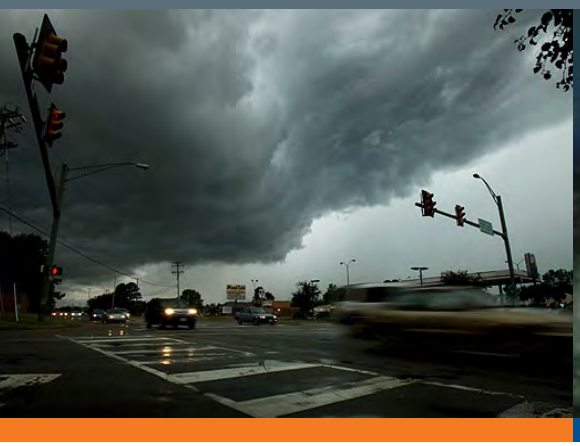
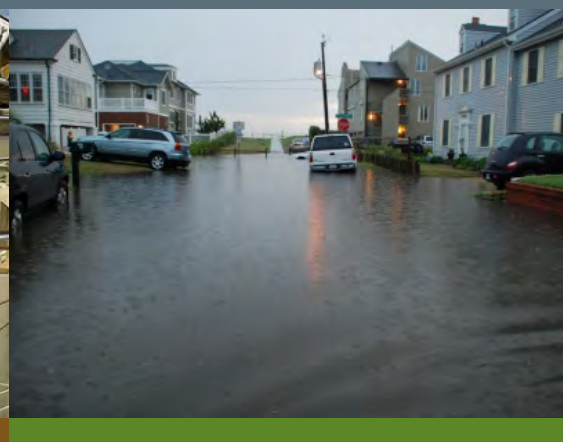
Peninsula Hazard Mitigation Plan 2011 Update

June 2011





Submitted by: Dewberry
8401 Arlington Boulevard
Fairfax, Virginia 22031-4666
703.849.0100

Dewberry®

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Executive Summary

Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

The area covered by this plan includes:

Participating Communities	
Counties	**Cities**
James City County	Hampton
York County	Newport News
	Williamsburg

*These are the same jurisdictions that participated in the *Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan* dated January 2006.

The contents of this Plan are designed and organized to be as reader-friendly and functional as possible. While significant background information is included on the processes used and studies completed (e.g., risk assessment, capability assessment), this information is separated from the more meaningful planning outcomes or actions (e.g., mitigation strategy, mitigation action plans).

Chapter 2 includes a complete narrative description of the process used to prepare the Plan. This includes the identification of the planning team and the involvement of the public and other stakeholders. It also includes a detailed summary for each key meeting, along with any associated outcomes.

The Capability Assessment, located in Chapter 3, describes the Peninsula jurisdictions' ability to implement the plan's mitigation actions, programs, and projects through planning, staffing, and funding. It provides a comprehensive examination of each participating jurisdiction's capacity to implement meaningful mitigation strategies and identifies existing opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the

use of detailed survey questionnaires for local officials and an inventory and analysis of existing plans, ordinances, and other relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses, or conflicts in programs or activities that may hinder mitigation efforts, and to identify activities that should be built upon to establish a successful and sustainable regional hazard mitigation program.

Regional Hazard Identification and Risk Assessment (HIRA) is presented in Chapter 4. This section serves to provide a detailed description of the region, including prevalent geographic, demographic, and economic characteristics. In addition, transportation, housing, and land use patterns are discussed. This baseline information provides a snapshot of the regional planning area and thereby assists county and municipal officials in recognizing the social, environmental, and economic factors that ultimately play a role in determining community vulnerability to natural and human-caused hazards. It also identifies, analyzes, and assesses the region's overall risk to natural hazards. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect the individual municipal jurisdictions.

The Risk Assessment builds on available historical data from past hazard occurrences, establishes detailed profiles for each hazard, and culminates in a hazard risk ranking based on conclusions about the frequency of occurrence, spatial extent, and potential impact of each hazard. FEMA's HAZUS^{MH} loss estimation methodology was also used to evaluate known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as communities seek to determine the most appropriate mitigation actions to pursue and implement — enabling communities to prioritize and focus their efforts on the hazards of greatest concern and those structures or planning areas facing the greatest risk(s). The hazards analyzed in this plan include:

- Flood;
- High Wind;
- Tornadoes;
- Winter Storms;
- Drought;
- Earthquakes;
- Landslides;
- Wildfire;
- Sinkholes; and
- Dam Failure.

The Mitigation Strategy, found in Chapter 5, consists of broad regional goal statements as well as specific mitigation actions for each local government jurisdiction participating in the planning process. The strategy provides the foundation for detailed jurisdictional Mitigation Action Plans that link specific mitigation actions for each jurisdiction to locally-assigned implementation mechanisms and target completion dates. This section is designed to make the Plan both strategic (through the identification of long-term goals), but also functional through the identification of short-term and immediate actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make the communities of the Peninsula region less vulnerable to the damaging forces of nature, while improving the economic, social, and environmental health of the community. The concept of multi-objective planning was emphasized throughout the planning process, particularly in identifying ways to link hazard mitigation policies and programs with complimentary community goals related to housing, economic development, downtown revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

The Plan Maintenance Procedures, found in Chapter 6, include the measures that the participating jurisdictions will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.

Chapter 1: Introduction

The Disaster Mitigation Act of 2000 (DMA2k), approved by Congress and signed into law (Public Law 106-390) in October 2000, is a key component of the Federal government's attempt to reduce the rising cost of disasters in the United States. The Act establishes the Pre-Disaster Hazard Mitigation Program (PDM) and new requirements for the post-disaster Hazard Mitigation Grant Program (HMGP). It emphasizes the importance of mitigation planning in communities and makes development of a hazard mitigation plan a specific eligibility requirement for any local government applying for Federal mitigation grant funds.

In an effort to highlight the importance of planning in the mitigation process, the DMA2k law requires local governments to develop and submit natural hazard mitigation plans in order to qualify for PDM and HMGP grant funding. Specifically, the Act requires that the plan demonstrate a jurisdiction's commitment to reduce risk from natural hazards, serving "as a guide for decision makers as they commit resources to reducing the effects of natural hazards." The final plan must be adopted by the jurisdiction and then approved by the Virginia Department of Emergency Management (VDEM) and ultimately the Federal Emergency Management Agency (FEMA).

In order to facilitate DMA2k compliance for its member jurisdictions, the Peninsula Hazard Mitigation Planning Committee (PHMPC) developed a Natural Hazard Mitigation Plan in 2006 pursuant to the requirements of DMA2k. That planning process also incorporated steps to meet the requirements of the Flood Mitigation Assistance (FMA) program, which will qualify its member jurisdictions for additional Federal flood mitigation assistance.

Hazard mitigation, defined, is any sustained action taken to reduce or eliminate long-term risk to human life and property. Planning is the process of setting goals, developing strategies, and outlining tasks and schedules to accomplish these goals. In preparing this plan, the PHMPC identified the natural and human-caused hazards that threaten their jurisdictions, determined the likely impacts of those hazards, and assessed the vulnerability of the communities to the studied hazards. The PHMPC also assessed its capability to address those hazards through integration with existing programs and policies to maximize utility and ensure a cohesive message. The PHMPC then set mitigation goals and prioritized appropriate strategies to lessen the potential impacts of hazard events.

For the 2011 plan update, each section of the 2006 plan was carefully analyzed and new data was inserted where appropriate.

- The Planning Process section was updated to include a summary of planning activities for the update.
- The Regional Profile includes new jurisdiction-specific information in an effort to ensure the plan is current.
- The HIRA incorporates new hazards, combines old hazards, and aligns them all with the Commonwealth of Virginia's 2010 Standard Hazard Mitigation Plan Update. New maps were also incorporated into this section.
- The Mitigation Strategies section includes revised regional goals and objectives and also incorporates each participating local government's mitigation action plan. An update to the 2006 strategies is included in the appendices.
- Lastly, the Plan Maintenance section includes an explanation of the continued monitoring of the plan intended for the next 5-year planning cycle.

The entire 2006 plan was reformatted and reorganized during the 2011 update.

Scope

The Peninsula Natural Hazard Mitigation Plan identifies goals and measures for hazard mitigation and risk reduction to better ensure that the participating communities are disaster-resistant. The plan not only addresses current concerns, but has also been developed to help guide and coordinate mitigation activities and local policy decisions for future land use.

This plan follows FEMA's DMA2k planning requirements and associated guidance for developing Local Hazard Mitigation Plans. The guidance sets forth a four-task mitigation planning process:

- organize resources;
- assess hazards and risks;
- develop a mitigation plan; and
- evaluate your work.

The plan also utilizes the criteria set forth in FEMA's Crosswalk Reference Document for Review and Submission of Local Mitigation Plans.

Plan Organization

The Peninsula Natural Hazard Mitigation Plan is organized into six sections. The organization of the plan is as follows:

Table 1-1: Plan Organization

Chapter Number	Title
1.0	Introduction
2.0	Regional Profile
3.0	Capability Assessment
4.0	Regional Hazard Identification and Risk Assessment
5.0	Regional Mitigation Goals and Objectives/Specific Community Actions City of Hampton City of Newport News City of Williamsburg James City County York County
6.0	Plan Implementation and Maintenance

In the future, if communities wish to create a community-specific plan, appropriate sections can be utilized.

Chapter 2: Regional Profile

The Peninsula planning region includes the City of Hampton, City of Newport News, York County, City of Williamsburg and James City County. The communities participating in the 2011 hazard mitigation plan update plan are summarized in Figure 2-1, and were the same communities that participated in the 2006 planning initiative.

Location

The lower Virginia Peninsula in southeast Virginia is bounded by the York River, James River, and Chesapeake Bay. The region encompasses the independent cities of Hampton, Newport News, and Williamsburg, and includes James City County and York County. The region has extensive natural areas, including the Chesapeake Bay, picturesque rivers, State parks, wildlife refuges, and botanical gardens.

This Peninsula is rich in colonial American history. The first permanent English settlement in North America was established in 1607 at Jamestown, in James City County. Fort Monroe, in Hampton, played an important role in the American Civil War as President Abraham Lincoln reinforced the Fort so that it would not fall to Confederate forces. Virginia's first capital was in Williamsburg and much of the historic district of that city has been restored. Also, the decisive battle of the American Revolution, the Battle of Yorktown in 1781, took place on the Virginia Peninsula. In 1862 during the American Civil War, the Union Army invaded the Peninsula as part of the campaign to capture Richmond. The 1862 Battle of Yorktown took place along the York River.

