include appropriate erosion and sediment control measures, which may include, without limitation: redundant controls; accelerated stabilization; more frequent inspections; and other measures that may be required by the approving authority to serve the purpose of this Chapter 38.

Observations: This Plan is robust in nature.

Recommendations: There are no additional recommendations at this time.

Calvert County Road Ordinance – 2016

The purpose of the Calvert County Roads Ordinance is to establish the guidelines, regulations and criteria for the planning, development, construction, improvement, reconstruction, maintenance, and repairs to the roads, within the county including, but not limited to, sidewalks, curbs, gutters, storm drainage infrastructure and facilities, utilities, incidental structures, street lighting, and landscaping, etc.

Specific sections of the plan that directly relate to flood mitigation and that are acceptable standards are as follows;

§104-28 Drainage

A. Every roadway and residential subdivision shall be provided with storm drains, culverts, drainage ways, or other means of conveyance adequate to collect and dispose of all water, originating on or flowing across the roads and property without inundating or damaging roads, lots, or other properties.
B. Drainage facilities shall be designed in accordance with Part 4, Storm Drainage Design Criteria, of this ordinance.
D. Flood Plain District - Development of designated flood plain areas designated by mapping or elevation shall be restricted to the uses specified in the County Zoning Ordinance and in accordance with erosion and sediment control plans approved by the U.S. Department of Agriculture/NRCS.

§104-41 Introduction

D. All drainage structures are to be built according to the current edition of The Calvert County Construction Standards for Roads, Streets, and Incidental Structures, or as otherwise approved. A structure schedule specifying the Calvert County and/or MSHA detail number shall be provided on the plans.

E. Where a subdivision is traversed by a water course, stream, or other natural drainage course, the director shall require the developer to:
1. Dedicate an easement area of sufficient width to adequately dispose of the surface drainage

water expected in a 50-year storm, and conforming substantially with the lines of such natural water course;
2. Furnish by dedication sufficient easement or construction, or both, to safely dispose of such stormwater.

§104-42 Right-to-Discharge and Storm Drain Easements

A. Storm Drain Easements are required by the County for all public or private storm drainage facilities, whether natural or improved, surface or subsurface, including stormwater management facilities. Additionally, no structures other than those of the storm drainage system itself are allowed within the storm drain easements and access to these areas is not to be restricted in any way.

C. The standard storm drain easement width is a minimum of 20 feet.

§104-43 Study of Impact on Downstream Development

A. A local study of the impact on existing downstream development and/or conditions to be caused by proposed upstream development will be conducted. This study will then be submitted to the Engineering Division prior to final plan approval. This study will include a development impact statement to the county addressing the following:

§104-45 General - Overland Flow of a 1% chance Frequency Rain Storm

A. The Engineering Division Chief may require a study showing the routing of a 100- year storm through a proposed development and proposed storm drainage system.
B. Factors to be considered in requiring a 1% chance storm routing are size and type of development, proposed lot and road grading, proximity of streams, location of septic fields, possibility of property damage, etc. Proposed developments shall be examined individually based on the above criteria, the development impact statement, and other contributing factors.

§104-68 Retaining Walls Supporting Any Infrastructure and Embankments

A.3 - Existing retaining walls of any height located within a right-of-way or associated easement may be subject to removal or modification if the director deems that the wall poses a potential safety hazard, obstructs vision, alters stormwater management or storm drainage function, or hinders maintenance work within a right-of-way and/or easement area.

Observations: This Plan is robust in nature.

Recommendations: There are no additional recommendations at this time.

Calvert County Stormwater Management Ordinance - 2010

The purpose of the Calvert County Stormwater Management Ordinance is to “protect, maintain and enhance the public health, safety, and general welfare” by delineating the minimum requirements and provisions to mitigate the impacts of stormwater runoff. The goal is to manage stormwater by using innovative environmental site design and to maintain, even after development, the pre-development runoff patterns and to “reduce stream channel erosion,

pollution, siltation and sedimentation, and local flooding."

The Stormwater Ordinance applies to all new, improvement, and redevelopment projects that have not received final approval for erosion and sediment control and stormwater management plans by May 4, 2010.
The Ordinance contains specific sections relevant to Flood Mitigation and are considered acceptable standards are listed as follows:

§ 123-6. Exemptions

B. Additions or modifications to existing single family detached residential structures if they comply with C of this section;

C. Developments that do not disturb over 5,000 square feet of land area; including new and redevelopment.

§ 123-8. Redevelopment

B. All redevelopment designs shall:

1. Reduce impervious area within the limit of disturbance (LOD) by at least 50 percent according to the Design Manual;

2. Implement ESD to the MEP to provide water quality treatment for at least 50 percent of the existing impervious area within the LOD;

3. Use a combination of Section 123-8 B. (1) and (2) of this Ordinance for at least 50 percent of the existing site impervious area.

§ 123-9. Variances

B. Fees in lieu of stormwater management practices shall be required at the discretion of the Engineer when a written variance is issued in accordance with the provisions of this Ordinance. The Board has established a fee schedule for fees in lieu of stormwater management practices based on the following (which may be amended from time to time):

Table 6.2: Fees in Lieu for Calvert County Stormwater Ordinance

Type of Development	Fee
Single Family Residential	$600.00/Dwelling Unit
Commercial Development	$8,000.00/Impervious Acre

§ 123-10. Minimum Control Requirements

A.2 - Control of the 2-year and 10-year frequency storm event is required according to the Design Manual and all subsequent revisions if the Department determines that additional stormwater management is necessary because historical flooding problems exist and downstream floodplain development and conveyance system design cannot be controlled.

A.3 - The Department may require more than the minimum control requirements specified in this Ordinance if hydrologic or topographic conditions warrant or if flooding, stream channel erosion,

or water quality problems exist downstream from a proposed project.

Observations: This Plan is robust in nature.

Recommendations: There are no additional recommendations at this time.

Maryland State Plans

Planning studies include a wide variety of projects such as comprehensive plans, master plans, land use plans, revitalization plans, mitigation plans, and transportation plans. In general, land use plans and comprehensive plans discuss the direction of growth of the community and can pave the way to integrate principles of hazard mitigation

State of Maryland Hazard Mitigation Plan – August 2016

The State Hazard Mitigation Plan identifies a number of objectives and policies to assist local communities such as Calvert County and its municipalities with their hazard mitigation strategies. The following specific mitigation actions discuss the State's support to local governments with local mitigation projects:

- Since many important mitigation decisions are and will continue to be made at the local government level MEMA will continue to support the development and implementation of local hazard mitigation plans.

- The State will strive to improve knowledge and data sharing capabilities statewide.

- MEMA has integrated local mitigation plan mitigation goals, objectives and strategies into the 2016 State of Maryland Hazard Mitigation Plan and will continue in future updates.

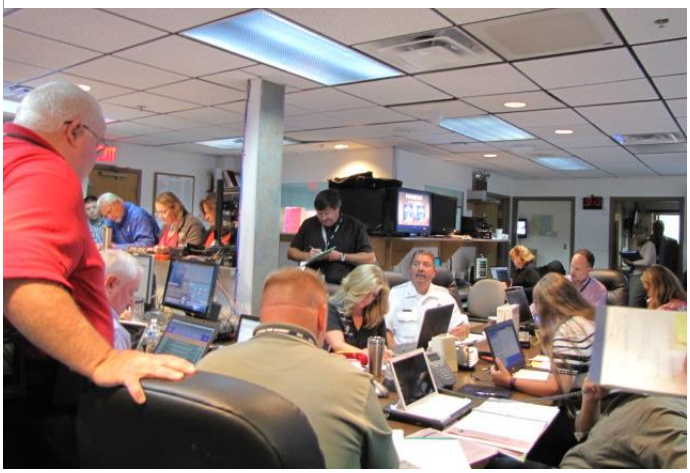
- MEMA will continue to support local governments in the updating and development of local hazard mitigation plans by providing extensive technical assistance. This assistance will include continued training on regulatory requirements and the use of Hazard Analysis and Risk Assessment Data and Floodplain Management training.

- MEMA will partner with responsible State agencies to identify mitigation strategies for State-owned facilities that have been identified in the Risk Assessment as located in hazard areas for flash and riverine flooding.

Additionally, the State Hazard Analysis provided Calvert County a high risk ranking for tidal/coastal flooding, a medium-high ranking for both thunderstorms and flooding, and a high ranking for winter storms. The Analysis identifies most areas bordering the Chesapeake Bay are protected from flooding by the bluffs that characterize this portion of the Bay's western shore, with the exception of low-lying areas near Cove Point, Long Beach, Parker's Creek, and upper North Beach.

Emergency Response Capabilities and Responsibilities

Photo 6.3 – County Emergency Operations Center



Calvert County is vulnerable to various natural and technological hazards that have the potential to disrupt the county and cause serious damage. During emergencies, local response agencies generally have the capability to provide effective response actions that protect life and property. Mutual Aid Agreements and Memorandum of Understanding are in place to ensure the emergency support functions of the various groups involved in emergency management generally parallel their normal daily activities – that is, the same personnel, equipment, and materials used on a regular basis would be used to combat major disasters. Calvert County Fire/Rescue/EMS is an all-volunteer system which is comprised of 6 fire stations which include both Fire, Rescue, and EMS capabilities, 1 EMS only station; 1 advanced life support station with chase vehicles; and 1 dive team. In extreme circumstances, augmentation of these resources (e.g., from State/Federal governments) may be needed. The County is able to utilize available resources from the private sector and volunteer organizations where possible and/or necessary. The County Department of Public Safety maintains resource information on supplies, equipment, facilities, and skilled personnel available for emergency response and recovery.

The Calvert County Division of Emergency Management, within the Department of Public Safety, is the entity responsible for planning and coordinating plans, procedures and resources in preparation for, and response to, a natural or man-made disaster. Emergency management services at the State level are coordinated by the Maryland Emergency Management Agency. The County EMD office is located at 175 Main Street in Prince Frederick which also contains the County's Emergency Communications Center and Emergency Operation Center (EOC). The EOC is located in the lower level of the north wing of the Courthouse, along with the Calvert Control (911 Center). The Emergency Operations Center is staffed during normal working hours and the County 911 Center is staffed 24/7. Upon activation of the EOC, 24-hour staffing is available through personnel assigned to EOC communications. An alternate EOC is located at the Prince Frederick Fire Department located at 450 Solomons Island Rd South, Prince Frederick, Maryland 20678, on Route 2 and 4, just south of Duke Street, and is activated should the primary EOC become inoperable or uninhabitable. Calvert County's EOC is equipped with a bunkroom, showers, and full kitchen with cooking supplies, plates, utensils, and cups. The EOC has a backup generator which will operate all systems in the EOC. The alternate EOC mirrors the capabilities of the main EOC.

The EOC may be activated at one of four levels (**Figure 6.1**) depending upon the nature and scope of the incident or potential incident. The EOC may also be activated for a significant planned event in order to monitor events and provide for an effective response if necessary. The Director of Public Safety and/or Emergency Management Division Chief will designate the level of activation and will ensure appropriate notifications are made.

Figure 6.1 – Emergency Operations Center Activation Levels

All department and agency points-of-contact (POC) will be notified of the EOC activation by EMD through the Calvert County Mass Notification System and/or other available means. In turn, agency EOC Representatives will be notified through their agency's internal notification process.

The ultimate responsibility for Emergency Management of any disaster rests with the Calvert County Board of Commissioners. The Board is responsible for all policy-level decisions which are implemented through the County Administrator. A Public Information Officer is responsible for preparing news releases and coordinating the release of information to the media and the public.

As summarized in Table 5.3, various agencies within Calvert County have designated roles in the event of an emergency. Several agencies have a representative to the EOC: Fire and Rescue; County Health Department; Department of Social Services; American Red Cross; Calvert County Public Works; Board of Education; Maryland State Police; Calvert County Sheriff's Office; Emergency Medical Services (EMS); Radiological Officers, and Facilities Management. During some emergency situations, certain agencies may be required to relocate their center of control to the Emergency Operations Center. Appointing authorities can assign County employees to perform emergency work at any location in the County and for periods of time other than the normal hours of employment.

Table 6.3. Emergency Responsibilities of Select Calvert County Organizations

Action	Responsible Agency
Ordering an evacuation	Division of Emergency Management in conjunction with the Board of County Commissioners
Activating the emergency operations center	Division of Emergency Management
Opening and operating evacuation shelters	EOC activates the shelters if the Board of Education and Department of Social Services agree. Only schools with shower facilities (high schools) are used as shelters

Sandbagging certain areas	Property owners are primarily responsible for sandbagging with some assistance from Public Works.
Closing levee and floodwall systems	City of Chesapeake Beach
Closing streets or bridges	Public Works, Transportation, and Law Enforcement
Monitoring water levels at the high hazard dams which fall outside the city limits	Public Works, all bridges are privately owned
Shutting off power to threatened areas	Southern Maryland Electric Cooperative, BG&E
Releasing children from school	Board of Education

The implementation of the EOP and activation of the EOC may occur simultaneously. The level of EOP and EOC activation will be based upon the severity and scope of the incident. The ICS integrated with Emergency Support Functions (ESF) and various annexes established by this plan may be selectively activated based upon initial or anticipated requirements.

The EOP may be implemented by the President of the Board of County Commissioners, the County Administrator, the Director of Public Safety, the Emergency Management Division Chief, or their designees. Annex A of the County's Emergency Operations Plan lays out the procedures to be used by the County's Division of Emergency Management staff in the operation of the Emergency Operations Center during major emergency or disaster situations.

The Communications Annex (Annex B) provides information on communication capabilities during emergency situations when the Emergency Operations Center has been activated. The Annex identifies the organization and responsibilities of a number of agencies including the Division of Emergency Management; county departments with communication capabilities; Calvert Control; Fire, Rescue, and Police services; and Radio Amateur Civil Emergency Services.

Evacuation issues are addressed in Annex C of the County's EOP. The purpose of this Annex is to provide for an orderly and coordinated evacuation in the event of hazards such as a riverine flood, hurricane, hazardous materials incident, fixed nuclear facility incident, major fire, transportation accident, or terrorist attack. Measures considered for control and coordination when planning for an evacuation include; geographic area; traffic control points; assembly points; and shelters.

The County Public Information Officer prepares public information releases to advise residents of areas affected and actions to be taken, i.e. assembly points for persons without private transportation, evacuation routes to be used, etc. and insures that current and accurate information is available for dissemination.

The County's Emergency Management website also provides a link to emergency management information: http://www.co.cal.md.us/residents/safety/emergency/ and to resources including state and federal agencies and the American Red Cross.

The Department of Public Safety maintains a 24/7 monitoring and notification capability through the Calvert Control Center-911 Communications. The Division of Emergency Management Division Chief or his/her designee is responsible for making internal and external emergency notifications to identified agencies and organizations as required. The Calvert County Emergency Communications 911 Center also has capabilities to communicate with the deaf through text telephone (TTY), and maintains a roster of interpreters to communicate with non-English speaking individuals.

The Calvert Control Center-911 Communications operates the county's 911 and dispatch facility for police, fire, and emergency medical services. The Calvert Control Center uses a Computer-aided Dispatch (CAD) system to process telephone calls and dispatch police, fire, and EMS in a timely manner. The Calvert Control Center makes emergency notifications to identified agencies and organizations as required.

The DEM Division Chief, in cooperation with the Calvert County Public Information Officer (PIO), maintains the capability to provide warnings and emergency information to the public through multiple communications modes. Depending on the characteristics of the hazard and the size and population of the area that is threatened, one or more of the following systems/techniques can be used to warn the public including door-to-door sweeps by emergency service personnel; telephone fan-out to schools, major employers, hospitals, nursing homes, and day care centers.

Additional resources include but are not limited to:

- The Emergency Alert System (EAS): A national system jointly administered by the Federal Communications Commission, the Federal Emergency Management Agency (FEMA), and the National Weather Service. It is designed to provide the President of the United States automatic access to the nation's broadcast systems to speak directly to the nation in times of national disaster.

- Emergency Information Line: Maintained by DEM and provides pre-recorded preparedness information residents will need during an emergency. During an activation of the EOP the capabilities are expanded and the emergency information line is staffed with call takers 24 hours a day, reporting to and receiving messaging information from the PIO.

- Comcast Channel 6: Provides residents with critical information during severe weather or other emergencies. Current programing can be interrupted during emergencies to provide information and recommended protective actions directions to the public. The channel 6 emergency messaging system provides the capability for "crawl messaging" for persons with hearing disabilities and audio instructions with descriptive messages for residents with visual disabilities.