The Peninsula jurisdictions are part of the Virginia Beach, Norfolk, Newport News, Virginia, North Carolina Metropolitan Statistical Area (MSA). The Virginia portion of this MSA is generally termed “Hampton Roads.” The land portion of Hampton Roads is divided into two regions: the Peninsula, on the north; and South Hampton Roads, on the south side, where the majority of the area's population resides.

Hampton Roads is an important area of water-based commerce, especially for the cities of Norfolk, Portsmouth, and Newport News. The Norfolk Naval Shipyard is located in Portsmouth a few miles up the Elizabeth River.

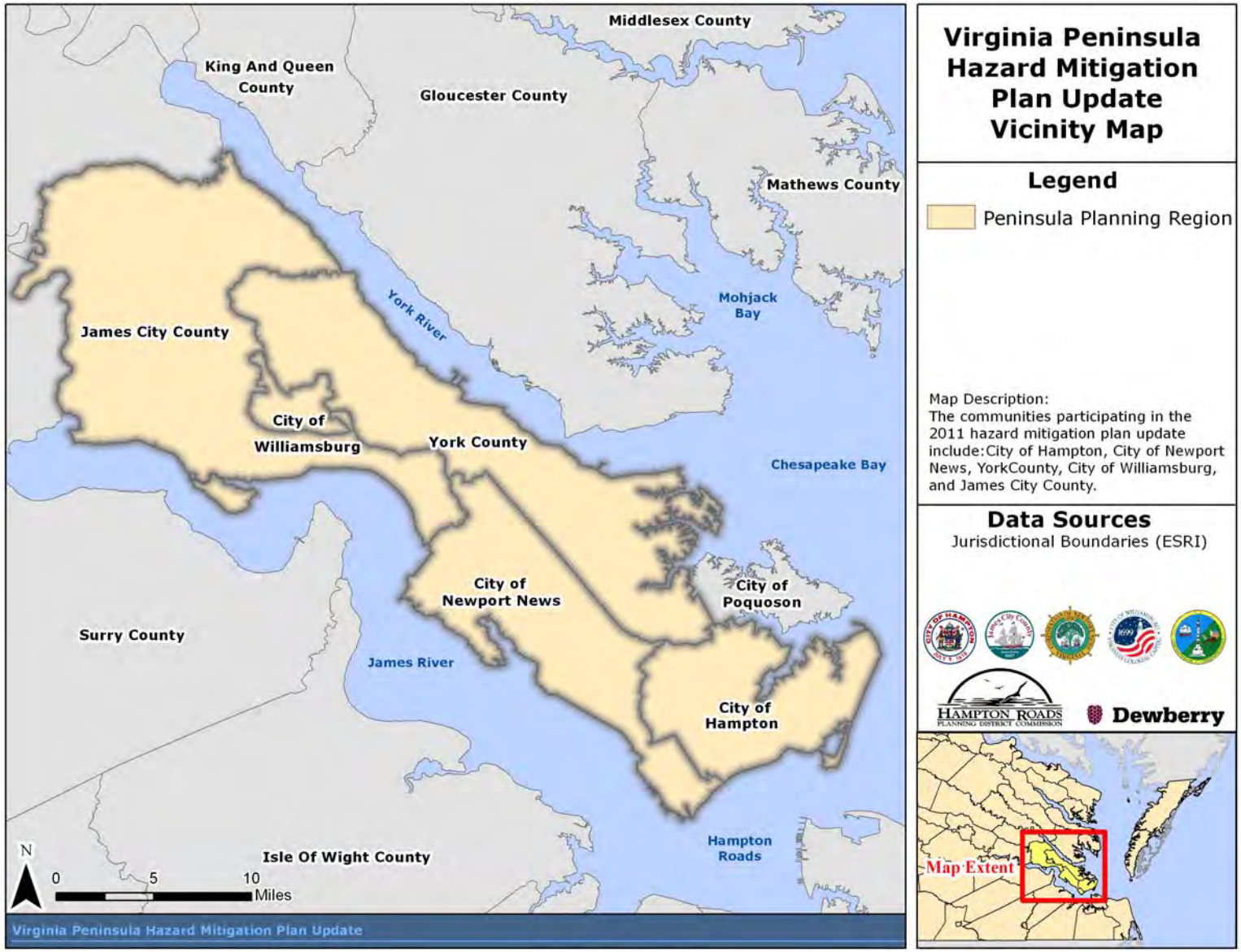

Figure 2-1: Peninsula Vicinity Map

Newport News Shipbuilding a Division of Huntington Ingalls Industries is located near the mouth of the James River in Newport News. There are also several smaller shipyards, numerous docks, and terminals. Massive coal loading piers and facilities were established in the late 19th and early 20th century by the Chesapeake & Ohio (C&O), Norfolk & Western, and Virginian Railways at the end of the Peninsula in Newport News. CSX Transportation now serves the former C&O facility at Newport News.

Geography

The Peninsula planning region is located at the south-east corner of the Commonwealth of Virginia; it lies across the James River from South Hampton Roads, and is part of the Virginia Beach, Norfolk, Newport News, Virginia, North Carolina Metropolitan Statistical Area (MSA. Figure 2-1 shows the Peninsula Region's counties and cities.

For this plan update, the Peninsula is made up of the City of Hampton, City of Newport News, York County, City of Williamsburg, and James City County.

The Peninsula region of Virginia is home to numerous Federal government military facilities such as Fort Monroe, Fort Eustis, the U.S. Coast Guard Training Center, Langley Air Force Base, U.S. Army Transportation Corp, Camp Peary, and Naval Weapons Station Yorktown. Historic and cultural resources include Jamestown, Yorktown, and Colonial Williamsburg.

Climate

The area has a moderate climate. Average temperatures are approximately 67 degrees, and range from January lows in the mid-40s to July highs in the high-80s. Annual rainfall averages above 42 inches.

Climate change is both a present threat and a slow-onset disaster and acts as an amplifier of existing hazards. Extreme weather events have become more frequent over the past 40 to 50 years and this trend is projected to continue.[1] Rising sea levels, coupled with potentially higher hurricane wind speeds, rainfall intensity, and storm surges are expected to have a significant impact on coastal communities, including those on the Virginia Peninsula. More intense heat waves may mean more heat-related illnesses, droughts, and wildfires. As climate science evolves and improves, future updates to this plan might consider including climate change as a parameter in the ranking or scoring of natural hazards.

Hydrology

The Peninsula is located in the Coastal Plain physiographic province of Virginia (Figure 2-2). Elevations range from 0 to 250 feet above sea level. The total land area is 1,304 square miles.

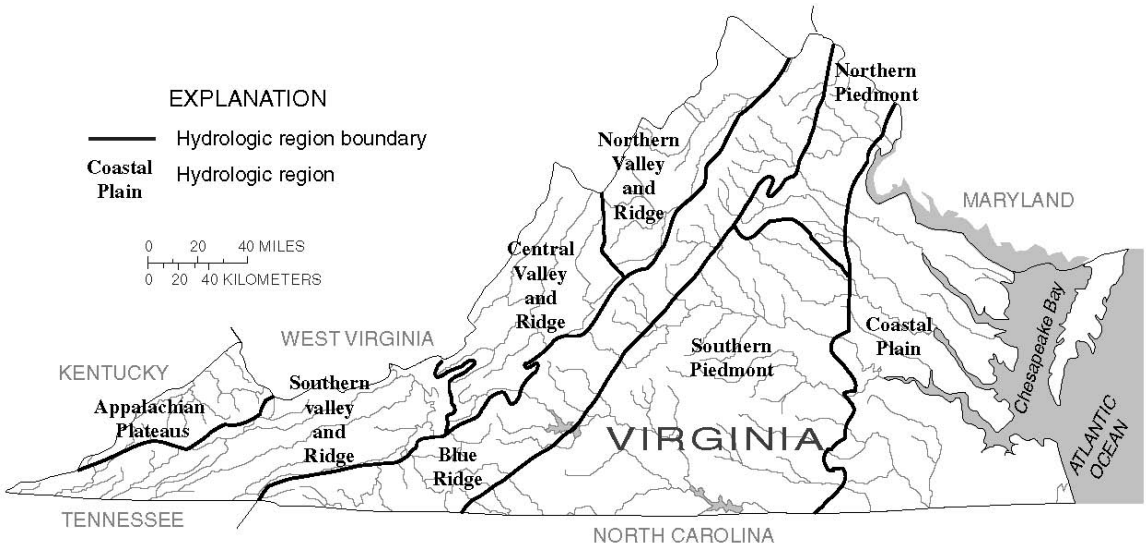

Figure 2-2: Hydrologic Regions of Virginia

Source: U.S. Department of the Interior, U.S. Geological Survey, Fact Sheet 023-01

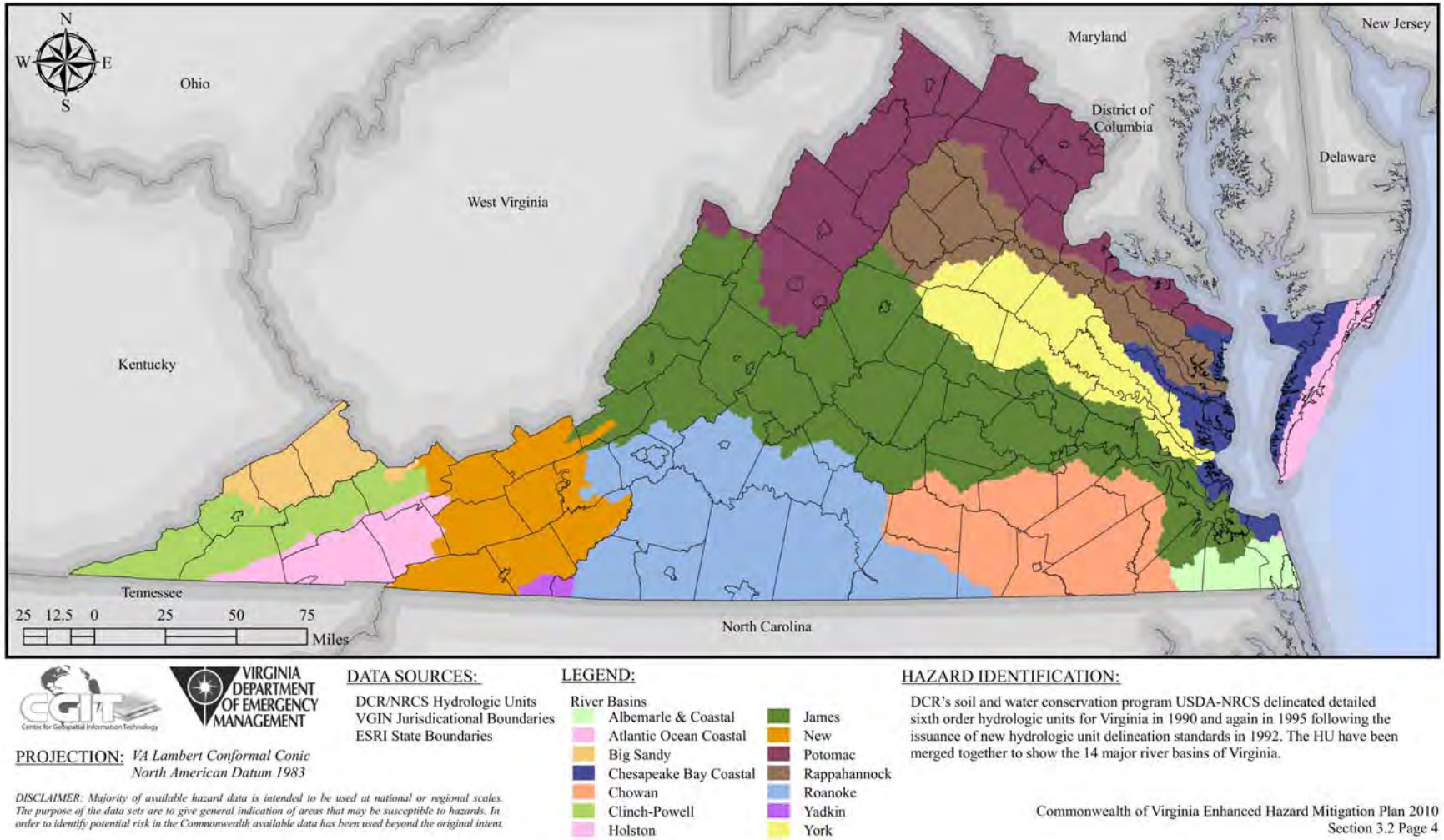

Figure 2-3: Shaded Relief of Virginia

Source: Commonwealth of Virginia Emergency Operations Plan HIRA Figure 3.2-1.

Population Growth and Development Trends

Bordered by the York River to the north, James River to the south, Hampton Roads, and the Chesapeake Bay to the east, the Lower Virginia Peninsula is home to more than 470,000 people[2]. Future population projections indicate that the area will have nearly 530,000 residents by 2030.[3]

The Peninsula region has been one of Virginia's fastest growing regions in recent years. Between the 1990 and 2000 Census, the population of the region grew by 12.8% (see Table 2-2). Population projections since the 2000 Census, completed by the Weldon Cooper Center for Public Service at the University of Virginia, show that the region as a whole continues to grow, but at a less rapid pace and is confirmed by the 2010 Census results. Population change between 2000 and 2010 indicates a 4.9% increase in population for the region, with a 6.15 decline in the City of Hampton and very minimal growth in the City of Newport News.

U.S. Census data for 2010 was not yet available when the Hazard Identification and Risk Analysis (HIRA) was completed; since then some of the redistricting data has become available. It should be noted that the 2009 Weldon-Cooper Center projections are slightly higher for the region (1.26%) than the actual 2010 population. This difference is important to note but does not have a significant impact on the results of the HIRA. The Virginia Employment Commission projections for 2030 will most likely change based on the 2010 data. The remaining census data will be made available through U.S. Census Bureau American Fact Finder in February 2011 (http://factfinder2.census.gov).

Table 2-2: -Regional Population Statistics

Jurisdiction	Census Data			% change 1990 – 2000	% change 2000 – 2010	Weldon-Cooper 2009 estimate [1]	2030 Population Projection [2]
	1990	2000	2010				
City of Hampton	133,793	146,437	137,436	9.50%	-6.15%	144,749	144,650
City of Newport News	170,045	180,150	180,719	5.90%	0.32%	182,591	183,372
City of Williamsburg	11,530	11,998	14,068	4.10%	17.25%	13,572	14,159
James City County	34,859	48,102	67,009	38.00%	39.31%	63,696	100,294
York County	42,434	56,297		32.60%	16.28%	65,964	86,823

			65,464				
Total	**392,649**	**442,984**	**464,696**	**12.80%**	**4.90%**	**470,572**	**529,298**

[1] Weldon Cooper Center, UVA 2005
[2] Virginia Employment Commission, Electronic Labor Market Access, 2005

In addition to population projections, the Weldon Cooper Center also summarizes building permits by community to provide a picture of residential construction activity by year. Building permits are categorized by type of building (single-family, 2-4 unit structures, and 5+ unit structures) and by builder-estimated value of construction. For multi-unit structures, the data indicates the number of units permitted rather than the number of buildings. The information excludes permits issued for mobile homes, garages and other out-buildings, additions and renovations, and commercial construction. These data provide insight to the amount of construction occurring in each of the team jurisdictions (see Table 2-3).

Table 2-3: -2009 Annual Building Permit Data

Jurisdiction	Single Family Units		Structures with 2-4 Units		Structures with 5+ Units		Total Units	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost
Hampton	139	$31,459,576	0	$0	554	$23,874,979	693	$55,334,555
Newport News	61	$6,918,375	0	$0	288	$9,093,970	349	$16,012,345
Williamsburg	21	$4,699,000	0	$0	24	$2,304,696	45	$7,003,696
James City	367	$69,851,098	0	$0	0	$0	367	$69,851,098
York	166	$28,345,134	0	$0	96	$6,700,689	262	$35,045,823
Total	754	$141,273,183	0	$0	962	$41,974,334	1716	$398,572,7

History of the Peninsula Region

City of Hampton, Virginia

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

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

County, encompassing Buckroe and Fox Hill, were consolidated under one municipal government.

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

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

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

Hampton is now a thriving city with numerous industries including high-tech firms, seafood processing, NASA, military, and tourism. Fort Monroe is currently the headquarters for the U.S. Army Training and Doctrine Command, but is facing closure and redevelopment as a result of the 2005 Base Realignment Closure Commission. The Fort Monroe Reuse Plan was signed into effect August 2008, and the city and Federal government are working together on implementation of the Plan. Langley Air Force Base, where historic Langley field was constructed in 1917, is home of the First Fighter Wing. NASA Langley Research Center, where America's first astronauts were trained, is now a major center for aviation research.

City of Newport News, Virginia

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

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

Jamestown. In gratitude, they named the point of landing "Newport's News." Over the years, the "s" was dropped, thus the name Newport News.

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

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

City of Williamsburg, Virginia

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

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

The College of William and Mary, located in Williamsburg, currently enrolls 5,800 undergraduate and almost 2,000 graduate students. Originally founded on February 8, 1693, William and Mary is the second-oldest institution of higher learning in the United States and the fourth oldest in North America. The school was one of the original Colonial colleges; the College's Wren Building is one of the oldest academic buildings in continuous use in the United States. The College educated several American leaders, including three U.S. Presidents. George Washington served as one of the College's first Chancellors. Current chancellor, Sandra Day O'Connor, was the first woman to serve on the United States Supreme Court.

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

James City County, Virginia

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

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

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

York County, Virginia

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

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

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

Planning Process

The PHMPC held two meetings during the plan update process supplemented with numerous conference calls to accommodate busy schedules. The dates and the description of activities at these meetings are below, and each meeting was organized and facilitated by the contractor, Dewberry, LLC. Meeting sign-in sheets are located in Appendix D.

Table 2-4: Mitigation Planning Meetings

Date	Meeting Purpose
September 20, 2010	Project Kickoff Meeting
January 28, 2011	Hazard Identification and Risk Assessment Phase I
January 28, 2011	Mitigation Strategies
February 26 – 28, 2011	Mitigation Actions Meeting
First Week of May, 2011	Draft Plan Presentation

Kickoff Meeting

The update of the Peninsula Hazard Mitigation Plan began with data collection. A kick-off meeting was held on September 20, 2010, with representatives from the counties and cities in the planning region. A list of participants for each committee meeting can found in Appendix D. At the kickoff meeting, the planning process was discussed in detail, along with the proposed schedule of deliverables. Additionally, the committee was asked to review the list of hazards in the 2006 plan and determine if the list should carry over as-is to the 2010 plan, or if changes were necessary.

Following the kickoff meeting, community, county, State, and Federal resources were identified and contacted to collect pertinent policy and regulatory information from each jurisdiction. This information included comprehensive plans, zoning ordinances, development ordinances, and building codes. Dewberry collected information about natural hazards including past occurrences and projected frequencies of future occurrence and the anticipated risk, where available.

Hazard Identification and Risk Assessment Results Meeting #1

A second meeting was held on January 28, 2011, to discuss the results of the plan's HIRA section. The HIRA process involved analyzing the region's greatest hazard threats and determining its most significant vulnerabilities with respect to natural hazards. Risk was determined by looking at the total threat and vulnerability for all jurisdictions posed by each hazard identified by the Mitigation Advisory Committee (MAC). The HIRA was performed in large part using GIS data from the participating jurisdictions, HAZUS-MH MR 3 (a GIS-based FEMA loss estimation software), and State sources.

This meeting also served for development of regional goals and objectives.

Simultaneous to conducting the HIRA, Dewberry also assessed the mitigation capabilities of each jurisdiction in the planning region. A capability assessment was performed to review the existing programs and policies addressing natural hazards. A thorough analysis of the adequacy of existing measures was performed, and potential changes and improvements were identified. The committee reviewed the capability assessment at the second HIRA meeting conducted January 28, 2010.

Mitigation Actions Meeting

During the week of February 25, 2011, the committee conducted separate meetings at the offices of each of the five participating jurisdictions to identify and develop potential regional mitigation actions for implementation. At these meetings the vulnerability analysis results were presented in the context of each specific local government. The PHMPC considered issues related to potential damage from hazard events within the region, evaluated the 2006 projects, and helped draft an action plan to specify the recommended projects, who is responsible for implementing the projects, and when they are to be completed.

The region will continue to implement the plan and perform periodic reviews and revisions through on-going PHMPC reviews and revisions. The City of Hampton, Office of Emergency Management will conduct an annual planning review of the mitigation plan and public meetings will be held during the 5-year review/update period.

Peninsula Hazard Mitigation Planning Committee

Hampton, as the administrative lead for the project, convened an advisory committee comprised of representatives from various participating jurisdictions and the Hampton Roads Planning District Commission. The PHMPC worked with the Dewberry team and provided input at key stages of the process. Efforts to involve municipal, city, and county departments and community organizations with possible roles in implementing the mitigation actions or policies included invitations to attend meetings and serve on the PHMPC, access to the project website, e-mail updates, strategy development workshops, and opportunities for input and comment on all draft deliverables.