- The Emergency Notification Network (EMnet): Emergency Management information can be provided to the media through the internet or satellite for immediate transmission to the general public. EMnet is a privately managed messaging network for the emergency management community. It is a satellite-based secure system that provides two-way internet capabilities in the event the

primary system is not available. Participants use the network to convey urgent messages and support documentation (reports, photos, information, etc.…) within the emergency management community, as well as to create and issue EAS messages to broadcasters. EMnet also allows the DEM Staff to see EAS messages which are originated by other organizations such as the National Weather Service that are issued to the county and other local jurisdictions.

- FEMA's Integrated Public Alert and Warning System (IPAWS): IPAWS is an internet-based capability Federal, State, territorial, tribal, and local authorities can use to issue critical public alerts and warnings. IPAWS is accessed through software that meets IPAWS system requirements. There is no cost to send messages through IPAWS, although there may be costs associated with acquiring compatible alert origination software. IPAWS is not mandatory and does not replace existing methods of alerting, but instead complements existing systems and offers new capabilities.

- Mass Notification System (MNS): Provides the capability to distribute notifications and emergency alerts to residents via electronic mail, cellular telephone, or pager using a text messaging system. List-serves and focused MNS groups provide information electronically to the residents of neighborhoods that are highly vulnerable to localized flooding and other hazards. MNS registration is accessible on the Calvert County Website as well as for individuals with access and functional needs who request assistance in registering for the delivery mode of their choice.

Local Radio Stations: Calvert County has agreements in place with local radio providers to broadcast emergency information on local stations during disasters or emergencies.

Western Shore:

WKIK FM	102.9 MHz	California
WKIK AM	1560 kHZ	La Plata
WPRS FM	104.1 MHz	La Plata
WTOP FM	103.5 MHz	Frederick and DC
WYRX FM	97.7 MHz	Lexington Park
WPTX AM	1690 kHz	Lexington Park
WSMD FM	98.3 MHz	Mechanicsville
WGOP AM	540 kHz	Pocomoke
WRAR FM	105.5 MHz	Tappahannock
WNNT FM	100.9 MHz	Warsaw

Eastern Shore:

WCEI FM	96.7 MHz	Easton
WEMD AM	1460kHz	Easton
WCEM FM	106.3 MHz	Cambridge
WCEM AM	1240 kHz	Cambridge

Public Access Cable Television:

Comcast Cable Channel 6	Calvert County Government

- Calvert County may also use variable messaging sign boards along major roadways as another method for providing information and warnings to the public.

- Radio Amateur Civil Emergency Services (RACES)

    - Provide support for ESF's 2- Communications, 5- Emergency Management, 6- Mass care, Emergency Assistance, Housing and Human Services.
    - Coordinate and provide emergency communications for outlying areas, local shelters, Maryland State Emergency Management Agency in the EOC.
    - Provide backup communications via RACES network for communications between adjacent county EOC's.
    - Provide other communications services requested if within the scope or capability of RACES personnel to do so.
    - Participate in training and exercises as determined by the Director of Emergency Management.

County Government, Departments, and Staffing Capabilities

Calvert County was founded around 1650 and was renamed from Patuxent County to Calvert County in 1658. Its governing body is the Board of County Commissioners of Calvert County. Calvert County government's departments and divisions conducting emergency planning, response and resiliency planning, and implementation include: Economic Development, Public Safety, General Services, Planning and Zoning, and Public Works.

County department responsibilities are summarized below:

- Department of Economic Development: Calvert County's Department of Economic Development focuses on encouraging existing businesses, attracting new employers, and promoting tourism. This department administers programs related to: infrastructure, labor, incentive programs, utilities, transportation, and telecommunications. The Department also handles public outreach through a Public Information Specialist.

- Department of Public Safety: The Department of Public Safety manages daily emergency response calls; works to mitigate man-made, technological and/or natural disasters; and serves as a point of contact and coordination for Homeland Security issues at the County, State, and Federal levels. Public Safety functions as a reference or resource center for all emergency related issues.

- Department of Public Safety, Emergency Management Division: The Emergency Management Division strives to minimize the effects of future disasters through mitigation, planning, training and response efforts. The Division maintains and updates the Emergency Operations Plan and promotes public awareness of disaster prevention or preparedness to insure the County is ready for any emergency.

- Department of Public Safety, Fire, Rescue & Emergency Medical Services Division: This division is responsible for providing fire protection, rescue and emergency medical services to the citizens of Calvert County.

- General Services, Housing Authority: The County's Housing Authority assists citizens in obtaining safe and affordable housing. Some of the programs administered include: the Housing Choice Voucher Program, Public Family Housing, Housing for Seniors and the Disabled, the Special Loan Program, the Calvert Loan Program, and the Rental Allowance Program.

- General Services, Parks & Recreation Division: The Parks and Recreation Division develops a comprehensive program that provides recreational activities in the community centers, public schools and County parks. It is also responsible for the management, maintenance, and development of the County's active recreation parks.

- Department of Planning and Zoning: The Department of Planning and Zoning is responsible for the Comprehensive Plan, Zoning Ordinance, and zoning maps. This department administers and supervises: the Critical Area and Forest Conservation Programs, tree planting, building permits, Site Plan and Subdivision review, historic preservation progams, and zoning enforcement. Other functions include: applying for and administering grants, serving as staff to the Historic Preservation Commission, Environmental Commission, and the Agricultural Preservation Advisory Board, and implementing county and state agricultural preservation programs.

- Public Works Department: The primary function of the Public Works Department is to oversee building construction projects. This includes road and bridge construction and maintenance as well as review of subdivision plans, and building or grading permits, and stormwater management plans.

Specilaized staffing for mitigation and hazard related projects:

- PZ ES staffs one Chief of Inspections and Permits, two electrical inspectors, two plumbing inspectors, two building inspectors, and one code enforcement officer and one Certified Floodplain Manager (CFM).

- There is one surveyor in the Public Works Department who conducts survey work for only county projects. For private properties, residents are required to hire their own surveyors.

- The Department of Planning and Zoning has one GIS Specialist.

- The CFM in Planning and Zoning ES works with Inspections and Permits on flood issues. The CFM conducts reviews with the MDE of the County Flood Management Program once every other year.

CHAPTER 7: MITIGATION STRATEGY

Update Process Summary

Requirement §201.6(c)(3): *The Plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

The mitigation strategy serves as the long-term road map to reduce the potential losses, vulnerabilities, and shortcomings identified in the Hazard Identification and Risk Assessment section. A typical mitigation strategy includes a list of goals and objectives, along with specific mitigation actions to address the goals and objectives. Actions are then prioritized, based on the community's requirements.

The mitigation strategy in this Plan comprises the following seven subsections:

- Goals and Objectives
- Identification and Analysis of Mitigation Techniques
- Mitigation Action Implementation Plan
- Municipal Mitigation Actions
- National Flood Insurance Program and Continued Compliance
- Prioritization of Mitigation Actions
- Deleted, Combined, and Removed Actions

Definitions

Goals: Goals represent broad statements that are achieved through the implementation of more specific, action-oriented objectives. Goals provide the framework for achieving the intent of the mission statement.

Hazard Mitigation Projects: Projects are defined as specific actions taken to address defined vulnerabilities to existing buildings or systems. Potential funding sources are listed for each project.

Mitigation Action Plan: Prioritized listing of actions (policies and projects), including a categorization of mitigation technique, hazards addressed, individual or organization responsible for implementation, estimated timeline for completion and list of potential funding sources.

Goals and Objectives

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards*

For the purposes of this Plan, goals are defined as general policy guidelines or broad statements that represent a vision for a community. Calvert County's Vision is to "Seek common planning solutions for the variety of hazards that pose a risk to Calvert County and its municipalities".

Objectives define strategies or implementation steps to attain the identified goals. Compared to goals, objectives are more specific and measurable. The goals for this planning process have been developed in close coordination with the Steering Committee based on the following: findings from the THIRA (issues), mitigation capability assessment (gaps); and original goals and objectives from the 2010 plan (revisited and revised by the Steering Committee).

The goals and objectives from the 2010 (original) Calvert County Hazard Mitigation Plan were reviewed and reorganized by the Steering Committee and were designed to serve as the basis for the mitigation actions at the County and municipal level. Each mitigation action is linked to one or more goals and objectives.

Following is the list of the 2017 Calvert County Hazard Mitigation Plan goals and objectives. Goals and objectives that were determined to be applicable at the county level as well as to both municipalities have an asterisk (*) placed next to them. The goals and objectives have been organized to mirror the 2016 Maryland State Hazard Mitigation Plan categories, be in harmony with the goals from the State Plan, categorized to match the goals in the Calvert County Flood Mitigation Plan, and to be applicable at both the county and local levels.

Preventative Measures

Goal 1*: Minimize losses and institute adequate regulations through land use regulations.

- Identify and support public and private projects and programs to retrofit, relocate, or acquire properties as well as remove structures susceptible to repetitive flooding.
- Continue to implement systematic maintenance programs for stormwater management systems.

- Discourage new development in high hazard areas through appropriate regulations and land use planning.
- Enforce local, state and federal floodplain regulations and building standards for development in flood hazard areas.

Goal 2*: Ensure hazard mitigation goals are consistent with all other County and Municipal plans and ordinances.

- Incorporate hazard mitigation principles into new and existing plans and ordinances.
- Integrate a hazard mitigation section into Calvert County Comprehensive Plan and Chesapeake Beach and North Beach Comprehensive Plans.

Property Protection

Goal 3*: Minimize future losses from all disasters by reducing the risk to people and property.

- Protect populations and properties throughout Calvert County that may be susceptible to economic or physical loss from disasters, consistent with the standards established in this Plan and other plans which have, or may be, adopted by the County or Towns.
- Provide protection of critical facilities/infrastructure vital to disaster response, such as fire and police stations, and those vital to the continuous operations of the County, municipalities and communities, such as hospitals and health care facilities, water and sewer facilities, electrical and other utilities, and transportation systems.

Goal 4*: Emphasize pre- and post-disaster planning to decrease vulnerability to loss of existing and new construction.

- Promote to elected officials, builders, and existing and potential homeowners, the economic and safety benefits of designing mitigation features into new construction and retrofit of existing structures.
- Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofit.

Public Education and Outreach

Goal 5*: Support a balance between government regulation/enforcement, and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for property owners, families and individuals.

- Continue to develop and support disaster preparedness education and awareness programs, targeting residents, visitors, businesses, and elected officials.
- Continue to develop economic incentive programs, for both public and private sectors, that promote structural retrofitting where and when it is determined to be the best option.

Goal 6*: Emphasize the benefits of hazard mitigation principles through ongoing public outreach activities.

- Educate the public on higher standards of protection to structures and facilities.
- Identify and coordinate public information programs and events such as contests and festivals with public and private partners.
- Identify and seek funding sources that will support hazard mitigation awareness and training programs.

Goal 7: Reduce economic vulnerability and increase recovery capabilities of business and industry.

- Continue public education and outreach on the topics of economic vulnerability and recovery through collaborative programs involving government, businesses and community organizations.

Natural Resources

Goal 8*: Protect natural resources and open-spaces that provide flood and other hazard mitigation.

- Encourage actions that protect natural resources while supporting community resiliency and hazard mitigation efforts.
- Coordinate natural resource preservation and land use planning to ensure that those natural resource areas, that are shown in this or other adopted community plans to provide hazard mitigation benefits, remain open spaces, and retain the natural benefits they provide.

Emergency Services

Goal 9*: Ensure continued coordination and linkages between local jurisdictions and neighboring county and statewide mitigation and resiliency activities to strengthen response and recovery efforts.

- Include local, regional, and statewide jurisdictions in trainings, drills, and exercises to strengthen interagency cooperation.
- Encourage open data and/or data sharing policies and agreements between municipal, county, regional and state jurisdictions to aide in hazard and emergency response, and prepare for Next Generation 911 implementation.

Structural Projects

Goal 10*: Protect infrastructure, and critical facilities to reduce potential disruption of regular activities during and after hazard events.

- Efficiently utilize resources to reinforce infrastructure, to withstand potential hazards, and to ensure continued use during and after an event.
- Coordinate with the Towns of Chesapeake Beach and North Beach to research, secure, and effectively use external, or additional, sources of funding to help make the infrastructure and critical facilities on which the residents, businesses and visitors of the County and Towns depend, more resilient to various hazards and events.

Identification and Analysis of Mitigation Techniques

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

Mitigation actions have been developed for the entire County as well as for each participating municipality. While some actions may be more general in nature and could apply to more than one jurisdiction, most actions are specific to a jurisdiction. The mitigation actions that were developed were based on the following: issues identified in the Hazard Identification and Risk Assessment, gaps identified in the mitigation capability analysis, input from the Steering Committee on actions in the 2010 Plan, and feedback from the Public Meetings.

The actions in the 2010 Plan were reviewed and each action was examined by the Steering Committee and assigned one of the following categories:

- Not Started – Actions that had not been initiated since the adoption of the 2010 Plan
- In Progress – Work has been initiated on these actions; these projects have a definite end-date
- On-Going – Actions that are performed on a regular and continuous basis by the department
- Not Applicable – Actions that were deemed by the Steering Committee to not apply to the Hazard Mitigation Plan
- Completed – Actions that were completed since the adoption of the 2010 Plan
- Cancelled – Actions that were terminated.

Municipal-specific actions from the 2010 Plan were also revisited and updated based on municipal input. These mitigation actions may be implemented through a variety of local tools such as: changes in ordinances and policies, inclusion into capital improvements budgets, and grant funding.

In formulating the Mitigation Strategy, the Steering Committee used the six mitigation categories as utilized by the Maryland State 2016 Hazard Mitigation Plan. They include: 1) Preventative Measures, 2) Public Outreach and Education, 3) Natural Resource Protection, 4) Emergency Services, 5) Property Protection, and 6) Structural Projects. These categories form the basis of the mitigation actions detailed in this plan. Descriptions of each category and examples for each are included below:

Preventative Measures - Preventative activities are those that are performed to keep hazard-related issues from exacerbating in the community. They are effective in reducing a community's future vulnerability, particularly in areas where development has not occurred. Examples of preventative activities include: zoning and subdivision regulations; building codes; hazard mapping; floodplain regulations; stormwater management; drainage system maintenance, and capital improvements programming.

Natural Resource Protection - Natural resource protection activities include those actions that can reduce the impact of hazards by preserving or restoring the function of natural systems. Natural systems that can be classified as high hazard areas include floodplains, wetlands, and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives

and property while enhancing water quality or recreational opportunities. These actions are usually implemented by parks, recreation, or conservation agencies. Examples include: erosion and sediment control; stream and wetland restoration; habitat preservation, and slope stabilization.

Public Outreach and Education - Public Information and awareness activities are conducted to advise and educate residents, business owners, potential property buyers, and visitors about hazards and mitigation techniques that can be used to protect lives and property. Examples of measures used to educate and inform the public include: outreach and education; training; demonstrations; real estate disclosure; hazard expositions, and State/ Federal Program Coordination (StormReady, NFIP, CRS).

Property Protection - Property protection measures include those actions that can be undertaken by private homeowners so their structures can: better withstand hazard events; be removed from hazardous locations, or can be insured to cover potential losses. Examples include: acquisition; building elevation; retrofitting (i.e., wind proofing, flood proofing, seismic design standards, etc.), drainage, etc.

Emergency Services - Although emergency services are not necessarily considered mitigation techniques, these services minimize the impact of a hazard on people and property. Actions taken immediately prior to, during, or in response to a hazard event include: warning systems; search and rescue operations; evacuation planning and management, and flood fighting techniques.

Structural Projects - Structural projects such as reservoirs, levees and floodwalls, dams, channel improvements, crossings and roadways, drainage and storm sewer improvements, and drainage system maintenance are designed to control floodwaters.

Mitigation Action Implementation Plan

The mitigation actions that were developed were based on results from the Hazard Identification and Risk Assessment; mitigation capability analysis; input from the Steering Committee; actions that have been completed in the past; recent past hazard occurrences, and feedback from the Municipal Workshop. Based on qualitative ranking during the Hazard Identification and Vulnerability Analysis phase, three hazards were deemed as high priority hazards by the Steering Committee. These included: flood, severe thunderstorm, and coastal storm wind. Efforts were made to ensure that mitigation actions were included for each of these hazards.