The following members were a part of the PHMPC and were chosen by their respective jurisdictions to participate in the development of this plan:

Table 2-5: Committee Members

Member	Jurisdiction
Tracy Hanger	City of Hampton
Sara Ruch	City of Hampton
Curt Shaffer	City of Hampton
Tal Luton	James City County
Kate Hale	James City County
Natalie Easterday	Hampton Roads Planning District Commission

Rich Flannery	Hampton Roads Planning District Commission
Paul Long	York County
Stephen Kopczynski	York County
Ken Jones	City of Newport News
Bob Gregory	City of Newport News
Pat Dent	City of Williamsburg

Public Involvement and Citizen Input

An important component of this planning process is the opportunity for the general public to provide input. Individual citizen and community-based input provides the planning team with a greater understanding of local concerns and increases the likelihood of successfully implementing mitigation actions by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the natural hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any community's overall mitigation strategy for making a home, neighborhood, school, business, or city safer from the potential effects of natural hazards. To solicit feedback from members of the public, including academia, private industry, etc., a public outreach website was created and deployed. Additionally, open house meetings were held in the City of Hampton, Newport News, and York County, where members of the general public were invited to come and listen to an overview of the hazard mitigation plan. Appendix H shows jurisdiction-specific outreach initiatives for the 2011 update.

The PHMPC worked with the firm Resource Stack, Inc. to develop a public outreach webpage in connection with the Hampton Roads Planning District Commission website. On this webpage, updates of the plan development process, links to the draft plan, and fields for public comments were publicized. A screenshot of the website is shown below. Members of the public, other jurisdictions, nonprofits and other interested parties were able to view and utilize this website for plan review as desired, beginning in June 2011.

Hazard Mitigation
Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. - Federal Emergency Management Agency
Peninsula
Peninsula
Login | Register
The 2011 Peninsula Hazard Mitigation Plan Update has been underway since August 2010. As part of the 5-year plan update cycle, the maps below were developed highlighting the results of the Hazard Identification and Risk Assessment. We're interested in your feedback and have provided an area for public comment as well as a survey (available until Jun 30, 2011) for you to participate in. Please be sure to check back for the final Peninsula Hazard Mitigation Plan during the summer of 2011.
Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business or city safer from the effects of natural hazards.
- Virginia Peninsula Hazard Mitigation Plan
Public Comment
First Name*
Last Name*
Virginia Peninsula Hazard Mitigation Plan Update
Page: 1 2 Next
Sort By
Title
Desc
Drought Hazard
Flood Hazard
Want more information? Check your local emergency management website.
City of Hampton
City of Newport News
City of Williamsburg
York County
James City County
Check out the calendar page for information on upcoming public

Incorporation of Existing Plans and Studies

Coordination with other community planning efforts is paramount to the success of a hazard mitigation plan. Hazard mitigation planning involves identifying existing community policies, tools, and actions that will reduce a community's risk and vulnerability to natural hazards. The Committee identified a variety of comprehensive planning mechanisms such as land use or master plans, emergency response plans, mitigation plans, municipal ordinances, and building codes that guide and control community development. Cross-referencing existing planning efforts, mitigation policies, and action strategies into this Hazard Mitigation Plan links the specific natural hazards that present a risk to the community with the existing mitigation elements found in other community programs, other planning documents, and regulations. The development of this plan utilized information from community plans, studies, reports, and initiatives including:

- 2006 Peninsula Hazard Mitigation Plan;
- Municipal Comprehensive Plans from Peninsula area localities;
- Codified Ordinances from Peninsula area localities;
- Virginia Uniform Statewide Building Code – 2000;
- 2003 Hurricane Isabel Damage Assessment Reports;
- Peninsula area Tax Assessor and Land Use data; and
- Flood Insurance Studies and Flood Insurance Rate Maps for the Peninsula region.

Through the implementation of this plan, appropriate data and recommendations will be integrated into the other existing community activities.

The following sections of this plan complete the 10-step planning process:

- Chapter 4-Hazard Identification and Risk Assessment addresses Step 4: Assess Hazard;
- Chapter 5-Mitigation Goals and Objectives addresses Step 6: Set Goals; Step 7: Review Possible Activities; and Step 8: The Action Plan; and
- Chapter 6-Plan Implementation addresses Step 9: Plan Implementation and Step 10: Plan Maintenance

Chapter 3: Community Profiles and Capability Assessments

The capability analysis is a key element in developing suitable goals and objectives for mitigation. Because mitigation is most effective at protecting development that does not yet exist, a community's development trends can provide direction, incentive and alternatives to placing new development at risk from natural hazards. Furthermore, a careful analysis of existing capabilities increases the likelihood of identifying practices that could potentially *increase* the impacts of hazards upon the communities. A properly conducted mitigation capability assessment can also demonstrate potential gaps and highlight policy needs that can hinder or enhance mitigation programming.

The planning team developed the natural hazard risk assessment for each member jurisdiction using three main steps: 1) hazard analysis, 2) vulnerability assessment, and 3) capability assessment. This information provides the framework for the Peninsula Hazard Mitigation Planning Committee (PHMPC) to develop and prioritize mitigation strategies and plans to reduce the risks and vulnerabilities that the region's communities may encounter from future hazard events. The capability assessment will provide the member jurisdictions with a better understanding of preparedness levels and capability to mitigate against natural hazards.

Each community's capability with regard to natural hazard mitigation was examined through interviews with key personnel, data collection, and examination of regulations. The following sample matrix (Table 3-1) was completed for each of the five Peninsula communities, and was used to trigger discussion about existing policies, regulations, and processes for numerous hazards.

Table 3-1 – Capability Matrix	
	Town of HAZARDVILLE
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	22-July-77
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	0
-Number of NFIP policies	0
-Maintain Elevation Certificates	No
-Number of Repetitive Losses	0
CRS Rating	No
Stormwater Program	Yes
Building Code Version Full-time Building Official	USBC 2000 Edition (based on IBC)
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	TBD
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes-Cable-Emergency Alert System
GIS system	No
-Hazard Data	N/A
-Building footprints	N/A
-Tied to Assessor data	N/A
-Land Use designations	N/A
Structural Protection Projects	No
Property Owner Protection Projects	Acquisitions
Critical Facilities Protected	No
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Explanation of Sample Capability Assessment Matrix (as shown in Table 3-1)

Comprehensive Plan: Comprehensive Long-Term Community Growth Plan

Land Use Plan: Plan that designates type of land use desired/required for individual parcels; often based on Zoning.

Subdivision Ordinance: Regulations that dictate lot size, density, setbacks, construction type and other parameters for large developments.

Zoning Ordinance: Regulations that dictate acceptable uses for individual parcels; may be tied to Land Use Plan.

Floodplain Management Ordinance: Directs development in identified Flood Hazard Areas. Required for participation in the National Flood Insurance Program (NFIP).

Flood Insurance Rate Map (FIRM): The official map of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community. Digital maps are referred to as DFIRMs.

Substantial Damage Language: Provision of Floodplain Management Ordinance requires existing construction be brought into compliance if structure is damaged/improved by more than fifty percent of its value.

Certified Floodplain Manager: Association of State Floodplain Managers' designation for professionally certified floodplain managers.

Number of Flood-Prone Buildings: Number of buildings in the mapped Special Flood Hazard Area (SFHA).

Number of NFIP policies: Number of buildings insured against flood damage through the NFIP.

Number of Repetitive Losses: Number of properties with multiple flood insurance claims in past 10 years.

Number of Severe Repetitive Losses: Number of properties with either four or more insurance claims adding up to $20,000 or greater or two or more insurance claims adding up to more than the market value of the building over the last 10 years.

CRS Rating: The Community Rating System (CRS) of the NFIP is an incentive program that rewards communities for regulations/programs that exceed NFIP minimums through premium reductions for insured.

BCEGS: Building Code Effectiveness Grading System Rating assesses the building codes in effect and how they are enforced, with special emphasis on mitigation of losses from natural hazard.

Emergency Operations Plan: Disaster Response Plan focuses on different disaster types and scenarios.

Hazard Mitigation Plan: Plans such as this may address different types of hazards, including natural hazards, man-made hazards, and others as defined by a particular jurisdiction.

Warning: Community Warning systems in place, including NOAA Weather Radio reception, outdoor sirens, Cable Override, Flood Warning System, or Emergency Warning Notification System.

GIS: Geographic Information System, or geographic databases interfaced with community mapping to provide enhanced planning and response capability.

Structural Protection Projects: Constructed flood protection, such as levees, drainage facilities, detention/retention basins.

Property Protection Projects: Non-structural flood protection through acquisition, elevation of structures, or flood proofing.

Critical Facility Protection: Previous community projects to protect critical facilities. These may include protection of power substations, sewage lift stations, water-supply sources, the Emergency Operations Center (EOC), police/fire stations, or medical facilities.

Natural and Cultural Inventory: Inventory of resources, maps, or special regulations to protect natural or cultural resources; examples include wetlands, steep slopes, or historic structures.

Erosion or Sediment Control: Regulations to protect streams and waterways from sediment contributions originating from construction, runoff, or other sources.

Public Information or Environmental Education Program: Ongoing programs providing information to the public on hazards, environmental awareness, and emergency preparation. It may include flyers in city utility billings, a website, or an environmental education program for students.

The mitigation capabilities of each community are individually identified and included as part of each community profile.

City of Hampton Profile

The following sections present a detailed assessment of critical hazards that affect the City. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

Capability Assessment – City of Hampton

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team assessed Hampton's existing mitigation capabilities. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Hampton's mitigation plan.

Table 3-2: Capability Matrix – City of Hampton	
	City of Hampton
Comprehensive Plan	Yes, 12/89
Land Use Plan	Yes, 2010
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes, updated 2010
-Effective Flood Insurance Rate Map Date	DFIRM 11/9/2010
-Substantial Damage Language	Yes
-Certified Floodplain Manager	Yes
-Number of Floodprone Buildings	13,609
-Number of NFIP policies	11,424 (as of 9/2010)
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	824 (as of 9/2010); 27 severe repetitive loss
CRS Rating	Yes, rated an 8
Stormwater Program	Yes
Building Code Version	VUSBC (IBC 2006)
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2
Emergency Operations Plan	Yes 2010
Hazard Mitigation Plan	Yes 2006
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	No
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes – cable override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not all facilities fully protected.
Natural Resources Inventory	No
Cultural Resources Inventory	Partial
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes

Table 3-2: Capability Matrix – City of Hampton	
	City of Hampton
Public Information Program/Outlet	Yes, Emerg Mgmt & Public Works & Police Department
Environmental Education Program	Yes, Public Works

Form of Governance

Hampton has a Council-Manager form of government. The Hampton City Council is composed of seven elected members, including an elected Mayor. The Council selects the Vice Mayor after each election. Elections are held on the first Tuesday in May. Council members are elected to four-year terms in staggered elections in even years. The Council appoints a City Manager who administers day-to-day city services and directs city agencies.