Actions from the 2010 Plan that were categorized as “Not Started” “In Progress” and “On-Going” were carried over to the 2017 Plan Update and rephrased by the Steering Committee as needed, in addition to the new actions that were developed. Mitigation actions from the 20010 Plan that fell into the latter two categories: “In Progress” and “On-Going” were elaborated on identify progress made to date and adjusted to demonstrate the current status of these actions. Once the actions were finalized by the Consultant and Steering Committee, an implementation strategy was developed, which identified the following for each action:

- hazard mitigated;
- lead agency for implementation;
- approximate cost, and
- expected timeline.

Table 7.1 defines the acronyms used to populate the actions table. **Table 7.2** identifies County-level mitigation actions. Some actions from the 2010 Plan have been deleted based on consensus from the Steering Committee as having been completed, being infeasible, or inapplicable due to merging of agencies, elimination of staff positions, etc. Some recommendations from the original plan were merged with others for brevity and clarity purposes. Any actions removed from the plan are noted and justified in Table **7.7**.

Table 7.1 Acronyms for Mitigation Action Item Implementation Table

BOE	Board of Education
CCDNR	Calvert County Department of Natural Resources
CDBG	Community Development Block Grant
CERT	Community Emergency Response Teams
CIP	Capital Improvement Plan
COOP	Continuity of Operations
PZ	Planning and Zoning
CSCD	Calvert Soil Conservation District
DED	Department of Economic Development
DEM	Division of Emergency Management
DIP	Division of Inspections and Permits
DSS	Department of Social Services
EMPG	Emergency Management Performance Grant
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MEMA	Maryland Emergency Management Agency
PDM	Pre-Disaster Mitigation
PIO	Public Information Officer
RLP	Rural Legacy Program
SHA	State Highway Administration
TBD	To be Determined

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
Ongoing Actions							
1	Continue to support a regular maintenance program for emergency generators at the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc.	All	General Services, Public Safety, Technology Services	Coop with utility companies, county staff time.	Staff Time	Ongoing	Emergency Services
2*	Update Comprehensive Plan to include a Hazard Mitigation Section that provides an assessment of hazard vulnerability and appropriate mitigation recommendations	All	County – PZ, Municipalities – Municipal Staff/Officials	Calvert County and Municipalities CIP	Staff Time	1 year	Preventative Measures
3	Continue to conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event	All	County - Division of Emergency Management (Public Safety), Local -	County/Town staff time	Staff Time	Ongoing	Emergency Services
4	Continue to ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level and is well maintained.	All	Public Safety	County/Town staff time	$25,000-100,000	Ongoing	Emergency Services
5*	Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.	All	County and Municipal Staff/Officials	Public Safety technical and training assistance	TBD	Ongoing	Emergency Services

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
6	Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.	Flood	PZ	Staff Time	Staff time	Ongoing	Preventative Measures
7	Introduce NOAA Weather Alert radios in designated critical facilities across the county for situational awareness.	All	Public Safety	HMGP, EMPG	<$25,000	1-2 years	Public Education and Outreach
8	Continue to develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the County website and COMCAST		State Health Department, Technical Service's Public Relations Officer	State Health Department, county staff time	<$25,000	Ongoing	Public Education and Outreach
9	Continue to conduct hazard response practice drills and emergency management training exercises on an annual basis	All	Public Safety	County Staff time	$25,000-100,000	Ongoing	Emergency Services
10*	Identify natural resources that provide natural mitigation such as wetlands, buffers, etc and make them a priority for conservation.	All	PZ, Municipal Officials/Staff with technical assistance	Calvert County CIP, EPA, CDBG	$25,000-100,000	2-5 years	Natural Resource Protection
11	Develop and implement a post-disaster recovery plan.	All	Public Safety with technical assistance from MEMA/FEMA	Local Staff time	Staff Time	1-2 years	Public Education and Outreach
12	Continue to work with local radio stations to promote continuity of public awareness and disaster preparedness.	All	Public Safety	County staff time, COOP with local radio stations	Staff Time	Ongoing	Public Education and Outreach

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
13	Continue to maintain and replace county owned critical infrastructure.	All	Public Works	Calvert County CIP, SHA, MDOT	>$100,000	Ongoing	Property Protection
14	In flooded areas, conduct to conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed	Flood, Storm Surge, Nuisance Flooding	Health Department, Public Water Suppliers and Property Owners	Public Health	$25,000-100,000	Ongoing	Public Education and Outreach
15*	Work with local businesses and local industry owners to develop a continuity of operations plan.	All	Department of Economic Development (DED), PZ, Municipal Staff/Officials	County/Town staff time, MEMA technical assistance	<$25,000	Ongoing	Public Education and Outreach
16*	Continue to provide technical assistance to local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities	All	PZ, Public Safety, Local - Municipal Staff/Officials	County staff time, Public Safety, technical assistance	<$25,000	Ongoing	Public Education and Outreach
17*	Continue to ensure County and municipal compliance with local Stormwater Management Plans	Flood, Storm Surge, Nuisance Flooding	Public Works, Municipal Staff/Officials with technical assistance	County, North Beach, Chesapeake Beach	$25,000-$100,000	2-5 years	Preventative Measures
18	Continue to ensure compliance with approved Erosion and Sedimentation Control Plans and continue to work with local farmers to implement BMPs	Erosion, Flood	Public Works, Calvert Soil Conservation District (CSCD)	County staff time	<$25,000	Ongoing	Natural Resource Protection

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
19	Continue to distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific “do’s” and “don’ts” and emergency contact information	All	Public Relations Office	County	<$25,000	Ongoing	Public Education and Outreach
20*	Maintain zoning ordinance provisions for protection of all hazard areas	All	PZ, Municipalities	No Funding Required	Staff time	Ongoing	Preventative
21*	Continue to coordinate with the County, municipality and/or the Maryland Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow	Flood, Storm Surge, Nuisance Flooding	Public Works, Municipalities, Maryland Department of Transportation (MDOT), SHA	Calvert County CIP, MDOT, SHA	>$100,000	Ongoing	Structural Projects
22*	Give high priority to undeveloped floodplain areas for preservation.	Flood, Storm Surge, Nuisance Flooding	County – Division of Natural Resources (CCDNR), PZ, Local – Municipal Officials	HMGP, FMA, CDBG, PDM, Rural Legacy Program (RLP)	>$100,000	Ongoing	Natural Resources
23*	Continue a community-specific stormwater maintenance program consisting of routine inspections and subsequent debris removal	Flood, Storm Surge, Nuisance Flooding	Municipal Staff/Officials, Public Works	Local Funding	>$100,000	Ongoing	Natural Resource Protection

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
24	Recommend to the Board of Education to develop and implement a natural hazards awareness curriculum.	All	County Public Relations Officer, Board of Education (BOE) with technical assistance from FEMA/MEMA	No Funding Required	Staff Time	1-2 years	Public Education and Outreach
New Mitigation Actions – 2017							
25	Reduce vulnerability to wildfires by providing public education on increasing buffers and defensible spaces.	Wildfire	Public Safety	Local Funding	<$25,000	Ongoing	Preventative Measures
26	Make recommendations to the state to develop a disclaimer for developing along the cliffs.	Earthquake, Landslide, Erosion	Public Safety, PZ	Local	Staff Time	1-2 years	Natural Resource Protection
27	Continue to encourage Calvert County citizens to be better prepared to face hazards by promoting and offering Community Emergency Response Team (CERT) training/classes to increase the number of citizen responders in the municipalities and population centers.	All	Public Safety	State Homeland Security Grant	Staff time	Ongoing	Public Education and Outreach
28	Continue to identify at-risk populations (elderly, homeless, persons with physical or mental disabilities) to various hazards and maintain records of those vulnerable populations and the types of assistance they may need before, during, or after a hazard.	All	Public Safety, Department of Community Resources, Department of Social Services	Staff time	<$25,000	Ongoing	Public Education and Outreach

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
29	Continue to conduct annual Training Exercises for all hazard events at least twice a year.	All	Public Safety	Local Funding	<$25,000	Ongoing	Emergency Services
30	Continue the process to meet requirements to become certified as a Storm Ready Community (by the National Weather Service StormReady® Program).	Tornado, Hurricane, Nor'easter, Thunderstorm Winter Storm, Flood	Public Safety	State Homeland Security Grant, Local Funds	$25,000-100,000	Ongoing	Preventative Measures
31	Conduct seminars in schools on various hazards that could threaten the County and provide informational packets for students to take home.	All	Public Safety, BOE, County	Local Funds	Staff Time	1-2 years	Public Education and Outreach
32	Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	Tornado, Flash Flood, Thunderstorm	Public Safety	No Funding Required	Free	Ongoing	Emergency Services
33	Create a ReadyCalvert website for hazard education and preparedness to inform residents on what to do before, during, and after each potential hazard.	All	Public Safety, County staff time, Technology Services	Local Funds	<$25,000	1-3 years	Public Education and Outreach
34	Continue to maintain relationships with the County School Board to enhance the County's shelter capabilities.	All	Public Safety, County staff time	Local Funds	Staff Time	Ongoing	Preventative Measures

Table 7.2 – Mitigation Actions

Action ID	Project Description	Hazard Mitigated	Lead Agency	Funding Source	Est. Cost	Timeline	Action Category
35	Develop a volunteer database to identify qualified shelter staff (nurses, teachers, retired military, police, or emergency services, etc.) to bolster the County's staffing capabilities.	All	Public Safety, DSS	Local Funds	<$25,000	1-3 years	Emergency Services
36	Conduct data analytics of the County's emergency websites and media outlets to track the reach and efficacy of information including news posts, bulletins, and reading materials.	All	Public Safety, PIO, Technology Services	Local Funds	<$25,000	1-3 years	Public Education and Outreach
37	Develop an Emergency Management "Brand" to be the face of Emergency Preparedness and provide a trusted and reliable source of information to the public. Raise awareness of the County's Emergency Management Division and their roles and responsibilities.	All	Public Safety	Local Funds	<$25,000	1-3 years	Public Education and Outreach
38	Work with the Board of Education to introduce and conduct tornado drills in schools and educate children and families about the growing threat of tornados.	Tornado	Public Safety, BOE, County staff time	Local Funds	Staff Time	3-5 years	Public Education and Outreach
39	Continue to coordinate with County PIO to develop a "pre-approved' set of releases to be disseminated to the public in a timely manner in the event of an emergency.	All	Public Safety, PIO, County staff time	Local Funds	Staff time	Ongoing	Public Education and Outreach

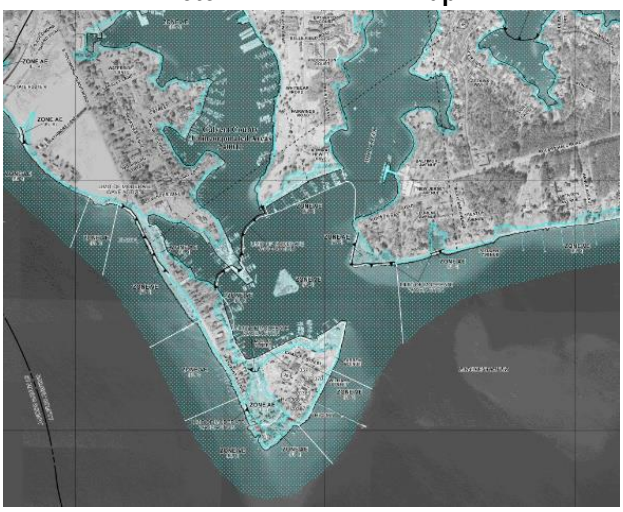
Municipal Mitigation Actions

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

Multi-jurisdictional plans require all municipalities to have at least one mitigation action to be included in the hazard mitigation plan. **Table 7.1** identifies the mitigation actions for the entire county. Actions that were determined to be applicable to the entire county as well as to both municipalities have an asterisk (*) placed next to the Action ID Number. These ten (10) actions were developed in the same manner as the county-level projects, and in addition, drew heavily from the suggestions from local representatives. The Table includes mitigation actions for each municipality, the hazard mitigated by the action, the Lead Agency which is the responsible entity for implementing the project, possible funding sources, estimated cost, and projected timeline.

National Flood Insurance Program (NFIP) and Continued Compliance

Photo 7.1 NFIP DFIRM Map



Requirement §201.6(c)(3)(ii): *[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Communities that participate in the NFIP are required to adopt flood maps and local requests for map updates; adopt and enforce minimum floodplain management regulations that help mitigate the effects of flooding on new and improved structures in the Special Flood Hazard Area; offer property owners flood insurance as a protection against flood losses in exchange for floodplain management regulations that reduce future flood damages, and perform community assistance and monitoring activities.

While FEMA is the official administering agency for National Flood Insurance Program (NFIP) participation, it is the County's responsibility to have the capability and to serve as a resource for flood mitigation activities. Calvert County is a participant in the NFIP. The County and both municipalities are committed to continuing compliance with the NFIP via three of its basic components:

1) floodplain identification and mapping risk;
2) responsible floodplain management, and
3) flood insurance.

After discussions with the Calvert County staff, and a brief questionnaire, the following information is summarized in **Tables 7.3 and 7.4** to document how the County, and its municipalities, currently address, and will continue to address, NFIP compliance and requirements in the future.

Currently, although the County participates, no municipalities in Calvert County participate in the NFIP. Updated DFIRM mapping is available through FEMA's Risk Map program, which became effective in 2015.

Table 7.3 – Calvert County Flood Insurance Program Continued Compliance

Flood Identification and Mapping	
Does the County make the Flood Insurance Rate Map and Flood Insurance Studies available to the public? Where are these documents housed within the County?	Yes. The documents are housed with the Department of Planning and Zoning.
Will the recently developed Digital Flood Insurance Rate Maps be made available to the public as well? How?	Yes. They are available on-line and through county staff.
Are Letters of Map Revisions (LOMRs) reviewed and signed by County officials? If during the subdivision review process, a new development determines a reduction in the floodplain delineation of the FIRM floodplain, is the developer required to submit a LOMR submission to FEMA?	The developer must provide the LOMRs to the county for review. The FIRMS must be amended through FEMA prior to acceptance by the county for review.
Does the County provide advice to community residents regarding elevation certificates and Letter of Map Amendment (LOMA) applications?	Yes.
Does the County maintain records of approved letters of map change?	Yes. All correspondence with FEMA is maintained.
Does the County assist residents in interpreting the FIRM and County flood studies to determine the property's status in the floodplain? If yes, which department?	Yes. The Department of Planning and Zoning.
Floodplain Management	
Are any restrictions on floodplain use enforced through the subdivision and building permit process?	Yes. Restrictions are enforced at both levels and Site Plan review.
Do all proposed developments require plans to go through the County's subdivision approval process or to acquire a building permit for new structures?	Yes.
Are all new structures required to be at least 1.5 feet above the 100-year base flood elevation?	Calvert County has a 2’ free board requirement.
Is the County committed to educating residents about the value and availability of flood insurance? Is an annual letter sent to residents in the floodplain explaining the importance of flood insurance and where it may be obtained?	Yes.

Does the County assist residents in interpreting the FIRM and County flood studies to determine their property's floodplain status, and offer advice regarding elevation certificates and LOMA applications?	Yes.
When was the last Community Assistance Visit conducted and, as of that date, was Calvert County found to meet the requirements for continued participation in the NFIP?	We revised our maps and ordinance in 2011 and 2014. We joined the CRS in 2016. Kevin Wagner, MDE, conducted our CAV just prior to joining the CRS. Calvert County meets the requirements for continued participation in the NFIP.

Table 7.4 Town of Chesapeake Beach Flood Insurance Program Continued Compliance

Flood Identification and Mapping	
Does Chesapeake Beach make the Flood Insurance Rate Map and Flood Insurance Studies available to the public? Where are these documents housed within Chesapeake Beach?	The Town Web page has the current FIRM maps, for Chesapeake Beach, on-line. The Town Clerk has hard copies of the maps and Flood Insurance Study available at Town Hall – 8200 Bayside Road, Chesapeake Beach, MD 20732 Phone 410-257-2230
Will the recently developed Digital Flood Insurance Rate Maps be made available to the public as well? How?	See above.
Are Letters of Map Revisions (LOMRs) reviewed and signed by Town officials? If during the subdivision review process, a new development determines a reduction in the floodplain delineation of the FIRM floodplain, is the developer required to submit a LOMR submission to FEMA?	Yes, the Town reviews and signs LOMRs. IF the developer chooses to request a revision, the Town will review, provide any appropriate advice and upon acceptability sign. The developer would be required to make the submittal, pay fees, etc.
Does the Town provide advice to community residents regarding elevation certificates and Letter of Map Amendment (LOMA) applications?	Yes.
Does Chesapeake Beach maintain records of approved letters of map change?	Since our first request has only recently been submitted, we have not, to my knowledge, had any prior requests. Once approved, the letters will be scanned and stored on-line.
Does Chesapeake Beach assist residents in interpreting the FIRM and Town flood studies to determine the property's status in the floodplain? If yes, which department?	Yes, the Floodplain Administrator provides limited advice in assisting a property owner to make a determination of whether the property is affected by s flood hazard area and the area's status.

Floodplain Management	
Are any restrictions on floodplain use enforced through the subdivision and building permit process?	Yes, once identified as impacted by a flood hazard area, the application is reviewed and advice given to the applicant, as to procedures, requirements and suggestions for minimization or mitigation.
Do all proposed developments require plans to go through Chesapeake Beach's permit approval process or to acquire a building permit for new structures?	While a very few structures (fences, sheds under 250 square feet, ETC.) are exempted from requiring a permit, the Town reviews and considers issuance of all submitted applications for new structures.
Are all new structures required to be at least 1.5 feet above the 100-year base flood elevation?	The Town Floodplain Management Ordinance has a requirement of a buffer of at least 2 feet above the base flood elevation.
Is Chesapeake Beach committed to educating residents about the value and availability of flood insurance? Is an annual letter sent to residents in the floodplain explaining the importance of flood insurance and where it may be obtained?	The Town attempts to keep the affected property owners informed about new impacts to a flood hazard area which may affect that property owner. No such letter has ever been sent to advise of the benefits of Flood insurance.
Does Chesapeake Beach assist residents in interpreting the FIRM and Town flood studies to determine their property's floodplain status, and offer advice regarding elevation certificates and LOMA applications?	Yes
When was the last Community Assistance Visit conducted and, as of that date, was Chesapeake Beach found to meet the requirements for continued participation in the NFIP?	Approximately 3 – 4 years ago. We were found to meet the requirements.

Prioritization of Mitigation Actions

***Requirement: §201.6(c)(3)(iii)**: [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Once the mitigation actions and implementation plan were finalized, the Steering Committee developed specific criteria to prioritize the actions. Mitigation actions from the 2010 Plan that fell into the latter two categories: "In Progress" and "On-Going" were reprioritized. A new set of criteria was used and the Plan was revised to reflect the following three criteria to reflect changes in priorities. The criteria included: Social Considerations, Administrative Considerations, and Economic Considerations. The following questions were asked to evaluate criteria for project prioritization.

Social Considerations – Life/Safety Impact

- Will the project have minimal, direct or significant impact on the safety of residents, businesses, and properties?
- Will the proposed action adversely affect one segment of the population?
- Will the project be a proactive measure to reduce a particular risk or risks?

Administrative Considerations – Administrative/Technical Assistance

- Is there sufficient staff currently available to implement the project?
- Is training required for the staff to implement this project?

Economic Considerations – Project Cost

- What is the approximate cost of the project?

For each criterion, the level of importance (high, medium, or low) was determined and corresponding points were assigned, as indicated in Table 6.5

Table 7.5. Evaluation Criteria for Project Prioritization

Criteria	Points	High	Points	Medium	Points	Low
Life/Safety Impact	10	Significant impact on public safety for businesses, residents and/or properties	6	Direct impact on businesses, residents and/or properties	2	Minimal/negligible impact on businesses, residents and/or properties
Administrative/ Tech Assistance	5	No additional staff or technical support needed to implement action	3	Some administrative and technical support needed to implement action	1	Significant administrative and technical support needed to implement action
Project Cost	5	Low cost (<$25,000)	3	Moderate cost ($25,000-$100,000)	1	High cost to implement (>$100,000)

Points were then assigned to each action and totaled, to determine the ranking of actions as shown in **Table 7.6**. It should be noted that this Plan does not include a prioritization of projects within a category; i.e., there is no ranking of projects listed within the High Priority category.

Table 7.6 – Mitigation Projects Prioritization

Action ID	Project Description	Life/ Safety	Admin/Tech	Cost	Total Score
Ongoing Actions					
1	Continue to support a regular maintenance program for emergency generators at the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc.	10	5	5	20
2*	Update Comprehensive Plan to include a Hazard Mitigation Section that provides an assessment of hazard vulnerability and appropriate mitigation recommendations	6	3	5	14
3	Continue to conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event	10	5	5	20
4	Continue to ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level and is well maintained.	6	5	3	14
5*	Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.	10	3	3	16
6	Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.	10	5	5	20
7	Introduce NOAA Weather Alert radios in designated critical facilities across the county for situational awareness.	2	5	5	12
8	Continue to develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the County website and COMCAST	2	5	5	12
9	Continue to conduct hazard response practice drills and emergency management training exercises on an annual basis	2	3	3	8
10*	Identify natural resources that provide natural mitigation such as wetlands, buffers, etc and make them a priority for conservation.	2	3	3	8
11	Develop and implement a post-disaster recovery plan.	2	3	5	10
12	Continue to work with local radio stations to promote continuity of public awareness and disaster preparedness.	2	5	5	12
13	Continue to maintain and replace county owned critical infrastructure.	2	1	1	4

Action ID	Project Description	Life/ Safety	Admin/Tech	Cost	Total Score
14	In flooded areas, conduct to conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed	6	3	3	12
15*	Work with local businesses and local industry owners to develop a continuity of operations plan.	6	3	5	14
16*	Continue to provide technical assistance to local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities	2	3	5	10
17*	Continue to ensure County and municipal compliance with local Stormwater Management Plans	2	3	3	8
18	Continue to ensure compliance with approved Erosion and Sedimentation Control Plans and continue to work with local farmers to implement BMPs	2	5	5	12
19	Continue to distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific “do’s” and “don’ts” and emergency contact information	2	5	5	12
20*	Maintain zoning ordinance provisions for protection of all hazard areas	2	5	5	12
21*	Continue to coordinate with the County, municipality and/or the Maryland Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow	6	1	1	8
22*	Give high priority to undeveloped floodplain areas for preservation.	2	3	1	6
23*	Continue a community-specific stormwater maintenance program consisting of routine inspections and subsequent debris removal	2	3	1	6
24	Recommend to the Board of Education to develop and implement a natural hazards awareness curriculum.	2	5	5	12
New Mitigation Actions – 2017					
25	Reduce vulnerability to wildfires by providing public education on increasing buffers and defensible spaces.	2	5	5	12
26	Make recommendations to the state to develop a disclaimer for developing along the cliffs.	6	5	5	16

Action ID	Project Description	Life/ Safety	Admin/Tech	Cost	Total Score
27	Continue to encourage Calvert County citizens to be better prepared to face hazards by promoting and offering Community Emergency Response Team (CERT) training/classes to increase the number of citizen responders in the municipalities and population centers.	2	5	5	12
28	Continue to identify at-risk populations (elderly, homeless, persons with physical or mental disabilities) to various hazards and maintain records of those vulnerable populations and the types of assistance they may need before, during, or after a hazard.	2	5	5	12
29	Continue to conduct annual Training Exercises for all hazard events at least twice a year.	2	5	5	12
30	Continue the process to meet requirements to become certified as a Storm Ready Community (by the National Weather Service StormReady® Program).	6	5	3	14
31	Conduct seminars in schools on various hazards that could threaten the County and provide informational packets for students to take home.	6	5	5	16
32	Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	6	5	5	16
33	Create a ReadyCalvert website for hazard education and preparedness to inform residents on what to do before, during, and after each potential hazard.	6	5	5	16
34	Continue to maintain relationships with the County School Board to enhance the County's shelter capabilities.	6	5	5	16
35	Develop a volunteer database to identify qualified shelter staff (nurses, teachers, retired military, police, or emergency services, etc.) to bolster the County's staffing capabilities.	2	5	5	12
36	Conduct data analytics of the County's emergency websites and media outlets to track the reach and efficacy of information including news posts, bulletins, and reading materials.	2	5	5	12
37	Develop an Emergency Management "Brand" to be the face of Emergency Preparedness and provide a trusted and reliable source of information to the public. Raise awareness of the County's Emergency Management Division and their roles and responsibilities.	2	5	5	12

Action ID	Project Description	Life/ Safety	Admin/Tech	Cost	Total Score
38	Work with the Board of Education to introduce and conduct tornado drills in schools and educate children and families about the growing threat of tornados.	2	5	5	12
39	Continue to coordinate with County PIO to develop a "pre-approved' set of releases to be disseminated to the public in a timely manner in the event of an emergency.	2	5	5	12

High-Priority Actions

The actions listed below received the highest scores (16-20) based on the ranking.

- Continue to support a regular maintenance program for emergency generators at the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc.
- Continue to conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event
- Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.
- Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.
- Make recommendations to the state to develop a disclaimer for developing along the cliffs.
- Conduct seminars in schools on various hazards that could threaten the County and provide informational packets for students to take home.
- Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.
- Create a ReadyCalvert website for hazard education and preparedness to inform residents on what to do before, during, and after each potential hazard.
- Continue to maintain relationships with the County School Board to enhance the County's shelter capabilities

Deleted, Combined, and Removed Actions

Action items from the original 2010 Flood Mitigation Plan that have been completed, deemed infeasible, or merged/combined with another action item have been removed from this plan. Those actions are itemized, described, and justified in the table below.

Table 7.7 – Removed Actions from 2010 Plan

Action No.	Action	Status	Notes
6B	Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP	Removed	This item is covered in the FMP
6E	Establish a partnering relationship with the NWS to enhance the existing Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program	Completed	
7	Coordinate with FEMA and MEMA regarding updating Calvert County's, North Beach's and Chesapeake Beach's Flood Insurance Rate Mapping via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional Base Flood Elevations	Completed	The County and Towns updated their FIRMS and floodplain ordinances in 2014.
10A	Make available for municipal use the digital natural hazard mapping files that were developed as part of this planning study	Completed	GIS maintains this.
10B	Conduct engineering inspections of county fire stations to determine mitigation retrofitting measures necessary	Completed	
10C	Encourage the owners/operators of private schools and daycares to develop and implement an emergency response plan	Completed	It is a licensing requirement in Maryland and is done through the Health Dept.
11A	Ensure municipal compliance with minimum NFIP floodplain development regulations	Removed	This item is covered in the FMP
12	Evaluate all manufactured homes to ensure their resistance to wind and flood hazards	Completed	This action refers to Hallowing Point Trailer Park. In 2015, the trailer park was removed from its location in the 100-year floodplain, eliminating the need to evaluate all manufactured homes to ensure their resistance to wind and flood hazards. To planners knowledge there are no other manufactured homes in the 100-year floodplain.

13	Consider expanding the automated emergency alert community calling system (Code Red)	Completed	System upgraded to EverBridge
15B	Store in an easily accessible location and make available for public inspection, the community's Flood Insurance Rate Mapping and associated Flood Insurance Study	Completed	Website
16B	Workshops for local engineers, architects and contractors/builders on IBC and hazard resistant construction	Removed	
17	Dry floodproof known flood-prone structures in accordance with the general guidelines	Removed	This item is covered in the FMP
18	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the FEMA guidance documents that were provided as part of the hazard mitigation planning program	Completed	
19A	Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the county	Completed	
19C	Develop a new, or revise an existing, Zoning Ordinance to include separate zones or districts for known hazard areas	Completed	
19E	Preserve the highest priority undeveloped steep slope areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical steep slope areas may be preserved/protected via local ordinance	Completed	The Department of Community Planning and Building protects steep slopes through development review and permit issuance (Article 8 of the Calvert County ZO). Outside the Critical Area, impacts to steep slopes of 25% or more are prohibited and inside the Critical Area impacts to steep slopes 15% or more are prohibited.
20	Wet floodproof known flood-prone structures in accordance with the general guidelines	Removed	This item is covered in the FMP
24B	Update and implement a comprehensive water resources management plan that analyzes the county's existing water resources supply and evaluates the county's anticipated water use demand	Completed	The Department of Community Planning and Building completed this action in 2010. The 2004 comprehensive plan was amended to include the Water Resources Element, which assesses existing drinking water resources and its supply and demand.
25A	Elevate known flood-prone structures in accordance with the general guidelines	Removed	This item is covered in the FMP

25B	Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that minimize/eliminate wetland disturbance	Completed	
26	Relocate and/or acquire known flood-prone structures in accordance with the general guidelines	Removed	This item is covered in the FMP
27	Preserve critical undeveloped forested areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical forested areas may be preserved/protected via local ordinance	Removed	This item is covered in the FMP
28	Coordinate with FEMA, MEMA, NWS, and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools	Not Feasible	After discussions between Calvert BOE and DEM representatives, it was determined that the DEM could not influence or dictate official school curriculum
28A	Enroll in the Firewise Communities Program	Removed	Calvert is not in a wildfire zone
28B	Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical wetlands may be preserved/protected via local ordinance	Combined with 25B and removed	This item is covered in the FMP
29	Provide adequate shelters, with backup power, in various parts of the county to serve as refuge areas during floods and other hazard events	Completed	
30	Ensure that all documented information can be accessible from the county internet/intranet site. Provide pertinent public information on COMCAST	Removed	This material was covered under 15B
31	Follow the recommendations of the Chesapeake Bay Cliff Erosion Study Commission including the acquisition and relocation of willing property owners	Completed	Could be more properties in the future.

CHAPTER 8: PLAN MAINTENANCE

Update Process Summary

Requirement §201.6(c)(4)(i): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

Once this Plan has received approval from the Maryland Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA), the Plan will be adopted by the Calvert County Commission and its two municipalities. This County Hazard Mitigation Plan Update is intended to be a 'living document'. Plan adoption is not considered the final step in the planning process, but rather as a first step to 'realization'. The plan monitoring and maintenance schedule is a cycle of events that involve periodic review, adjustments, and improvement. This Chapter establishes a method to monitor how the Plan will be evaluated and maintained in the future.

Monitoring, Evaluating, and Updating the Plan

In order to ensure that the Plan continues to provide a framework of reducing risk in the County, the Emergency Management Agency will take responsibility to convene an annual meeting of the Hazard Mitigation Plan Steering Committee. The Committee will comprise of the members who were involved in the preparation of the Plan Update as well as municipal representatives.

An annual report form is included at the end of this Chapter for each high priority County project, and for each municipality to provide an update to the County on the status of their mitigation

projects. This form will be distributed to both municipalities, requesting them to document the status of each hazard mitigation action taken for their jurisdiction. Each action proposed in the Mitigation Plan will be categorized as one of the following: completed, in progress, not started, modified, or cancelled. The Steering Committee will assist the Emergency Manager to prepare a status report of the mitigation actions based on the annual report forms from the municipalities as well as the County. The Emergency Manager's status report of the mitigation actions, based on the annual report forms, will also be sent to MEMA and FEMA Region 3 for reporting and documentation purposes.

In addition to conducting an annual review of the Plan, the Steering Committee will review the Plan within 30 days after a disaster. Each goal and objective will be examined for its relevance and validity to the changing situation in each municipality and the mitigation actions will be reviewed to ensure that they address any recent issues that may have stemmed from disaster events. During quiet times, the Plan will be updated every five years to reflect the current risk, vulnerabilities, development trends, and as mitigation actions are implemented. While an annual report will be competed each year, any state and Federal mandates from MEMA and FEMA respectively, will be addressed in the five-year update. The municipalities will not be responsible for making any changes to the Hazard Mitigation Plan based on MEMA or FEMA requirements in between the five-year update.

Benefit-Cost Analysis

A benefit-cost analysis determines the cost effectiveness of a project to minimize damage or prevent damage from future hazard events. By determining the benefit-cost of the proposed mitigation project, it will provide the communities, as well as project developers, with additional knowledge about the feasibility of the proposed mitigation alternative. If the costs outweigh the benefits, then other alternatives that are more effective can be identified to accomplish the Plan's goals.

Continued Public Involvement

Requirement §201.6(c)(4)(iii)): *[The plan **shall** include a] discussion of how the community(ies) will continue public participation in the plan maintenance process.*

The preparation of this Plan has involved the public throughout the process through public meetings and via newspapers, the Internet, and social media. Calvert County is dedicated to continuing to solicit public participation during the five-year update as required by FEMA. Copies of the Hazard Mitigation Plan Update will be provided to the public libraries and be placed on the County's website, along with a mechanism for submission for comments. Additionally, annual update meetings should be open to the public, and an advertising and outreach campaign undertaken to encourage the public to attend and provide comment.