Guiding Community Documents

The City of Hampton has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, 15 neighborhood/small area plans, capital improvement plans, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Hampton Community Plan

The Code of Virginia requires all cities and counties in the State to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The Community Plan represents the integration of city plans in promotion of major policies and strategies, and was developed through a comprehensive process over a four month period by members of the community. Maintenance of the Plan is the responsibility of the Department of Planning. The document features the following:

- Long-range intentions regarding the direction and nature of future development; assessments of current conditions and citizen desires for incorporation into long-range public policy
- A unified vision comprised of eight elements that focus on aspects of future community development: Customer Delight, Healthy Business Climate, Healthy Growth and Development of Children and Youth, Healthy Neighborhoods, Healthy Diverse Community, Healthy Region, Strong Schools, and Youth

- An environmental element focusing on Chesapeake Bay water quality, balancing environmental restraints and development needs, protecting significant natural resources, linking environmental education to youth development, and promoting waste reduction, pollution prevention, and water and energy conservation
- Plans for continued growth and development and urban design in designated strategic areas of interest, including:
    - Coliseum Central
    - Downtown Hampton
    - Buckroe Beach
    - North King Street Corridor
    - Kecoughtan Road Corridor
    - Phoebus
    - Fort Monroe
- Plans for necessary transportation enhancements and improvements to service projected growth
- Plans for operation and expansion of public facilities to accommodate expected growth in the City, including bikeways, playgrounds, and pools.

Zoning & Development Standards

- Identifies existing Federal and State regulations for wetland, floodplain, and Resource Protection Area and Resource Management Area (RPA/RMA) protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Hampton has adopted the minimum requirements of the NFIP by designating the Flood Zone District as a Special Public Interest District in Zoning Ordinance §17.3-31. The community has 824 properties with NFIP policies including 27 severe repetitive loss properties. Structures in A Zones must be constructed at or above the Base Flood Elevation (BFE), and structures in V Zones must have their lowest horizontal structural member elevated to or above the BFE, which includes an additional three feet for wave height. The Department of Codes Compliance enforced requirements for “substantially damaged” homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made. Building permit applications and parcel information are all available online. The parcel information includes flood hazard area designation.

A Site Plan Review Committee for new development is made up of representatives from Public Works, Division of Fire and Rescue, Police

Division, Planning Department, Codes Compliance, and any other department that the Director of Public Works deems necessary to review proposed plans. During the review of new site plans, recommendations concerning the plan may be made and any such suggestions shall be reported to the City Manager when the plan is submitted for review. The committee is tasked with the responsibility of reviewing the plan to ensure its compliance with the City's building, structure, and safety codes. The Police Division is tasked with ensuring that Crime Prevention Through Environmental Design is achieved. This is accomplished by ensuring appropriate lighting and landscaping design, while minimizing design barriers that may result in unsafe or unlawful activities. The Office of Emergency Management is not involved in the Site Plan Review Committee.

Stormwater Program and Fees

The City's stormwater fee is a result of the Federal Clean Water Act of 1987, which mandated that cities of 100,000 or more persons reduce pollution before it reaches the Chesapeake Bay. Hampton established the stormwater fee because no Federal or State dollars were provided to implement water quality measures in accordance with the Federal mandate.

Monies from the stormwater fee are used to fund many programs related to water quality, including environmental education, street sweeping, capital improvements to the system, drainage maintenance, administration, review of permits, inspection, and monitoring activities.

Public Education

Among the readily available public outreach mechanisms for the City of Hampton, the City's website (http://www.hampton.gov) provides residents with pertinent information, provides an on-line complaint form and property information tool, and answers numerous Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Community Plan, on this site. The City provides special training to property owners via the Codes Academy and the City's Neighborhood College Leadership Institute. Emergency Preparedness information is also disseminated through the City Public Information Office's eNews, free e-mail briefs about what's happening in Hampton, and the City's local cable channel, Channel 47. The City utilizes social media through its Facebook page and a text message service called Citizen Observer.

The City of Hampton is the first locality in Virginia to establish a centralized 3-1-1 customer call center that offers citizens round-the-clock access to city

services and information. Residents within the city limits dial 3-1-1 and are connected with call center staff. Residents with cell phones may also access 3-1-1. Those citizens outside of the city limits may access the customer call center by calling 727-8311. Customer Advocates (call-takers) help with everything from reporting a missed trash collection to potholes to answering questions about the city budget or inquiries about a community center's hours.

The City's Department of Public Works has many different types of educational materials available for Hampton residents, businesses, teachers, youth, and adult groups. Materials may include coloring books, posters, promotional magnets, environmental tip sheets, and guides to all environmental services in Hampton. The City's Emergency Preparedness personnel worked with the City of Hampton Neighborhood Commission and Neighborhood Office to develop Hampton-specific Emergency Preparedness Information to specifically target vulnerable communities. The project produced a calendar with preparedness information, which is available on the City website. The Hampton Watershed Restoration Project offers annual waterway clean-ups, Chesapeake Bay friendly seminars, Adopt-a Stream cleanup, storm drain marking, environmental ambassador efforts, and public education activities.

Emergency Preparedness

Emergency Alert System (EAS) – EAS is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement was an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. FEMA tested the first iteration of this national satellite distribution network in June 2007.

Storm Ready – Hampton was one of the first five Virginia communities certified as "Storm Ready" by the National Weather Service. As of November 2010, 33 Virginia communities made the list, including Hampton, Williamsburg, Newport News, and York County. Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with

clear-cut guidelines on how to improve. To be officially considered "Storm Ready", a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Hampton Citizen Corps – The Hampton Citizen Corps, as part of the Virginia Corps, creates opportunities for volunteers to help communities prepare for and respond to emergencies by bringing together local leaders, citizen, and organizations. Hampton's Citizen Corps includes five core programs: Neighborhood Watch, Volunteers in Police Service, Medical Reserve Corps, Fire Corp, and Community Emergency Response Team (CERT).

CERT, which is a core program that is relevant to hazard mitigation, helps communities respond to disasters during the first 72 hours following an event when flooded roads, disrupted communications, and emergency demand overwhelm local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

Other Mitigation Activities

Hampton is currently in the process of incorporating its Repetitive Loss Plan into the 2011 Peninsula Hazard Mitigation Plan. This process will ensure that Repetitive Losses are addressed comprehensively in the community.

The City of Hampton is currently in the planning stages of relocating its EOC/911/311 facility into an area outside of the floodplain. This will ensure that citizens are able to receive emergency services during a flood event in a timely manner.

Finally, Hampton is in the process of developing Memorandums of Understanding (MOUs) with neighboring localities to ensure that hurricane shelter capacity needs for the community are addressed and emergency generators and/or pre-wiring of shelter facilities for quick hook up at designated shelters.

City of Newport News Profile

The following sections present a detailed assessment of critical hazards that affect the City of Newport News. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

Capability Assessment – City of Newport News

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Newport News. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Newport News' mitigation plan.

Table 3-3: Capability Matrix – City of Newport News

	City of Newport News
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	6-5-2007
-Substantial Damage Language	Yes
-Certified Floodplain Manager	Yes
-Number of Floodprone Buildings	4,596
-Number of NFIP policies	2,662 (as of 9/2010)
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	60 (as of 9/2010); 1 Severe repetitive loss
CRS Rating	None
Stormwater Program	Yes
Building Code Version	VUSBC (IBC 2006)
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes

Table 3-3: Capability Matrix – City of Newport News	
	City of Newport News
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, for Surry only
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes, cable-override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

The City of Newport News is administered by a Council-Manager form of government in which two citizens are elected from each of three districts—North, Central, and South—to serve on City Council. The Mayor is elected at-large. The City Council establishes the City's public policy through resolutions and ordinances, approves proposed programs, and controls the funding of these programs. The City Council is guided by the City Charter; as adopted and approved by the Virginia General Assembly, and by its own rules of procedures, resolutions, and ordinances. The City Council makes decisions after obtaining input from citizens and staff.

The City Manager, City Attorney, and City Clerk are appointed by the City Council and department heads are appointed by the City Manager. As chief administrative officer of the City, the City Manger oversees the work of all City Departments and offices and administers the policies established by City Council.

Guiding Community Documents

The City of Newport News has a range of guidance documents and plans for each of its departments. These include a comprehensive plan, a Flood Protection Plan, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the comprehensive plan, entitled *Framework for the Future*.

Framework for the Future (2030)

The Code of Virginia requires all cities and counties in the State to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The City of Newport News' *Framework for the Future* features the following:

- Long-range intentions regarding the direction and nature of future development, current conditions, and citizen desires for incorporation into long-range public policy
- Thirteen elements that focus on aspects of future development: economic development, land use, transportation, education, parks and recreation, housing, public safety, historic preservation, human services, culture, environment, urban services, and the Land Use Plan[4]
- An environmental element that concentrates on air quality, wetlands, floodplains, natural heritage areas, soils, and water quality
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:
    - Oyster Point/Port Warwick
    - Patrick Henry Mall area, south of the airport
    - Endview Plantation
    - Lee Hall Industrial Park
    - South East Community

The *Framework for the Future* also contains a *Chesapeake Bay Technical Support Document* addendum which further discusses physical constraints to development in the city: protection of potable water supply; shoreline erosion control; public and private access to the waterfront; and redevelopment of intensely developed areas and other areas targeted for redevelopment.

Zoning & Development Standards

- Identifies existing Federal and State regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Newport News has exceeded the minimum requirements of the NFIP through adoption of their floodplain management ordinance. The floodplain is designated as an Overlay Zoning District in Zoning Ordinance, Article XXXI, Section 45, Division 2. The community has 60 properties with NFIP policies, and one severe repetitive loss property. The City conducted a post-flood analysis after Hurricane Floyd and concluded that one foot of freeboard would be mandated for floodplain structures. The ordinance was amended to incorporate one foot of freeboard for structures, and two feet of freeboard above the BFE for storage of certain chemicals. The freeboard also applies to structures built in the Coastal High Hazard Area. The City's Building Permit application includes a notation regarding the map panel and zone designation, and a space for the First Floor Elevation.

A Site Plan Review Committee for new commercial and multi-family development projects is made up of representatives from Fire and Police Departments, Newport News Waterworks, Department of Public Works, Department of Economic Development, Planning, and Codes Compliance. The Engineering Department sends at least three representatives to deal with traffic, stormwater, and storm sewer issues. Emergency Management is not involved in the Site Plan Review Committee. The City has been considering the U.S. Army Corps of Engineers (USACE) request to be included in the early stages of site plan review.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and the City of Newport News is responsible for enforcing the code locally. As of November 2010, the VUSBC is based on the 2006 International Building Code, International Plumbing Code, International Mechanical Code, International Fuel Gas Code, International Energy Conservation Code, International Residential Code, and the 2005 National Electrical Code, and went into effect in May 2008[5]. The code contains the building regulations required when constructing a new building/structure or an addition to an existing building; maintaining or

repairing an existing building; or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. Newport News charges fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the VUSBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and State agencies, related to any construction, reconstruction, alterations, conversion, repair, or use of buildings and installation of equipment therein. The VUSBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

Flood Protection Plan

The *Flood Protection Plan* was developed in 1999 as part of a review of stormwater management program elements in order to receive Flood Mitigation Assistance funding and as a future NFIP CRS program element. The plan details the City's floodplain management activities, including (re)development regulations, capital projects, maintenance and education/outreach. New initiatives from the plan included development of flood reduction strategies for the Salter's Creek and Newmarket Creek floodplains.