Requirement §201.6(c)(4)(ii): *[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

As indicated in the Plan Integration section (Chapter 6), the Calvert County Floodplain Regulations; Calvert County Road Ordinance; Calvert County Stormwater Management Ordinance; The Broomes Island Flood Mitigation Plan; and The Cove Point Community Flood Mitigation Plan, among other documents, are identified for incorporation of hazard mitigation

actions once the Plan is adopted. Each of these mechanisms will continue to be used to meet the intent of this Plan, as appropriate. Once the County adopts this Hazard Mitigation Plan Update, mitigation strategies discussed in this plan will be implemented via the aforementioned mechanisms as well as through the incorporation into the new planning mechanisms. Specific options for incorporating hazard mitigation principles into each of these plans and ordinances have been made in Chapter 6, which may be incorporated as an amendment to the document.

Incorporation of Mitigation Actions into Existing Planning Mechanisms – Municipalities

Requirement §201.6(c)(4)(ii): *[The plan shall describe] a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.*

Once the County Commission adopts the 2017 Calvert County Hazard Mitigation Plan Update, the Document Review section of Chapter 6 of this Plan Update should be reviewed and disseminated to various County agencies and municipalities that develop and implement specific plans and ordinances. Each participating municipality will be responsible for implementing the specific recommendations in the document review section of the Plan and incorporating these recommendations into their local planning documents such as comprehensive plans, zoning ordinances, land development, and subdivision regulations.

Plan Adoption

Adoption by the Local Governing Body

Requirement §201.6(c)(5)**:** [*The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., County Commission).*

Include adoption resolution from Calvert County here

Multi-Jurisdictional Plan Adoption

Requirement §201.6(c)(5)**:** *For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.*

Include adoption resolutions from all municipalities in Calvert County here

Hazard Mitigation Plan
Sample Annual Report Form

Progress Report Period _____ to _____

Next Plan Update _____

Project Title_____ Project ID #_____

Project Type: (select one)

County Project_____ Municipal Project _____

Responsible County Agency(ies) or Municipality _____

Address: _____

Contact: _____

Title: _____

Phone: _____

Email: _____

Project Description:

Project Status (select one)

Completed ____ In Progress ____ Not started/delayed ____ Modified ____ Cancelled ____

How many people were protected by this action? _____

Were there any structures mitigated? If so, how many? _____

Explain:

Obstacles/challenges/delays incurred:

_____

_____

Method to resolve obstacle/challenge/delay:

_____

_____

Next steps to be accomplished over the next reporting period:

_____

_____

Hazard Mitigation Plan
Sample Annual Report Form

Other comments:

Appendix A
Meetings

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Meetings and Agendas

Calvert County
FLOOD MITIGATION AND ALL HAZARDS MITIGATION PLAN UPDATE
Steering Committee Meeting #1
19 October 2016
10:30am-12 noon
AGENDA

Introductions

- County Staff
  - Community Planning and Zoning
    - David Brownlee, Tay Harris
  - Emergency Management
    - Al Jeffery, Shelly Gooding
- Steering Committee Members
- Consultants
  - Deepa Srinivasan, President, Vision Planning and Consulting, LLC
  - Mike Scott, ESRGC, Salisbury University

PowerPoint Presentation – Deepa Srinivasan and Ashley Samonisky

- Overview of the Flood Mitigation and Hazard Mitigation Planning Processes
- Schedule
- Deliverables

Discussion of Relevant Plans, Ordinances, and Programs - Deepa Srinivasan

Examination of 2010 Flood Mitigation Plan

- Goals and Objectives
- Mitigation Actions

Examination of 2010 All Hazards Mitigation Plan

- Goals and Objectives
- Mitigation Actions

Wrap-up

- Next steps
- 2nd Steering Committee Meeting and Public Meeting
- Questions

Adjournment

SIGN-IN SHEET
1st Steering Committee Meeting
Calvert County HMP/FMP
24 October 2016

Name	Agency/ Municipality	Title	Phone No.	Email	Address
Brandi Elliott	Home owner		3017069623	brenicel@gmail.com	9010 Broomes Island Rd Broomes Island MD
TAY HARRIS	CPB ES	Planner	410.535.1600 X2501	tay.harris@verizon.net	150 Main Street Prince Frederick, MD 20678
ALAN STATLER	COVE POINT BEACH ASSOC.	—	443-404-6009	ALANSTATLER@COMCAST.NET	
Jim Lierig	DPW	Engineer	410.535.2204	lierigjh@co.cal.md.us	150 Main St Prince Frederick MD 20678
Dave Brawner	CPB	Principal Planner	410-535-1600 x2338	brownlde@co.cal.md.us	" " "
	—				

SIGN-IN SHEET
1st Steering Committee Meeting
Calvert County HMP/FMP
24 October 2016

Name	Agency/ Municipality	Title	Phone No.	Email	Address
Danita Boonchaisri	Calco Econ Dev	Bus Dev Mgr	410-535-4583	danitab@co.cal.md.us	175 Main St. Prince Fred 20678
Shelly Goodwin	Cal. EMA	Ent Spec.	410-535-1600 x2842	goodwinss@co.cal.md.us	175 Main P.F. 20678
Jeffery	Cal EMA	EM Director	443 629 5647	JeffreyAb@co.cal.md.us	175 Main St PF MD

Steering Committee Meeting #1 – 10/24/16 9:30am-11:30am
Courthouse Square Building, 205 Main Street, Prince Frederick

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

Attendees were given a brief introduction to the Consulting firm contracted for the planning and update process, Vision Planning and Consulting. Introductions were given to the principal Vision contacts for working on the project, Deepa, Mike, and Ashley. Deepa discussed the integrated planning process, deliverables, and timelines for the two plans.

Committee members then examined each of the goals and objectives laid out in the 2010 plans for both the Flood Mitigation Plan and the All Hazards Mitigation Plan. Each goal and objective was evaluated line by line for clarity, cohesiveness, and relevance. Terminology was discussed, and suggestions made to help the plan be more comprehensible to the business sector and the general public.

Copious notes were taken to include all of the discussion and recommendations made by committee members. Steering committee members will be emailed notes/minutes once they have been compiled.

Tay provided an update on the FMP mitigation actions current standing so we can see what has been done, what is pending, and what is being deferred, and why. Next steps include compiling a similar list for the All Hazard MP's Mitigation Actions from the 2010 plan.

Next steps include scheduling the second Steering Committee meeting to discuss the Hazard Identification and Risk Assessment (by Dr. Mike Scott), updating the goals and objectives for review by the committee, and planning first public outreach meeting for mid-November or early December.

Calvert County
FLOOD MITIGATION AND ALL HAZARDS MITIGATION PLAN UPDATE
Steering Committee Meeting #2
14 November 2016
11am -1pm
AGENDA

Examine 2010 Flood Mitigation Plan

- Mitigation Actions

Examine 2010 All Hazard Mitigation Plan

- Mitigation Actions

Develop new mitigation actions

Wrap-up

- Next steps
- 3nd Steering Committee Meeting and Public Meeting - 28 November 2016
- Questions

Adjournment

SIGN-IN SHEET
2nd Steering Committee Meeting
Calvert County HMP/FMP
14 November 2016

Name	Agency/ Municipality	Title	Phone No.	Email	Address
Andy Baldwin	DPW	Project Engineer	410-535-2204	baldwinc@co.cal.md.us	150 Main St. Prince Frederick, Md 20678
Jen Andrzejczyk	BREEZY POINT		301-758-0391	JenExit@gmail.com	5035 Breezy Point Rd Lusby MD 20657
Steve Farrell	Broomes Island		410-535-1442	steveF714@comcast.net	9345 River View Rd Broomes Is. MD 20615
AV Lefberg	EM	Chief Division	2781 410-535-1600	dellermab@co.cal.md.us	
Dave Brownlee	CPB	Principal Env. Plan	410-535-1600 x 2338	brownldc@co.cal.md.us	150 Main St. P.E., MD 20678
John Hohman	TNB	Tom Engineer	410-535 5940	johnp@tnbinc.org	POB 2540 FF 20709
Ashley Simonitsky	VPC	Planner		asimonitsky@vision-pc.net	
Deepa Srinivasan	VPC	Pres		dsrinivasan@vision-pc.net	
Holi Kilbourne	Ches. Bay Lab	Professor	410-326-7209	Kilbourn@umces.edu	146 Williams St. (Parsons) PO Box 38 Solomons, MD 20688
Tom Harris	CBPCS	Planner	410.535.1600 x250	Harriset@co.cal.md.us	150 Main St, 3rd Floor PE, MD 20678

Steering Committee Meeting #2 – 1/14/16 11:00am-1:00pm
County EOC, Courthouse Building, 175 Main Street, Prince Frederick

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

The Steering Committee's focus for this meeting was to evaluate the Goals and Objectives and the Action Items for the Flood Mitigation Plan. There were a few new members attending the meeting so the committee began with a round of introductions and a brief review of the committee's purpose and an update from the last meeting.
Attendees were given handouts of the goals and objectives as well as the action items for their review and a discussion was held to gather input or recommendations on the content and verbiage of these documents.

Each action item for the Flood Mitigation Plan was reviewed independently for its current status (in progress, completed, deferred), relevance, and feasibility. Completed Items will be removed from the list, in progress and ongoing efforts will be rephrased to address work already completed, and items determined to be unfeasible will be removed.

Next steps include organizing the input and recommendations from this meeting, updating the action items to reflect those improvements, begin updating the plan itself, and preparing for the first public meeting.

The next Steering Committee meeting, November 28th from 12:30-3:00pm, will cover the risk assessment and the discussion of the Action Items for the Hazard Mitigation Plan.

Calvert County
FLOOD MITIGATION AND ALL HAZARDS MITIGATION PLAN UPDATE
Steering Committee Meeting #3
28 November 2016
12:30pm - 3pm
AGENDA

Review Hazard Identification and Risk Assessment

- Flood
- Other Hazards

Review mitigation actions from 2010 Hazard Mitigation Plan

Wrap-up

- Next steps
- Public Meeting - 28 November 2016
- Final Steering Committee Meeting (tbd)
- Questions

Adjournment

3rd Steering Committee Mtg
Sign in
28 NOV 2016

Name	Agency	Email	Phone
Steve Farrell	Broomes Island	stevef714@comcast.net	410-535-1442
Holli Kilbourne	UMCES-CBL	kilbourn@umces.edu	410-326-7209
Andy Balchin	CCG DPW	~~balchinac@calvertcountymd.gov~~ balchinac@co.cal.md.us	410 535-2204
Michael Scott	SU/ESRGC	mjscott@salisbury.edu	410-713-2
Deepa Srinivasan	VPC	dsrinvasan@urban-planet	240893
Dave Brownlee	CPB	brownldc@co.cal.md.us	410-535-1600 x 2338
Ian Liong	DPW	liongkhe@co.cal.md.us	410 535 2204
Deepa Srinivasan	VPC	—	—
Ashley Samonisky	VPC	—	—

Steering Committee Meeting #3 – 11/28/16 12:30pm-3:00pm
Harriet Brown Community Center, 901 Dares Beach Road, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

The Steering Committee was presented with the initial findings of the Hazard Identification and Vulnerability Assessment by Dr. Mike Scott of the Eastern Shore Regional GIS Cooperative (ESRGC). This presentation provided definitions of terms used throughout the process and gave basic background information on the various hazards Calvert County could potentially face.

In addition to examining the various types of hazards, special attention was paid to flooding, as this is the most common problem for the county. Dr. Scott discussed the process for generating the 1% chance flood area and the data sources used to come up with this estimate.

Using HAZUS, a special program designed by FEMA, Dr. Scott was also able to assign a dollar amount for the potential losses associated with a serious flooding event. Property exposures could reach over 14 million dollars in parts of Calvert County.
Similar exposure estimates were generated for every hazard type listed in the plan; wind events, tornado, thunderstorms, extreme temperatures, drought, winter storms, hail, and earthquakes.

Committee members then discussed changing the prioritization (Low, Moderate, High) for these hazards based on the probability of them occurring. Some items were moved from high to moderate and some from moderate to low.

Finally, members were asked to mark-up maps showing the 1% flood area to include known or repetitive loss areas the county is currently facing that are not already represented on the map.

2016 All-Hazards Mitigation Plan and Flood Mitigation Plan Update Calvert County, MD

Public Meeting
28 November 2016

Presented by:
Deepa Srinivasan, Vision Planning and Consulting, LLC
Dr. Michael Scott, ESRGC, Salisbury University

VISION

Project Purpose

To update the all-hazards mitigation plan and flood mitigation plan to improve Calvert County's resistance to natural hazards, including flooding, by identifying actions to reduce the impact of various hazards to people and property.

Key Players

- Calvert County Staff – Emergency Management, Community Planning and Building, GIS, etc.
- Hazard/Flood Mitigation Plan Steering Committee
- Municipalities
- Consultants
  - Deepa Srinivasan, President, Vision Planning & Consulting
  - Dr. Mike Scott, ESRGC - Salisbury University
- Public
- Maryland Emergency Management Agency (MEMA)
- Federal Emergency Management Agency (FEMA R_3)

Steps in the Planning Process

1. Reconvene 2009 Steering Committee and develop planning process (meetings)
2. Assess hazards, risks, vulnerability
3. Assess municipal capabilities
   - Existing Plans, Programs, Policies – Capability questionnaire
   - Plan Integration – Document Reviews
   - Local Codes and Zoning Ordinances
   - Current and Proposed Projects
4. Develop goals and objectives and mitigation actions
   - Preventative Measures
   - Projects
   - Natural Resource Protection
   - Outreach and Communication
   - Other Mitigation Actions

Steps in the Planning Process (cont'd)

5. Write mitigation plan and prioritize projects (using Evaluation Criteria)
   - Social
   - Technical/Administrative
   - Economic
6. Develop implementation plan
   - Priorities for Mitigation Actions
     - Short-, Medium-, or Long-Range
     - Potential Funding Sources
     - Responsible Entities
     - Target Completion Dates
   - Five-Year Plan Maintenance Cycle

Steering Committee Meetings

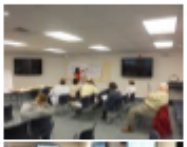
4 Steering Committee Meetings

Meeting 1: October 2016
- Planning process, schedule, deliverables
- Goals and objectives

Meeting 2: November 2016
- Mitigation Actions

Meeting 3: November 2016
- Hazard identification and risk assessment

Meeting 4: January 2017
- Mitigation actions prioritization
- Implementation strategy



Public Meetings

- Public Meeting 1 (Nov 2016)
  - Planning process, hazard identification, risk assessment
  - Goals and objectives
- Public Meeting 2 (Jan 2016)
  - Mitigation actions and projects
  - Prioritization criteria for mitigation projects

Goals and Objectives
Flood Mitigation Plan

Prevention

Goal 1: Direct population concentrations away from known or predicted high flood hazard areas through appropriate regulations.

- Address hazard mitigation goals through existing plans and ordinances.
- Continue to examine the zoning ordinance, and include language to ensure that any new development does not increase the vulnerability to flooding and make changes if required.
- Continue to ensure that the current building codes, floodplain ordinances, wetland protection, and erosion and sediment control standards are properly enforced.

Goals and Objectives
Flood Mitigation Plan

Prevention - cont.

- Continue to implement a multi-objective management approach that promotes public involvement & coordination of floodplain management with other community concerns such as economic development, housing, water quality, and recreation.
- Ensure continued coordination and notification procedures between departments within the County and municipalities that are responsible for implementing flood mitigation activities.
- Develop recommendations for wetlands, buffer zones, etc. in municipal ordinances.

Goals and Objectives
Flood Mitigation Plan

Property Protection

Goal 2: Ensure new construction and reconstruction is resistant to flood damage.

- Encourage owners of high-risk, pre-FIRM residential structures to use retrofitting techniques to avoid repeated flooding.
- Support projects and programs to retrofit, relocate/acquire structures that are susceptible to repetitive flooding.
- Continue to emphasize the importance of flood insurance to residents through CRS and other efforts.

Natural Resource Protection

Goal 3: Protect natural resources and open-space within the floodplain and watersheds.

- Ensure all acquired properties are cleared of all structures, returned to their natural state, and remain in public ownership in perpetuity.

Goals and Objectives
Flood Mitigation Plan

Emergency Services

Goal 4: Ensure continued coordination during emergencies.

- Continue to evaluate coordination, notification, and response procedures.

Goal 5: Ensure critical facilities are less vulnerable to flooding.