Stormwater Program and Fees

In 1993, the City implemented a Stormwater Management Service Charge to fund a comprehensive stormwater management program, including capital project funding. Consequently, stormwater management capital project funding does not compete with other project funding such as that for schools and public buildings. Within the Salter's Creek and Newmarket Creek drainage basins, a *Master Drainage and Flood Control Plan* identified major capital projects to address flooding associated with the conveyance system. Implementation of these projects is ongoing and continues as funding becomes available.

Maintenance of the City's stormwater conveyance system is a priority element of the Comprehensive Stormwater Management Program and Flood

Protection Plan. Major outfall ditches are on regular maintenance intervals generated by an automated work order system. Roadside, back, and side lot ditch maintenance is done on a manual, preventative maintenance schedule.

Stormwater program employees are available to assist property owners with shoreline erosion problems. The engineers can conduct on-site inspections and provide recommendations, and may also act as a liaison with the State's Shoreline Erosion Advisory Service (SEAS). The City's Department of Planning and Department of Development distribute a brochure on shoreline erosion that includes recommended measures and examples of poor shoreline management.

Public Education

Among the readily available public outreach mechanisms for the City of Newport News, the City's website (http://www.nngov.com/) provides residents with pertinent information, on-line complaint forms, and a real estate information site, and answers numerous FAQs. The City also posts most of its guiding documents, including the Comprehensive Plan, on this site.

The City has implemented a program to educate citizens about floodplain management issues. Direct mailings, community meetings, and newspaper advertisements are used to inform citizens about the NFIP and the Flood Assistance Program (see below). The City has also provided at least two of its five libraries with references on floodplain management and flood insurance.

Public educational advisories, public forums, and brochure distribution addressing preparedness issues are conducted on an ongoing basis. The City uses presentations at booths, fairs, special needs meetings, and neighborhood group meetings to promote family preparedness and public awareness of shelter locations and evacuation routes.

The Emergency Management Division is currently evaluating the use of Social Networking sites like Facebook, Twitter, and others. A final decision on use has not yet been made. Currently the City of Newport News utilizes Facebook, Youtube, Twitter, Flicker, RSS Feeds, and Video Streaming[6].

Emergency Preparedness

Emergency Alert System (EAS) – EAS is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement was an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. FEMA tested the first iteration of this national satellite distribution network in June 2007. Newport News is adding a radio station that will broadcast Newport News information only.

Storm Ready – Newport News was one of the first five communities in Virginia to be "Storm Ready." Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially considered "Storm Ready", a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Other Mitigation Activities

Newport News is currently evaluating the effectiveness and feasibility of a 311 informational system and a joint municipal center to address the needs of the community.

Additionally, Newport News is also in the process evaluating options for implementing a Computer-Aided Design interface to improve communications with other jurisdictions.

City of Williamsburg Profile

The following sections present a detailed assessment of critical hazards that affect the City of Williamsburg. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

Capability Assessment – City of Williamsburg

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Williamsburg. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Williamsburg's mitigation plan.

Table 3-4: Capability Matrix – City of Williamsburg

	City of Williamsburg
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Floodplain Requirements 8-9-07
-Effective Flood Insurance Rate Map Date	3-2-94
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	0
-Number of NFIP policies	48 (as of 9/2010)
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	4 (as of 9/2010)
CRS Rating	None
Stormwater Program	Yes
Building Code Version	IBC - 2006
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes

Table 3-4: Capability Matrix – City of Williamsburg	
	City of Williamsburg
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, Surry
-Emergency Notification (R-911)	No
-other (e.g., cable override)	Text alerts in public bldgs (w/James City County), WMBG Radio
GIS system	Enterprise System in Place
-Hazard Data	Enterprise System
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

One highlight from the matrix is the existence of 48 NFIP policies, although there are no buildings within the 100-year floodplain. This suggests the City may be unaware of flooding or drainage issues.

Form of Governance

The Williamsburg City Council is composed of five members, elected at-large. The Council appoints the Mayor, Vice Mayor, City Manager, City Attorney, and Clerk of Council. The Mayor chairs the City Council and acts as the official head of the City government. The City Manager administers the City government, carrying out the policies of City Council. The Council members serve four-year staggered terms, with elections held in May in even-numbered years.

Guiding Community Documents

The City of Williamsburg has a range of guidance documents and plans for each of their departments. These include a comprehensive plan and emergency management plans. The City uses building codes, zoning

ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan

The Code of Virginia requires all cities and counties in the State to have a comprehensive plan and to review it every five years to determine if it needs to be revised. The *2006 Comprehensive Plan* is the City's sixth plan, and will be updated in 2011. Although the *1953 Comprehensive Plan* was the first formal plan adopted under State law, the City's first plan in 1633 encouraged a new settlement at Middle Plantation with high ground, better drainage, good water, and a more central location to the growing colony, out of the range of a ship's guns and less vulnerable to mosquitoes. The modern-day document features the following:

- Long-range intentions regarding the direction and nature of future development;
- Plan goals, grouped into nine general categories: character of the city, economy, neighborhoods and housing, transportation, public safety, education and human services, recreation and culture, environmental services, implementation;
- Nine geographic planning areas: Capitol Landing Road, Center City – Colonial Williamsburg, Jamestown Road – Route 199, Quarterpath Road – Route 199, Richmond Road – Ironbound, Richmond Road – Longhill Road, Shopping Centers, South Henry Street, and Strawberry Plains – Monticello Avenue;
- Community Character element focusing on planned improvements to nine entrance corridors including Richmond Road, Monticello Avenue, Jamestown Road, North and South Henry Street, Capitol Landing Road, Second Street, York Street, and Page Street;
- Plans for continued growth, development, and urban design in designated growth/redevelopment areas. The following areas were under review in 2005 for mixed-use development:
    - Riverside Hospital property holdings
    - High Street; and
- Plans for necessary transportation enhancements and improvements to service projected growth.

As a result of recommendations in the *1989 Comprehensive Plan*, a Listing of Significant Architecture and Areas in Williamsburg was created for the 1989 Plan. The database is based on the results of a 1992 Architectural Survey. An Architectural Review Board (ARB) reviews development proposals for

listed properties or properties in the vicinity of the Architectural Preservation District and Corridor Protection Districts. Design Review Guidelines transcribe the design review and community preservation goals used by the ARB. The latest Comprehensive Plan designates 301 acres as "museum support," or areas that are part of Colonial Williamsburg or the historic campus of the College of William and Mary. Colonial Williamsburg maintains a database with 88 of the historic structures within their purview.

Zoning & Development Standards

- Identifies existing Federal and State regulations for wetland and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.
- Includes new floodplain requirements that exceed the minimum NFIP requirements.

The City of Williamsburg developed new floodplain requirements in August 2007, which are located in Article XII of the Zoning Ordinance. Previously, FEMA Region III had determined that the City of Williamsburg was in compliance with the minimum requirements of the NFIP through adoption of their Chesapeake Bay Preservation Ordinance, which still stands in Article VIII of the Zoning Ordinance. The new floodplain requirements are in addition to these previous provisions. Where there is conflict between different provisions, the more restrictive regulation shall apply. Williamsburg has adopted stringent RPA and RMA zones with 100- and 500-foot buffers, respectively. The new floodplain requirements address new structural requirements (e.g., lowest floor elevation), requires all new structures and modifications to existing structures to comply with these regulations, which prohibit expansion that would result in any increase to the BFE.

The FIRM indicates that limited non-tidal floodplains exist along College Creek, Papermill Creek, Tutter's Neck Pond, and Queen Creek. The City's plan review and building permit applications do not contain any reference to flood hazards; however, the land disturbance application references flooding concerns and the *Site Plan Checklist* mandates delineation of floodplain limits on the site plans. The community has four properties with NFIP policies, and no severe repetitive loss properties.

A Technical Review Committee for new development is made up of representatives from Codes Compliance, Fire, Police, Public Works, and Planning.

Stormwater Program

Oversight for the City's drainage system is provided by the Department of Public Works and Utilities, Engineering Division. Engineering staff reviews site and subdivision plans to ensure compliance with the City's ordinances; provides project management for the City's capital improvement program; and provides quality control on construction of public improvements. Site plans for large developments are required to incorporate a stormwater fee or stormwater utility to ensure long-term maintenance of the drainage improvements. The Department has assisted with installation of Best Management Practices (BMPs) for several chronically flooded intersections. Engineers are also available to assist citizens with questions on all aspects of Public Works and Utilities.

Public Education

Among the readily available public outreach mechanisms for the City of Williamsburg, the City's website http://www.ci.williamsburg.va.us/index.htm provides residents with pertinent information, a property information tool, and answers to numerous FAQs. The City also posts most of its guiding documents, including the Comprehensive Plan.

The Fire and Police Departments conduct numerous types of public outreach regarding crime and fire prevention, including a program for fourth grade students regarding fire and all-hazard safety. The Emergency Preparedness web site contains sections promoting family disaster preparedness, and a Neighborhood Guide with action plans and other valuable information for Williamsburg's residents and visitors. City Hall maintains a display of pertinent brochures and disaster-related handouts.

The City maintains local Television Channel 48, has developed an e-notification system, and holds social media accounts through Facebook and Twitter.

Emergency Preparedness

Emergency Alert System (EAS) – EAS is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement was an initiative of Governor Warner's Secure Virginia

Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. FEMA tested the first iteration of this national satellite distribution network in June 2007. WMBG 740AM provides public notifications for Williamsburg.

Community Emergency Response Teams – The City has developed functioning Neighborhood Response Teams, trained through the Citizen Corps/CERT process, to assist with government response to natural and manmade disasters and emergencies. CERT helps communities respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand overwhelm local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

The City has also developed specialized programs to assist with tracking both natural and manmade hazards. Skywarn Training provides individuals with an understanding of thunderstorm construction and prepares them for the task of storm spotting. While radar, satellite, and lightning detection networks provide the National Weather Service with valuable technical detection capabilities, trained storm spotters provide valuable qualitative information. The City provides both Basic and Advanced Skywarn Training. In addition, the City uses CSX Mapping for railroad emergencies.