- Identify appropriate mitigation techniques for critical facilities in the floodplain currently and in the long term.

Structural Projects

Goal 6: Reduce potential disruption of the County's critical infrastructure during hazard events.

- Ensure regular maintenance of the County's critical infrastructure within the 100-year floodplain.
- Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofit.

Goals and Objectives
All-Hazards Mitigation Plan

Goal 1: Minimize future losses from all disasters by reducing the risk to people and property.

- Protect populations and properties in Calvert County susceptible to economic or physical loss from disasters consistent with the standards established in this Plan and the current Calvert County Comprehensive Plan.
- Provide protection of critical facilities/infrastructure vital to disaster response, such as fire and police, and those vital to the continuous operations of the county, such as hospitals and health care facilities, water and sewer facilities, electrical and other utility, and transportation systems.

Goals and Objectives
All-Hazards Mitigation Plan

Goal 2: Support a balance between government regulation & enforcement, and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for property owners, families and individuals.

- Continue to develop and support disaster preparedness education and awareness programs, targeting specific benefits to residents, visitors, businesses, and elected officials.
- Continue to develop economic incentive programs for both public and private sectors promoting benefits of structural retrofitting.

Goals and Objectives
All-Hazards Mitigation Plan

Goal 3: Minimize losses and institute adequate regulations through proper land use regulations.

- Develop and support public and private projects and programs to retrofit, relocate, or acquire properties susceptible to repetitive flooding.
- Require systematic maintenance programs for stormwater management systems.
- Discourage new development in high hazard areas through appropriate regulations and land use planning.

Goals and Objectives
All-Hazards Mitigation Plan

Goal 4: Reduce economic vulnerability and increase recovery capabilities of business and industry.

- Continue public education through collaborative programs with government, businesses and community organizations through seminars and online resources.

Goal 5: Emphasize pre- and post-disaster planning to decrease vulnerability of existing and new construction to loss.

- Promote to elected officials, builders, and existing and potential homeowners, the economic and safety benefits of designing mitigation features into new construction and retrofit of existing structures.
- Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofit.

Goals and Objectives
All-Hazards Mitigation Plan

Goal 6: Define the benefits of hazard mitigation principles through public education.

- Educate the public on higher standards of protection to structures and facilities from hazards.
- Identify and coordinate public information programs and events such as contests and festivals with public and private partners.
- Identify and seek multiple funding sources that will support hazard mitigation awareness and training programs.

Goal 7: Ensure hazard mitigation goals are consistent with existing County plans and ordinances.

- Incorporate hazard mitigation principles into new and existing plans and ordinances.

Plan Integration

Small Area Plans
- Cove Point Community Flood Mitigation Plan
- Broomes Island Flood Mitigation Plan
- Breezy Point/Neeld Estate Flood Mitigation Plan

County Plans and Ordinances
- Calvert County Floodplain Regulations
- Calvert County Soil and Erosion Control Regulations
- Calvert County Road Ordinance
- Calvert County Stormwater Management Ordinance

Schedule

Flood Mitigation Plan
- Hazard Identification and Vulnerability Assessment – October and November 2016
- Mitigation Strategy – November and December 2016
- Implementation Plan – January 2017
- Deliverables to County – January 2017

Hazard Mitigation Plan
- Hazard Identification and Vulnerability Assessment – October and November 2016
- Mitigation Strategy – November 2016 through February 2017
- Deliverables to County – May - June 2017
- Plan Approvals – MEMA and FEMA R3 – August 2017

Thank You!

VISION PLANNING & CONSULTING, LLC

Calvert County
FLOOD MITIGATION AND ALL HAZARDS MITIGATION PLAN UPDATE

Steering Committee Meeting #4
9 January 2017
2pm - 4pm
AGENDA

Finalize mitigation actions and implementation plan

Discuss prioritization

Wrap-up

- Next steps
- Draft plan
- Questions

Adjournment

SIGN-IN SHEET
4TH Steering Committee Meeting
Calvert County HMP/FMP
January 9th, 2017

Name	Title	Agency	Phone	Email	Address
Andy Baldwin	Project Engineer	CCG DPW	410-535-2704	baldwinac@co.cal.md.us	150 Main St Prince Frederick, MD
Steve Farrell		(Broomes Is.)	410-535-1442	stevef714@comcast.net	9345 River View Broomes Is, 20615
BILL & JACKIE PARKS		NEELD	(301) 929-1226	BILLPARKS1945@YAHOO.COM	25-29 BEACH HUNTING TOWN
MARY OSBOURN-RE, 24		NEELD ESTATE	443-995-3182	MOSBOURN@COMCAST.NET	2907 Beach Dr. Huntingtown MD.
John Hofmann	Tax Engineer	North Beach	410-535-5940		
Jen Anderson		Breezy Point	301-758-0391	JenExit@gmail.com	5035 Breezy Point Rd, CB 20732
Jay Harris		CPB	410.535.1600	Harristo@co.cal.md.us	150 Main Street PF, MD 20678
Shelly Gosling		EMD	410,		

Steering Committee Meeting #4 – 01/09/2017 2:00pm-4:00pm
Harriet Brown Community Center, 901 Dares Beach Road, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

The Steering Committee was presented with the combined list of recommendations from the Small Area Plans, the recommendations from the 2010 plan, and the recommendations from the flooding issues identified at the first public outreach meeting. Of these recommendations, some of the small area ones echoed the county wide ones and as such were re-worded to include all areas suffering from the same problems and the redundant recommendations were removed. Additionally, some of the recommendations were determined to be infeasible and as such they were removed.

Next, the Steering Committee was asked to prioritize the remaining recommendations based on Life/Safety Impacts, Administrative/Technical Assistance, and Project Cost. The recommendations were assigned a numerical value based on High, Medium, or Low costs or impacts, and then totaled to determine the recommendations ranking.

Finally, a draft plan was circulated for Committee members to review and provide feedback.

Calvert County
ALL HAZARDS MITIGATION PLAN UPDATE

Steering Committee Meeting #5

22 February 2017
12:30-2:30pm

AGENDA

Reexamine and Prioritize Hazards, Risks, and Vulnerabilities

Review Goals and Objectives

Develop New Mitigation Actions

Complete Implementation Plan

Wrap-up

- **Next steps**
- **6th and Final Steering Committee Meeting and Final Public Meeting – Early April 2017**
- **Questions**

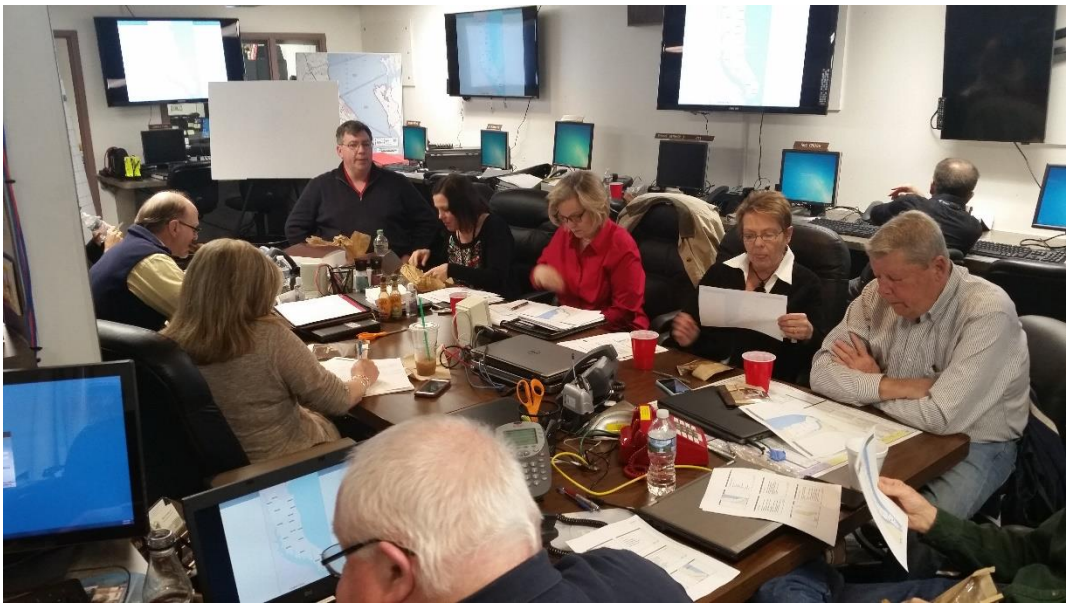
Adjournment

SIGN-IN SHEET
5th Steering Committee Meeting
Calvert County HMP
22 February 2017

Name	Agency/ Municipality	Title	Phone No.	Email	Address
Bill F.					
Jackie Parks	Reeld Estate Resident		301-929 1226	JACKIE PARKS · beach a yahoo.com	2829 BEACH DR. HUNTINGTOWN 20639
Mary Reily	REELD ESTATE Resident		443-995-3182	MOSHOURN @ COMCAST.NET	2907 Beach Dr. Huntingtown MD
Tay Harris	CPB	Environ. and Zoning Range Planner	410.535 1600 x 2501	Harriste@ co.cal.md. us	175 Main St. Prince Frederick MD
Mike Scott	ESRGC/SU		410-543-6456	mjscott@ salisbury.edu	1101 Camden Ave Salisbury, MD
Jeff Linhart	Calvert County DPW		410.535-2204 x 2217	Linqiche co.cal. md.us	150 Main Street Prince Frederick, MD 20678
Dave Brownlee	CPB	Env. Princ. Planner	410-535-1600 x2338	brownldc@co. cal.md.us	150 Main St.
Deepa Sriram	VPC	Consultant	240 893 8719	dsriram@ vhnw-pc.net	8171 Maple Lawn blvd Suite 245 Fulton MD 20759
Shelly Gooding	Calvert EMA	EM Spec.	410 535 1600	goodinss@ co.cal.md.us	175 Main St 20678
Al Jeffrey	Calvert EMA	Div. Chief	"	jeffery ab@ co.cal.md.us	"
Kelly Schmeisky	VPC	Consultant	888 872 9626	asamonisky@ vision-pc.net	Fulton, MD
Steve Farrell	Broomes Is. Resident	—	410 - 535 - 1442	stevef714@ comcast.net	9345 River View Rd Broomes Island 20615
A					

Steering Committee Meeting #5 – 02/22/2017 12:30pm-2:30pm
Calvert County Emergency Operation Center, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting



The Steering Committee was provided a brief overview and loss statistics for the various hazards that are most likely to face the County. A short Q/A session was held for anyone unfamiliar with the current science behind the hazards and projection estimates. These hazards, with the exception of flooding and coastal storms, were then discussed and ranked according to potential damage and likelihood of occurrence.

Once the hazards were ranked, action items for each of the hazards were suggested and discussed. The most oft recommended actions for each hazard tended towards public outreach and education. Providing the public with the most up to date information available, through the most likely channels (text, email, social media, mass notification, etc.), was the crux of the discussion.

Finally, Steering Committee members were advised of upcoming “homework” prior to the final Hazard Mitigation Plan meeting. Members will be emailed an updated copy of the Goals and Objectives and Action Items for the Hazard Plan and will be asked to read through each document and to provide notes and feedback before the documents are incorporated into the final plan.

Calvert County
ALL HAZARDS MITIGATION PLAN UPDATE

Steering Committee Meeting #6
13 April 2017
12:30-3:30pm
AGENDA

County Mitigation Actions
- **Discussion and finalization**
- **Review/comments by Committee**

Municipal Mitigation Actions
- **Summary (Deepa Srinivasan)**

Prioritization of County Actions
- **Review of prioritization criteria**
- **Project prioritization**

Plan Maintenance

Overview of Draft Plan

Wrap-up
- **Next steps**
- **Questions**

Adjournment

SIGN-IN SHEET
6th Steering Committee Meeting
Calvert County HMP
13 April 2017

Name	Agency/ Municipality	Title	Phone No.	Email	Address
AL Jeffery	Calvert County Emer. Man	Division Chief	410-535-1600 x2781	Jefferyab@co.cal.md.us	Courthouse
Shelly Gooding	Calvert Co EM	Emp. Spec.	410535 1600x2302	goodinssc@co.cal.md.us	175 Main St 20678
Mary Reilly	Reeld Estates		443 995-3187	MOSBOURNE@COMCAST.NET	2907 Exact Dr Huntingtown
Dave Brownlee	CPB	Env. Princ Planner	410-535-1600 x2335	brownldc@co.cal.md.us	150 Main St P.F.
Ashley Sankovsky	VPC	Consultant	888 872 9624	asankovsky@vision-pc.net	Fulton, MD
Deep Srinivasan	VPC	President	2408938719	dsrinivasan@vision-pc.net	Fulton, MD

Steering Committee Meeting #6 – 04/13/2017 12:30pm-3:30pm
Harriet Brown Community Center, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting



The Steering Committee met to finalize the mitigation actions developed for the County and municipalities. The actions had been emailed out prior to the meeting to ensure the Committee had time for review.

At the meeting, each action item was discussed to determine phrasing, efficacy, and implementation methods. Some action items were combined for clarification and efficiency. Actions relating to flooding were removed as they were elaborated on in the Flood Mitigation Plan. Recently completed actions were also removed.

This process reduced the final count of actions from 55 to 39 items. Additionally, Committee members ranked the actions by social, administrative, and economic impacts, which resulted in a numerical score that was used to prioritize the implementation of the actions.

An implementation plan was developed to determine Lead Agency, Timeline, Estimated cost and potential Funding Sources for each action item. Additionally, a list of the potential hazards mitigated by each item was included.

Finally, a draft plan was shared with the Committee members for review and comment. A copy of the draft plan was provided to the Emergency Management Division for review and comment as well.

Appendix B

Press Releases and Public Involvement

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Press Releases, Public Notices, and Public Involvement

A requirement of the planning process is to not only solicit input from the public and stakeholders in developing the plans, but to keep them informed on the entire process as well.

Requirement §201.6(c)(1): *The Plan must document the planning process, including how it was prepared and who was involved in the process for each jurisdiction.*

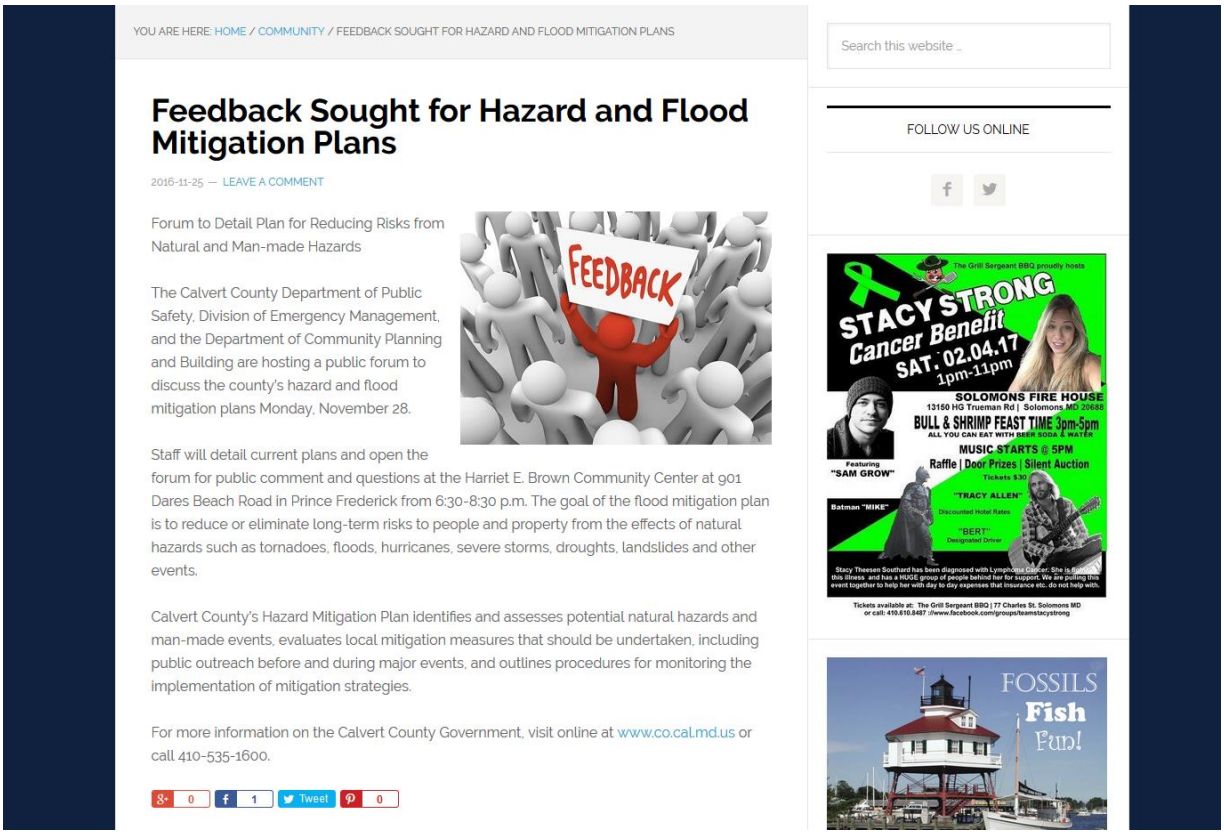
In fulfilment of this requirement, a press release publicizing the Hazard and Flood Mitigation Public Meeting was sent to the following media outlets on November 22nd, 2016:

- Sandra Martin, Bay Weekly
- Margaret Tearman, Bay Weekly
- Kathy Knots, Bay Weekly
- Margit Miller, Calvert Beacon
- Sarah Fleischman, Calvert Recorder
- Meghan Cady, Calvert Recorder
- Tamara Ward, Calvert Recorder
- Diane Burr, Chesapeake Current
- Dandan Zao, County Times
- Rob Perry, Maryland Independent
- Christopher Olson, SoMd Breaking News Facebook page
- Vickie Kite Milburn, Southern Maryland This is Living
- Donnie Morgan, St. Mary's Enterprise
- Marty Madden, The Baynet
- Dawn Richardson, Town of North Beach
- Frank Dawson, WKIK-FM Radio
- T-Bone and Heather, WSMD/WKIK-FM Radio, WSMD/WKIK-FM Radio, WSMD-FM Radio

The release was published in the Beacon, the Recorder online, and Bay Weekly. A representative from the Calvert Beacon attended the first Public meeting, held on November 28th, and Tweeted throughout the presentation.

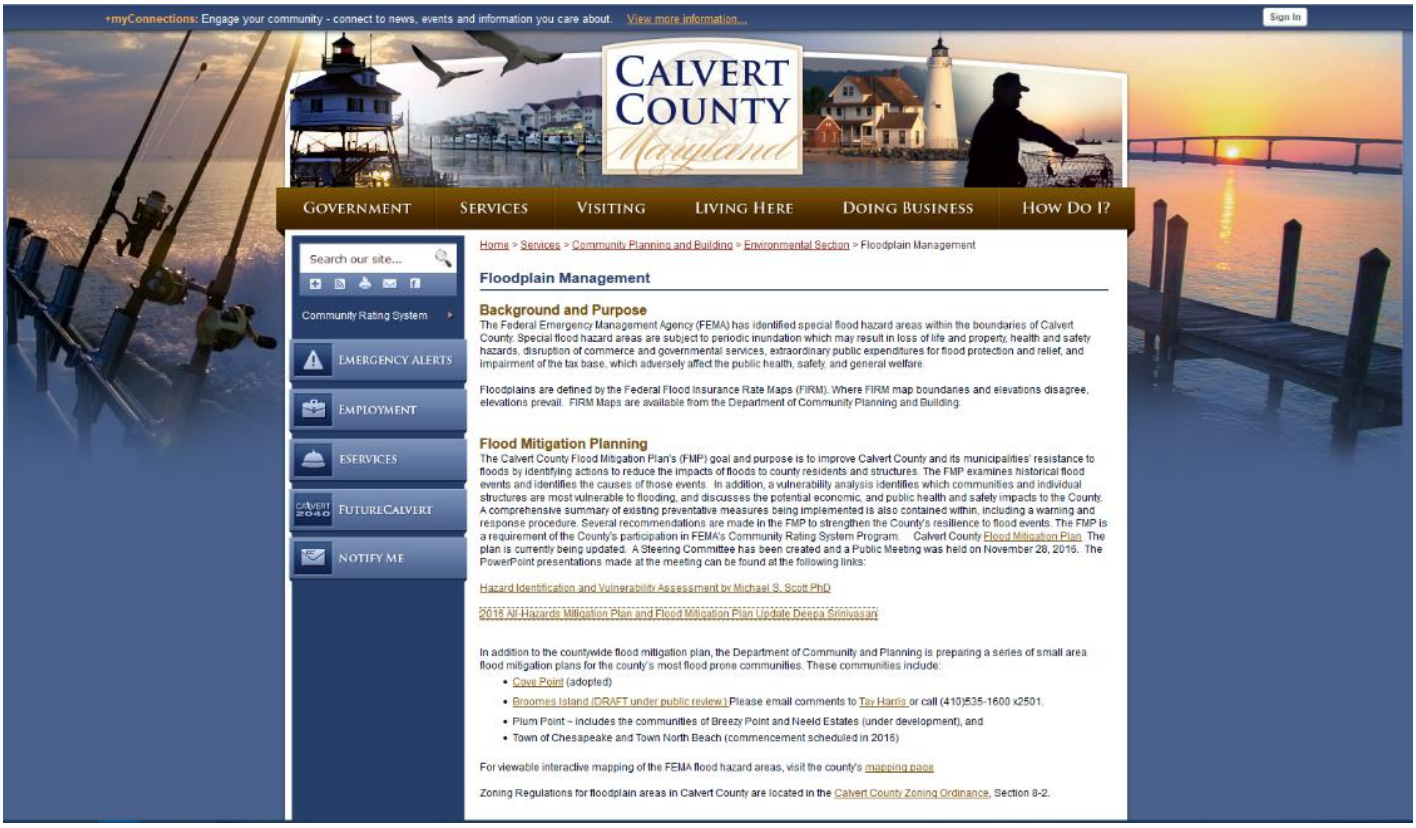
A notice was also posted to the Calvert County Government FB page where they have 3,700 likes(followers).

Calvert County Facebook Page

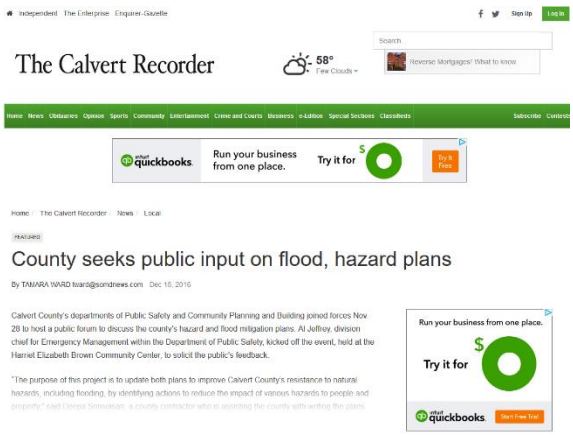


The Calvert Beacon, Online

Additionally, the slideshow presentations given during the first open, public meeting in November are posted to the Calvert County Floodplain Management Website for anyone to view.



The article written by the Calvert Recorder reporter can be found here; http://www.somdnews.com/recorder/news/local/county-seeks-public-input-on-flood-hazard-plans/article_df3b297c-0096-54a4-846c-8c061f0e1121.html



Open Public Meeting #1 – 11/28/16 6:30pm-8:30pm
Harriet Brown Community Center, 901 Dares Beach Road, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

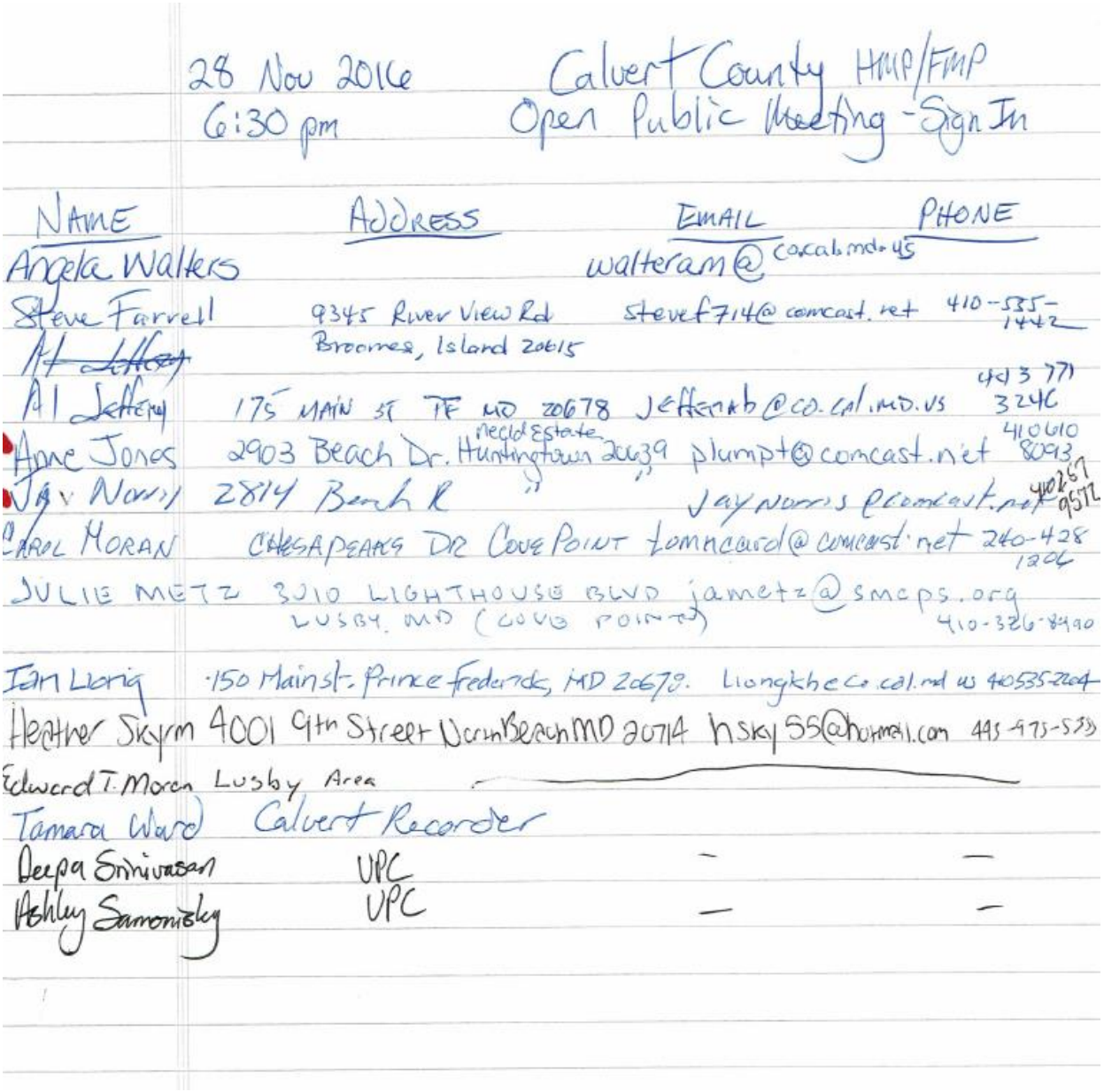
Dr. Mike Scott of the Eastern Shore Regional GIS Cooperative (ESRGC) presented the initial findings of the Hazard Identification and Vulnerability Assessment by. This presentation provided definitions of terms used throughout the process and gave basic background information on the various hazards Calvert County could potentially face.

In addition to examining the various types of hazards, special attention was paid to flooding, as this is the most common problem for the county. Dr. Scott discussed the process for generating the 1% chance flood area and the data sources used to come up with this estimate.

Using HAZUS, a special program designed by FEMA, Dr. Scott was also able to assign a dollar amount for the potential losses associated with a serious flooding event. Property exposures could reach over 14 million dollars in parts of Calvert County.

Similar exposure estimates were generated for every hazard type listed in the plan; wind events, tornado, thunderstorms, extreme temperatures, drought, winter storms, hail, and earthquakes. A Q&A session for the public was then held. Further clarification on terms, process, and what this means for residents was discussed. Residents and property owners then offered input on any concerns they currently have with their properties, neighborhoods/communities, and area points of interest.

The public was then asked to mark-up maps showing the predicted 1% flood area to include known or repetitive loss areas the county is currently facing that may not already represented on the map.



28 Nov 2016 Calvert County HMP/FMP
6:30 pm Open Public Meeting - Sign In

NAME	ADDRESS	EMAIL	PHONE
Angela Walkers		walteram@ cocals.md.us	
Steve Farrell	9345 River View Rd Broomes, Island 20615	stevef714@ comcast. net	410-535-1442
~~Al Jeffery~~			
Al Jeffery	175 MAIN ST TF MD 20678	Jeffersb@co.cal.MD.US	410 3 771 3246
Anne Jones	2903 Beach Dr. Huntingtown 20639 (recld Estate)	plumpt@comcast.net	410 610 8093
Jay Norris	2814 Beach R	Jaynorris@comcast.net	410 257 9572
CAROL MORAN	CHESAPEAKE DR COVE POINT	tomncarol@comcast.net	240-428 1206
JULIE METZ	3010 LIGHTHOUSE BLVD LUSBY, MD (COVE POINT)	jametz@smcps.org	410-326-8490
Jan Liang	150 Main St. Prince Frederick, MD 20678.	Liangkhe@co.cal.md.us	4105352604
Heather Skyrm	4001 9th Street Unit Beach MD 20714	hsky55@hotmail.com	443-975-5535
Edward T. Moran	Lusby Area		
Tamara Ward	Calvert Recorder		
Deepa Srinivasan	VPC	—	—
Ashley Samonisky	VPC	—	—

Open Public Meeting #2 – 1/09/2017 6:00pm-8:00pm
Harriet Brown Community Center, 901 Dares Beach Road, Prince Frederick, MD

Meeting Summary by Ashley Samonisky, Vision Planning and Consulting

Deepa Srinivasan of Vision Planning gave a presentation on the process used to update the Flood Mitigation Plan. Next, the updated list of mitigation actions, as well as the steps used by the Steering Committee to prioritize them, was presented to the public.

Additionally, Dr. Mike Scott of the Eastern Shore Regional GIS Cooperative (ESRGC) provided a brief presentation on the process for determining flood depth grids and generating the 10, 4, 2, 1, and .02% chance flood areas and the data sources used to come up with this estimate.

Using HAZUS, a special program designed by FEMA, Dr. Scott was also able to assign a dollar amount for the potential losses associated with a serious flooding event.

A Q&A session for the public was then held. Further clarification on terms, process, and what this means for residents was discussed. Residents and property owners then offered input on any concerns they currently have with their properties, neighborhoods/communities, and area points of interest.

SIGN-IN SHEET
2nd Public Involvement Meeting
Calvert County HMP/FMP
January 9th, 2017

Name	Phone	Email	Address
Jay E. Harris	410.535.1600	Harris.ste@co.cal.md.us	
SANDY SEES	410-535-2074	jsgees@comcast.net	2825 Beach Drive Neld Estates Huntingtown, MD 20639
JAY SEES	410-535-2074	jsgees@comcast.net	"
William Hildebrand			Beach Drive Huntingtown MD 20639
John Hofmann	410-535-5140	—	

SIGN-IN SHEET
2nd Public Involvement Meeting
Calvert County HMP/FMP
January 9th, 2017

Name	Phone	Email	Address
WILLIAM HILDEBRAND	410-535-2582	—	2826 BEACH DR. HUNTINGTOWN MD 20639
Ron Klauda	410-535-0570	rjklauda@gmail.com	1401 Foxtail Lane Prince Frederick MD 20678
Andy Balchis	410-535-2204	balchiac@co.cal.md.us	150 Main St Prince Frederick MD
Steve Farrell	410-535-1442	stevef714@comcast.net	9345 River View Rd Broomes Island 20615
Shelly Goodloe	4105351600	sgoodloe@co.cal.md.us	

Open Public Meeting #3 – 1/09/2017 6:00pm-8:00pm
Harriet Brown Community Center, 901 Dares Beach Road, Prince Frederick, MD

SIGN-IN SHEET
3rd Public Meeting
Calvert County HMP/FMP
April 13th, 2017

Name	Phone	Email	Address
Shelly Goodeing	4105351600 x2302	goodenss@co.cal.md	
Al Jefferey	" " x2781	jefferab@co.calmd.us	
Ashley Samenitsky		VHB	Consultant
Dan Swan	240 893 8719	dswan@mncppc.net	

2017 All-Hazards Mitigation Plan and Flood Mitigation Plan Update
Calvert County, MD

VISION

Public Meeting
13 April 2017

Presented by:
Deepa Srinivasan, Vision Planning and Consulting, LLC

Project Purpose

To update the all-hazards mitigation plan and flood mitigation plan to improve Calvert County's resistance to natural hazards, including flooding, by identifying actions to reduce the impact of various hazards to people and property.