Other Mitigation Activities

In addition to establishing and maintaining various programs and capital improvement plans, the City is also continuing its successful Williamsburg Heritage Tree Program. The purpose of the program is to identify, promote awareness, maintain, and protect designated Heritage Trees located within the City now and for future generations.

Heritage Tree Program Goals

- Establish a process of designating Heritage Trees located on either public or private property;
- Encourage proper maintenance, care, and protection of Heritage Trees;
- Inform and educate the public regarding the notable tree resources in the City; and
- Increase public awareness of the environmental benefit of Heritage Trees and trees in general.

James City County Profile

The following sections present a detailed assessment of critical hazards that affect James City County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

Capability Assessment – James City County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for James City County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation, as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for James City County's mitigation plan.

Table 3-5 - Capability Matrix – James City County	
	James City County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	9-28-2007
-Substantial Damage Language	Yes, but not called "substantial damage"
-Certified Floodplain Manager	Yes
-Number of Floodprone Buildings	200
-Number of NFIP policies	942 (as of 9/2010)
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	27 (as of 10/2010); 2 severe repetitive loss
CRS Rating	Class 8
Stormwater Program	Yes
Building Code Version	VUSBC (IBC 2006)
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	CERT, cable over-ride
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes

Table 3-5 - Capability Matrix – James City County	
	James City County
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

James City County is divided into five election districts, each of which is represented by an individual who serves on the Board of Supervisors for four years. Terms are staggered, with representatives from three of the districts elected in one year and representatives from the other two districts elected two years later. The Board of Supervisors passes all laws and determines all policies that govern the County. The Board appoints a County Administrator and most boards and commissions, appropriates funds for County operations, and generally oversees all County functions. The County Administrator is the chief administrative officer of the County and is responsible for executing Board policies. The Administrator acts as Clerk to the Board and handles the daily administrative operations of the County, as well as its long-range and strategic planning.

Guiding Community Documents

James City County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, strategic plans, streetscape policy guide, community appearance guide, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its future is through policies laid out in the Comprehensive Plan.

2009 Comprehensive Plan

James City County's *2009 Comprehensive Plan* features the following:

- A long-range plan for the physical development of the County by focusing on controlling residential growth, while preserving the County's natural beauty, improving education, and maintaining public services and a healthy economy.
- Land Use designations describing Conservation Areas as "critical environmental areas where ordinary development practices would likely cause significant environmental damage." These lands include wetlands, marshes, flood hazard areas, steep slopes, critical plant and wildlife habitats, and stream banks. Conservation areas should remain

in their natural state. Development, if it occurs, should consider negative impacts and methods to mitigate or eliminate these impacts.

- Environmental concerns including: decreasing water supply and quality, increased soil erosion and stormwater runoff, loss of scenic vistas, destruction of wildlife habitats, deforestation, air pollution, and loss of agricultural lands.
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes, and rivers from degradation, protecting shoreline property from erosion and minimizing the need for stream bank and shoreline erosion controls. The floodplain management regulations are cited as contributing toward both water quality and shoreline erosion control.
- Maps and detailed sections regarding aquatic resources, shoreline, and stream bank erosion problems and public/private waterfront access areas.

James City County prepared a *Development Potential Analysis Report* in 2002 to identify and quantify the residential development potential of properties located within the County's Primary Service Area. The Real Estate Assessment Subdivision Data Zone Database was the primary source of reference for identifying parcels and their associated improvement value. A total of 3,850 platted/vacant lots were identified in residential zoning with development potential.

Current development pressure and projects under construction or site plan review are located west of Interstate 64, primarily in the Berkeley, Powhatan, and Stonehouse Districts of the County, especially along Richmond Road in the southern part of Stonehouse. A special *Five Forks Study Area Traffic Impact Alternatives Analysis* was conducted in 2004 to identify and analyze the development and redevelopment potential within the Five Forks Area. Five Forks is a developed area in the immediate vicinity of the intersection of John Tyler Highway (State Route 5) and Ironbound Road (State Route 615). The study focused on existing traffic conditions and expected traffic impacts associated with four future land use scenarios. Emergency evacuation does not appear to be a factor considered in the study.

Zoning & Development Standards

- Identifies existing Federal and State regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

James City County has adopted a floodplain management ordinance that exceeds the minimum requirements of the NFIP. The Flood Zone District is designated as an Overlay District in County Code, Chapter 24, Division 3. The community has 942 properties with NFIP policies, 27 repetitive loss properties, and two severe repetitive loss properties. Manufactured homes are not a permitted in the floodplain, although there are some existing units in the floodplain and replacements are allowed with freeboard and proper anchoring. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons.

One foot of freeboard above the BFE is required for structures in the floodplain. Substantially damaged structures are addressed in §24-602 of the ordinance, entitled "Existing Structures in Floodplain Districts." Although the NFIP term "substantial damage" is not used, the resultant requirements are comparable. Flood hazard information is not currently noted on site plan applications or checklists, or the building permit application.

James City County has participated in the NFIP's CRS program, and has attained a Class 8 rating, rewarding property owners, countywide, with a ten percent reduction in flood insurance premiums.

The County's Development Review Committee (DRC), a subset of the Planning Commission, reviews large or complicated development plans proposed in the County. Emergency Preparedness, Police, and Fire do not participate in DRC reviews; however, the DRC does hear presentations from County staff if there are specific issues requiring attention.

Stormwater Program

The County Engineering and Resource Protection Division's role is to protect the natural resources through effective management of public and private land development and enforcement of environmental activities. Through Land Disturbance permits, the division enforces ordinances related to stormwater management, erosion and sediment control, and the Chesapeake Bay Preservation Act. The division also promotes watershed management through development of watershed plans, specifically for Powhatan Creek and Yarmouth Creek.

To meet the requirements of the Chesapeake Bay Preservation and Sediment Control Ordinances, virtually all new commercial and residential developments in James City County require the construction of one or more

BMP facilities. The majority of BMP facilities are wet or dry ponds, but a few are filtration or infiltration-type facilities. These facilities store stormwater runoff and treat the water by either slowly releasing the water over a 24-hour period or infiltrating it into the ground.

All BMP facilities require periodic maintenance to ensure that they function as designed and to prolong their useful life. Responsibility for this maintenance is assigned to the BMP owner(s) through a Declaration of Covenants for Inspection/Maintenance. In order to assist BMP owner(s) with the maintenance needs of their BMP, the Stormwater Division inspects the BMPs on a three to five year cycle and provides the results of the inspection to the owner(s). The staff also has information available that describes how to maintain the facilities and is available to make presentations to Homeowner Associations.

Public Education

Among the readily available public outreach mechanisms for James City County, the website (http://www.jccegov.com/index.html) provides residents with pertinent information, a property information tool, and answers to numerous FAQs. The County also posts most of its guidance documents, including the Comprehensive Plan. The County also provides detailed information on hurricane preparedness and links to other preparedness sites.

The County has many different types of materials available for residents, businesses, teachers, youth, and adult groups. Emergency Preparedness offers refrigerator magnets, a Surry Nuclear Power Station calendar that includes siren testing dates, numerous materials on family disaster planning, and an emergency information flyer. The Surry calendar is distributed to all households within a 10-mile radius of the facility. Fire and Emergency Management safety programs and presentations at fairs, shopping centers, and community groups are regularly held to share information with the public. Regular programming on County television stations, like JCCTV48, the Hurricane Season and Winter Storm Season sections in the Virginia Gazette, the local bi-weekly news, and the County emergency management hotline are additional resources that James City County residents can use to answer questions or learn more about hazards in the area. In addition, the County uses social media accounts on Twitter and Facebook to connect with residents.

County Development Management distributes a *Notice of Flood Hazard* flyer to owners of buildings located in or near floodplains in the County as part of

the annual County Flood Hazard Awareness Program. The public library maintains extensive literature on flood hazards and floodplain development. The County does audience specific presentations and holds an annual open house at the Emergency Operations Center for the public. The informational program Home Sweet Home helps residents better understand James City County's specific preparedness and response options.

Emergency Preparedness

EAS is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement was an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. In James City County, warnings are disseminated by TV, weather radio, local radio, social media, and by police and fire vehicles equipped with public address systems.

The County has contracted with a private radio station for future public disaster-related information specific to James City County. In cooperation with Williamsburg, James City County installed JCCAlert, a digital text alert system for severe weather, in public buildings including schools and libraries. The system incorporates Thunder Eagle Alert System technology which relays weather, Amber, and emergency alerts to e-mail, text messaging cell phones, and pagers for a large group of people, including government officials, broadcast engineers, and emergency management staff. Emergency management officials work closely with the School Board's emergency planner before, during, and after disasters. James City County also has a Reverse 9-1-1 system to facilitate telephone contact with select groups of residents based on the nature and location of an impending event. The County maintains an ongoing database of County emergency response incidents and each incident is geographically referenced.

James City County's evacuation planning is prepared by the Virginia Department of Transportation. Special needs residents can sign up with Heads Up, James City County's assistance program for residents with special needs, such as hearing impaired or wheelchair bound. The confidential database system is activated should emergency personnel need to respond to a medical emergency at an address or during a countywide disaster. The recently debuted Hampton Roads Special Needs program provides outreach to persons with special needs and can be accessed through an online self-

registry. Retirement and nursing homes in the area have been extremely pro-active in preparing their facilities to shelter residents in-place during disasters. Other medical and custodial care facilities are also proactive in establishing disaster plans.

James City County's CERT program helps the community respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand overwhelm local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

The Citizen Fire Academy is designed to introduce citizens to the Fire Department, its mission and role in public safety, and to train citizens on their role and responsibilities in fire and life safety. Participants receive information on disaster programs and response, fire extinguisher training, CPR, and how to access the Enhanced 911 system in the most efficient manner.

The Neighborhood Connections program provides a mechanism for relaying pertinent information to Homeowners' Association leaders in remote areas, with the expectation that these persons distribute the information to all residents.

York County Profile

The following sections present a detailed assessment of critical hazards that affect York County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

Capability Assessment – York County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for York County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation, as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for York County's mitigation plan.