Key Players

- Calvert County Staff – Emergency Management, Community Planning and Building, GIS, etc.
- Hazard/Flood Mitigation Plan Steering Committee
- Municipalities
- Consultants
  - Deepa Srinivasan, President, Vision Planning & Consulting
  - Dr. Mike Scott, ESRGC- Salisbury University
- Public
- Maryland Emergency Management Agency (MEMA)
- Federal Emergency Management Agency (FEMA R3)

Steps in the Planning Process

1. Reconvene 2009 Steering Committee and develop planning process (meetings)
2. Assess hazards, risks, vulnerability
3. Assess municipal capabilities
   - Existing Plans, Programs, Policies – Capability questionnaire
   - Plan Integration – Document Reviews
   - Local Codes and Zoning Ordinances
   - Current and Proposed Projects
4. Develop goals and objectives and mitigation actions
   - Preventative Measures
   - Projects
   - Natural Resource Protection
   - Outreach and Communication
   - Other Mitigation Actions

Steps in the Planning Process (cont'd)

5. Write mitigation plan and prioritize projects (using Evaluation Criteria)
   - Social
   - Technical/Administrative
   - Economic
6. Develop implementation plan
   - Priorities for Mitigation Actions
     - Short-, Medium-, or Long-Range
     - Potential Funding Sources
     - Responsible Entities
     - Target Completion Dates
   - Five-Year Plan Maintenance Cycle

Steering Committee Meetings

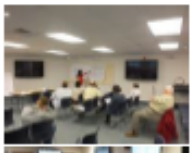
Four Steering Committee Meetings

Meeting 1: October 2016
- Planning process, schedule, deliverables
- Goals and objectives

Meeting 2: Early November 2016
- Mitigation Actions

Meeting 3: Late November 2016
- Hazard identification and risk assessment

Meeting 4: January 2017
- Mitigation actions prioritization
- Implementation strategy



Public Meetings

- Public Meeting 1 (Nov 2016)
  - Planning process, hazard identification, risk assessment
  - Goals and objectives
- Public Meeting 2 (Jan 2016)
  - Mitigation actions and projects
  - Prioritization criteria for mitigation projects

Hazard Identification

Overall Risk Ranking

Hazard	Rank
Flood	1
Coastal Storm Wind	2
Tornado	3
Severe Thunderstorm	4
Lightning	5
Earthquake	6
Winter Storm	7
Extreme Temperatures	8
Hail	10
Drought	11

Coastal Storm Winds

Category	Maximum Sustained Wind Speed (MPH)	Damage Expected
1	74—95	Very dangerous winds will produce some damage: well-built framed homes have damage to shingles, vinyl siding, and gutters
2	96—110	Extremely dangerous winds will cause extensive damage: major roof and siding damage
3	111—129	Devastating damage will occur: well-built homes lose roof decking and gable ends
4	130—156	Catastrophic damage will occur: well-built homes have loss of roof structure and some exterior walls
5	157+	Catastrophic damage will occur: high % of framed homes destroyed

Coastal Storm Winds include Hurricanes, tropical storms, & nor'easters. They have severe low-pressure centers and can generate high-level sustained winds, heavy precipitation, tornadoes, storm surge, wind-driven waves, & tidal flooding.

Tornado

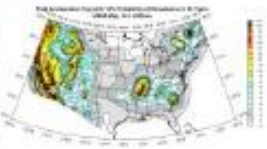
EF Number	Intensity Phrase	Wind Speed
0	Light damage	65-85 MPH
1	Moderate damage	86-110 MPH
2	Considerable damage	111-135 MPH
3	Severe damage	136-165 MPH
4	Devastating damage	166-200 MPH
5	Incredible damage	Over 200 MPH

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground.

Severe Thunderstorm

Severe Thunderstorms are caused when air masses of varying temperatures meet. This causes a rapid uplift of warm moist air that causes thunder, lightning, hail, strong winds, and heavy precipitations. Additionally can cause "straight-line winds" or a derecho.

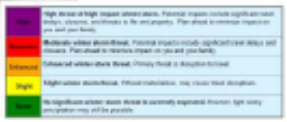
Earthquakes



Earthquakes are motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. They can be caused by crustal strain, volcanism, landslides, and cavern collapse. Earthquakes are most common along tectonic plate boundaries and intra-plate weak points.

Winter Storms

Winter Storms are actually a combination of hazards that include; snow, sleet, freezing rain, strong winds, and below normal temperatures.



Hazard Vulnerability

Quantified Hazard Vulnerability

Hazard	Annualized Losses	Expected Frequency	Potential Casualties
Coastal Storm Wind	$1,298,259	Low	Medium
Flood	$868,899	Medium	Medium
Tornado	$570,437	Low	Medium
Severe Thunderstorm	$97,904	High	Low
Earthquake	$53,016	Low	Low
Lightning	$38,387	High	Medium
Winter Storm	$10,179	High	Medium
Drought	$6,683	Low	Low
Hail	$2,640	High	Low
Extreme Temperatures	$74	High	Medium

Goals and Objectives

Hazard Mitigation Plan

Prevention

Goal 1: Minimize losses and institute adequate regulations through land use regulations.

- Identify and support public and private projects and programs to retrofit, relocate, or acquire properties as well as remove structures susceptible to repetitive flooding.
- Continue to implement systematic maintenance programs for stormwater management systems.
- Discourage new development in high hazard areas through appropriate regulations and land use planning.
- Enforce local, state and federal floodplain regulations and building standards for development in flood hazard areas.

Goals and Objectives

Prevention - cont.

Goal 2: Ensure hazard mitigation goals are consistent with all other County and Municipal plans and ordinances.

- Incorporate hazard mitigation principles into new and existing plans and ordinances.
- Integrate a hazard mitigation section into Calvert County Comprehensive Plan and Chesapeake Beach and North Beach Comprehensive Plans.

Goals and Objectives

Property Protection

Goal 3: Minimize future losses from all disasters by reducing the risk to people and property.

- Protect populations and properties throughout Calvert County that may be susceptible to economic or physical loss from disasters, consistent with the standards established in this Plan and other plans which have, or may be, adopted by the County or Towns.
- Provide protection of critical facilities/infrastructure vital to disaster response, such as fire and police stations, and those vital to the continuous operations of the County, municipalities and communities, such as hospitals and health care facilities, water and sewer facilities, electrical and other utilities, and transportation systems.

Goals and Objectives

Property Protection

Goal 4: Emphasize pre- and post-disaster planning to decrease vulnerability to loss of existing and new construction.

- Promote to elected officials, builders, and existing and potential homeowners, the economic and safety benefits of designing mitigation features into new construction and retrofit of existing structures.
- Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofit.

Goals and Objectives

Public Education and Outreach

Goal 5: Support a balance between government regulation/enforcement, and personal awareness and responsibility for hazard mitigation, by emphasizing education and training for property owners, families and individuals.

- Continue to develop and support disaster preparedness education and awareness programs, targeting residents, visitors, businesses, and elected officials.
- Continue to develop economic incentive programs, for both public and private sectors, that promote structural retrofitting where and when it is determined to be the best option.

Goals and Objectives

Public Education and Outreach

Goal 6: Emphasize the benefits of hazard mitigation principles through ongoing public outreach activities.

- Educate the public on higher standards of protection to structures and facilities.
- Identify and coordinate public information programs and events such as contests and festivals with public and private partners.
- Identify and seek funding sources that will support hazard mitigation awareness and training programs.

Goal 7: Reduce economic vulnerability and increase recovery capabilities of business and industry.

- Continue public education and outreach on the topics of economic vulnerability and recovery through collaborative programs involving government, businesses and community organizations.

Goals and Objectives

Natural Resources

Goal 8: Protect natural resources and open-spaces that provide flood and other hazard mitigation.

- Encourage actions that protect natural resources while supporting community resiliency and hazard mitigation efforts.
- Coordinate natural resource preservation and land use planning to ensure that those natural resource areas, that are shown in this or other adopted community plans to provide hazard mitigation benefits, remain open spaces, and retain the natural benefits they provide.

Goals and Objectives

Emergency Services

Goal 9: Ensure continued coordination and linkages between local jurisdictions and neighboring county and statewide mitigation and resiliency activities to strengthen response and recovery efforts.

- Include local, regional, and statewide jurisdictions in trainings, drills, and exercises to strengthen interagency cooperation.
- Encourage open data and/or data sharing policies and agreements between municipal, county, regional and state jurisdictions to aide in hazard and emergency response, and prepare for Next Generation 911 implementation.

Goals and Objectives

Structural Projects

Goal 10: Protect infrastructure, and critical facilities to reduce potential disruption of regular activities during and after hazard events.

- Efficiently utilize resources to reinforce infrastructure, to withstand potential hazards, and to ensure continued use during and after an event.
- Coordinate with the Towns of Chesapeake Beach and North Beach to research, secure, and effectively use external, or additional, sources of funding to help make the infrastructure and critical facilities on which the residents, businesses and visitors of the County and Towns depend, more resilient to various hazards and events.

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
1	Continue to support a regular maintenance program for emergency generators at the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc.	All
2	Update Comprehensive Plan to include a Hazard Mitigation Section that provides an assessment of hazard vulnerability and appropriate mitigation recommendations	All
3	Continue to conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event	All
4	Continue to ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level and is well maintained.	All
5	Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.	All
6	Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.	Flood

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
7	Introduce NOAA Weather Alert radios in designated critical facilities across the county for situational awareness.	All
8	Continue to develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the County website and COMCAST	
9	Continue to conduct hazard response practice drills and emergency management training exercises on an annual basis.	All
10	Identify natural resources that provide natural mitigation such a wetlands, buffers, etc and make them a priority for conservation.	All
11	Develop and implement a post-disaster recovery plan.	All
12	Continue to work with local radio stations to promote continuity of public awareness and disaster preparedness.	All

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
13	Continue to maintain and replace county owned critical infrastructure.	All
14	In flooded areas, conduct to conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed	Flood, Storm Surge, Nuisance Flooding
15	Work with local businesses and local industry owners to develop a continuity of operations plan.	All
16	Continue to provide technical assistance to local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities.	All
17	Continue to ensure County and municipal compliance with local Stormwater Management Plans.	Flood, Storm Surge, Nuisance Flooding
18	Continue to ensure compliance with approved Erosion and Sedimentation Control Plans and continue to work with local farmers to implement BMPs.	Erosion, Flood

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
19	Continue to distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information	All
20	Maintain zoning ordinance provisions for protection of all hazard areas	All
21	Continue to coordinate with the County municipality and/or the Maryland Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow	Flood, Storm Surge, Nuisance Flooding
22	Give high priority to undeveloped floodplain areas for preservation.	Flood, Storm Surge, Nuisance Flooding
23	Continue a community-specific stormwater maintenance program consisting of routine inspections and subsequent debris removal	Flood, Storm Surge, Nuisance Flooding
24	Recommend to the Board of Education to develop and implement a natural hazards awareness curriculum.	All

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
25	Reduce vulnerability to wildfires by providing public education on increasing buffers and defensible spaces.	Wildfire
26	Make recommendations to the state to develop a disclaimer for developing along the cliffs.	Earthquake, Landslide, Erosion
27	Continue to encourage Calvert County citizens to be better prepared to face hazards by promoting and offering Community Emergency Response Team (CERT) training/classes to increase the number of citizen responders in the municipalities and population centers.	All
28	Continue to identify at-risk populations (elderly, homeless, persons with physical or mental disabilities) to various hazards and maintain records of those vulnerable populations and the types of assistance they may need before, during, or after a hazard.	All
29	Continue to conduct annual Training Exercises for all hazard events at least twice a year.	All
30	Continue the process to meet requirements to become certified as a Storm Ready Community (by the National Weather Service StormReady® Program).	Tornado, Hurricane, Nor'easter, Thunderstorm Winter Storm, Flood

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
31	Conduct seminars in schools on various hazards that could threaten the County and provide informational packets for students to take home.	All
32	Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	Tornado, Flash Flood, Thunderstorm
33	Create a ReadyCalvert website for hazard education and preparedness to inform residents on what to do before, during, and after each potential hazard.	All
34	Continue to maintain relationships with the County School Board to enhance the County's shelter capabilities.	All
35	Develop a volunteer database to identify qualified shelter staff (nurses, teachers, retired military, police, or emergency services, etc.) to bolster the County's staffing capabilities.	All
36	Conduct data analytics of the County's emergency websites and media outlets to track the reach and efficacy of information including news posts, bulletins, and reading materials.	All

Mitigation Actions

Action ID	Project Description	Hazard Mitigated
37	Develop an Emergency Management "brand" to be the face of Emergency Preparedness and provide a trusted and reliable source of information to the public. Raise awareness of the County's Emergency Management Division and their roles and responsibilities.	All
38	Work with the Board of Education to introduce and conduct tornado drills in schools and educate children and families about the growing threat of tornados.	Tornado
39	Continue to coordinate with County PIO to develop a "pre-approved" set of releases to be disseminated to the public in a timely manner in the event of an emergency.	All

Plan Integration

Small Area Plans
- Cove Point Community Flood Mitigation Plan
- Broomes Island Flood Mitigation Plan
- Breezy Point/Neeld Estate Flood Mitigation Plan

County Plans and Ordinances
- Calvert County Floodplain Regulations
- Calvert County Soil and Erosion Control Regulations
- Calvert County Road Ordinance
- Calvert County Stormwater Management Ordinance

Schedule

Flood Mitigation Plan
- Hazard Identification and Vulnerability Assessment – October and November 2016
- Mitigation Strategy – November and December 2016
- Implementation Plan – January 2017
- Plan Implementation – June 2017

Hazard Mitigation Plan
- Hazard Identification and Vulnerability Assessment – October and November 2016
- Mitigation Strategy – November 2016 through February 2017
- Deliverables to Calvert County – June 2017
- Plan Approvals – MEMA and FEMA R3 – August 2017

Thank You!

In fulfillment of the public participation requirement, Calvert County posted the Draft Plan for public review and feedback on its website. This review period was for three-and-a-half weeks and was advertised on the County website, Facebook page, and was sent to the local newspaper.

Calvert Beacon Newspaper

Calvert's Public Safety Looking for Public Feedback

2017-06-23 — LEAVE A COMMENT

Public Feedback Sought for Calvert County Hazard and Flood Mitigation Plans

The Calvert County Department of Public Safety, Division of Emergency Management, and the Department of Planning and Zoning seek public feedback on the county's Hazard Mitigation Plan. The plan was recently updated and will be presented to the Calvert County Board of County Commissioners for review July 25.

The goal of the Hazard Mitigation Plan is to reduce or eliminate long-term risks to people and property from the effects of natural hazards such as tornadoes, floods, hurricanes, severe storms, droughts, landslides and other events. Calvert County's Hazard Mitigation Plan identifies and assesses potential natural hazards and man-made events, evaluates local mitigation measures that should be undertaken – including public outreach before and during major events – and outlines procedures for monitoring the implementation of mitigation strategies.

Residents have until Wednesday, July 5, to review and comment on the Hazard Mitigation Plan. It can be found online at the link provided below. Comments should be directed to Emergency Management Specialist Shelly Gooding via email at goodinss@co.cal.md.us or by calling 410-535-1600, ext. 2302.

Calvert County Facebook Page

Calvert County Website

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Appendix C
Acronyms

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Acronyms

BFE – Base Flood Elevation

CENG – Constellation Energy Nuclear Group

CRS – Community Rating System

dFIRM – Digital Flood Insurance Rate Map

EAS – Emergency Alert Systems

EMS – Emergency Medical Services

EOC – Emergency Operations Center

FEMA – Federal Emergency Management Agency

FMP – Flood Mitigation Plan

FPE – Flood Protection Elevation

GIS – Geographic Information Systems

HMP – Hazard Mitigation Plan

ISDN – Integrated Services Digital Network

LNG – Liquefied Natural Gas

LOMA – Letters of Map Amendments

LOMR – Letters of Map Revisions

MEMA – Maryland Emergency Management Agency

NFIP – National Flood Insurance Program

NPG – National Preparedness Goal

HMA – Hazard Mitigation Assistance

SMECO – Southern Maryland Electric Cooperative, Inc.

THIRA – Threat Hazard Identification and Risk Assessment

TTY – Tele-Type Writer (Communications Device for the Deaf)

WATS – Wide Area Telephone Service

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