Table 3-6 - Capability Matrix – York County	
	York County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	6-16-2009
-Substantial Damage Language	Yes
-Certified Floodplain Manager	Yes
-Number of Floodprone Buildings	3,358 Structures; 5,972 Parcels
-Number of NFIP policies	3,508 (as of 9/2010)
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	213 (as of 10/2010); 2 severe repetitive loss
CRS Rating	Class 8
Stormwater Program	Yes
Building Code Version	VUSBC (IBC 2006)
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes (Adopted 2008)
Hazard Mitigation Plan	Yes (Adopted 2006)
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, for Surry Nuclear Power Station, as well as Weather Warning Sirens on Langley Off-Base Housing in the Tabb area of the County (The Landings at Langley)
-Emergency Notification (R-911)	In Procurement Phase
-other (e.g., cable override)	Cable override & agreement with radio station.
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Yes

Table 3-6 - Capability Matrix – York County	
	York County
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Web site & online Customer Service Utility
Environmental Education Program	Yes

Form of Governance

The York County Board of Supervisors is comprised of five elected citizens, one from each of the five election districts. Supervisors serve four-year terms with the Chairman and Vice Chairman elected annually by the five-member board. The Board of Supervisors serves, by law, as the governing body of the County, charged with administering County functions which include: preparation of the budget and appropriation of funds; appointing members of various boards and committees; levying taxes; constructing and maintaining County buildings; adopting the comprehensive land use plan and approving and enforcing related ordinances; and adopting and enforcing ordinances for sanitation, health, and other regulations permitted by State laws.

Guiding Community Documents

York County has a range of guidance documents and plans for its departments. These include a comprehensive plan, a build-out study, a citizen's guide on land development, transportation studies, Yorktown Historic District and Design Guidelines, and emergency management plans. The County uses building codes, zoning and subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its future is through policies laid out in the Comprehensive Plan.

Charting the Course to 2025: The County of York Comprehensive Plan

The Code of Virginia requires all cities and counties in the State to have a comprehensive plan and to review it every five years to determine if it needs to be revised. York County's *Comprehensive Plan,* first adopted in 1991, and updated in 1999 and 2005, features the following:

- A long-range plan for the physical development of the County, including what kind of development – single-family residential, commercial, multi-family residential, industrial, etc. – is considered desirable and appropriate for each area of the County;
- Data that guides development to appropriate areas of the County based on the carrying capacity of the land, the existing development character, the presence of infrastructure and public facilities, and natural resources;
- Extensive public participation efforts. The Comprehensive Plan Review Citizen Input Process used for the 1999 plan update received an Achievement Award from the National Association of Counties in 1997;
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes and rivers from degradation; protecting shoreline property from erosion; and minimizing the need for stream bank and shoreline erosion controls;
- Maps of wetlands, flood hazard areas, Chesapeake Bay Preservation Areas, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils, and areas with steep slopes;
- An estimate of maximum build-out population, the total number of people who would be living in York County if all the residential land were developed at its highest allowable density. The plan established 80,000 as the desirable maximum build-out population, and residential land use densities were established and applied to areas of the County with the intent of achieving this goal. The County appears to be on track toward meeting this goal, with an estimated maximum build-out figure of approximately 81,000 under almost any realistic development scenario;
- Plans for continued growth and development in designated areas, including, but not limited to:
    - South County; south of Ft. Eustis Boulevard, and east of Route 17
    - North County; Lightfoot exit off of Interstate 64
    - Potential Mixed Use areas identified along Route 17 on Denbigh Boulevard, and in the Lightfoot and Skimino areas of upper County; and
- Citizen comments through surveys, neighborhood meetings, and committees.

Zoning & Development Standards

- Identifies existing Federal and State regulations for wetland, floodplain, and RPA/RMA for Chesapeake Bay protection.
- Outlines required standards for new development and redevelopment based on use and zoning designation.

York County has adopted an ordinance that exceeds the minimum requirements of the NFIP. The ordinance designates the Flood Zone District as an Overlay District in County Code, §24.1. The community has 3,508 properties with NFIP policies and two severe repetitive loss properties. Manufactured homes are not permitted in the floodplain, although there are some existing units in the floodplain. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons. The finished crown/centerline elevation of all new public or private streets must be at least 6.5 feet above mean sea level. The ordinance contains floodplain fill regulations that exceed minimum NFIP standards. Construction standards for structures in Zones A, AE, and V reference the VUSBC and the requirements therein. The ordinance does not mandate additional freeboard for development; however, freeboard between 1.5 feet and 3 feet above the BFE is strongly recommended and the ordinance notes that a reduction of flood insurance premiums may result. Development in approximate A Zones requires that detailed hydrologic and hydraulic analyses be used to determine a BFE and 100-year floodplain boundary for the property. Flood hazard information is not currently noted on the Building Permit Application, but must be included on site plans submitted for review. Residential permit applicants must complete the *Preliminary Natural Resources Inventory* worksheet that includes indicators of the presence of regulatory wetlands.

The zoning and code enforcement staff within the Department of Environmental and Development Services regulates land use and development activities and elimination of property-related nuisances. The Zoning Section is responsible for zoning code enforcement and the elimination of property-related nuisances, such as tall grass, weeds, and junked cars. The Board of Zoning Appeals is responsible for reviewing and hearing appeals from decisions of County administrative officials concerning the zoning and subdivision ordinances; considering requests for variance relief from the requirements of these ordinances. The department coordinates weekly staff-level reviews of site plans and proposed projects.

Stormwater Program

The York County Department of Environmental and Development Services reviews all new development in the County for compliance with State and county regulations. Offsite flow must be maintained at the pre-development rate if the downstream system is not adequate for increased flows. Installation of BMPs such as wet ponds or lakes, and dry ponds, as well as other engineered systems are typically used.
In addition, when the County receives complaints/inquiries about drainage problems, the staff completes a study to determine if there are easements, and whether the County has responsibility to correct the problem. The staff makes recommendations for addressing the issue that may include developing a project plan, adding it to the Capital Improvement Plan list, and ranking it with other projects in the schedule.
The County is working on drainage improvements for Moores Creek, which drains Woodlake, Running Man and properties in-between, Edgehill Subdivision, and the Brandywine Subdivision. Projects are proposed at the following locations over the next 5 years: Greensprings, Dare Elementary, County Operations, Marlbank Cove, Claxton Creek Area, Wormley Creek Head Waters, Cook Road/Falcon Road, Coventry Boulevard, CSX Railroad Crossing, and Victory Industrial Park (Phase II).

The County also has a Stormwater Advisory Committee (SAC) with the express goals of:

- Developing and implementing a public education and outreach program on stormwater issues;
- Increasing public involvement and participation in stormwater issues;
- Providing increased citizen access to County staff for stormwater and drainage issues; and
- Assisting County staff and the Board of Supervisors in identifying drainage problems and developing priorities for stormwater drainage projects.

The SAC has electronically posted and distributed copies of the committee's brochure, *A Homeowner's Guide to a Healthy Stormwater Drainage System*, and multiple fact sheets on topics ranging from flood prevention to low impact development and management of lakes and ponds. These documents are a means of educating the public about preventing flooding and maintaining drainage systems.

The Committee developed a presentation entitled *How to Reduce the Chance of Flooding* that is presented at HOA meetings and on the County's

Community TV station during hurricane season. The Committee also worked with the U.S. Army and U.S. Air Force, whose property borders York County, to ensure a coordinated approach to stormwater maintenance.

Public Education

Among the readily available public outreach mechanisms for York County, the County website (http://www.yorkcounty.gov) provides residents with pertinent information, and answers numerous FAQs. The County also posts most of its guidance documents, including the Comprehensive Plan, on this site. The County publishes a quarterly newsletter (CITIZEN NEWS), which is mailed to every household and business, and maintains a government access TV channel using Cox Cable, Verizon FIOS, as well as a County Youtube Channel. Public Service Announcements (PSAs) are posted on television and the internet.

York County's Department of Fire and Life Safety provides a number of educational programs and maintains a stock of different types of educational materials available for residents, businesses, teachers, youth, and adult groups. A Fire Prevention Educator provides child fire safety programs in the schools. The Department of Fire and Life Safety works with other County agencies and departments to sponsor *Safety Town*, a program for pre-school children in the summer to teach programs, such as fire safety, bike safety, electrical safety, and disaster preparedness. The Department partners with the York-Poquoson Sheriff's Office, York County Chamber of Commerce, the York-Poquoson American Red Cross, and other County organizations to promote life safety and preparedness. The Department's Office of Emergency Management promotes disaster preparedness year-round through public programs (some mentioned above) and in the County quarterly newsletter to residents. In 2005, the Office of Emergency Management partnered with a local home improvement store to promote preparedness during the Christmas season. The Department's web site promotes emergency preparedness and life safety.

The Department of Environmental and Development Services Online Customer Service System provides a service for customers to submit service requests to the Department over the Internet. In addition to entering a service request, customers can follow the status and progress of their request online. Complaint/request categories include: drainage; garbage/recycling/yard debris; code enforcement; sewer; and mosquitoes. The department provides site plan review status information online.

Emergency Preparedness

The mission statement for York County's Department of Fire and Life Safety is "To provide protection and life safety to our community in order to prevent emergencies when possible, to respond quickly and to minimize pain, suffering and loss when emergencies do occur[7]." The Department includes the Office of Emergency Management, which is charged with the responsibility of minimizing the effects of a significant emergency or disaster through the coordination of a comprehensive, risk-based program of mitigation, preparedness, response, and recovery. This mission benefits from the addition of a Certified Emergency Manager.

A comprehensive update to the County's Emergency Operations Plan was completed in 2008 by the Office of Emergency Management. The plan is maintained on the internal web site for County employees. The County has a Multi-Year exercise program that is part of the radiological emergency preparedness program and, because there are some basic functions regardless of the emergency, the lessons learned serve an all-hazard purpose. The Department is also responsible for maintaining an EOC with all the essential materials and supplies to sustain an emergency response.

Warning

The EAS is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement was an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters.

York County is in the process of procuring a community notification system and coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification to property owners in the inundation zone for associated dams that are located in York County.

The County recently made arrangements with a radio station in Gloucester (WXGM 99.1 FM) to broadcast emergency information for York County throughout a disaster and the recovery phase. Due to the large broadcasting area on the Peninsula and Southside, and widespread damage throughout Hampton Roads after Hurricane Isabel, the media became

overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities.

Neighborhood Emergency Information Distribution System (NEIDS) – Extended power outages during the 1998 ice storm resulted in a large number of remote-area residents without access to current disaster-related information. The York County staff created NEIDS to relay pertinent information to homeowners' association leaders in remote areas, with the expectation that these persons could further distribute the information to residents. The system was further refined after Hurricane Isabel, and pre-disaster meetings with community leaders help ensure that the system maintains its effectiveness despite changes in personnel at the County or community level.

"Storm Ready" is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially considered "Storm Ready," a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Evacuation

In addition to the information provided above regarding the State's Evacuation Plan, County planners note that storm surge zones located in the eastern part of the County are heavily developed with mostly single-family residential units. Evacuation of such a large number of people onto Route 17 and north across the Coleman Bridge through low-lying Gloucester County and on into Fredericksburg, while maintaining emergency vehicle access to all parts of the County, is challenging. To help address these issues, the Department of Fire and Life Safety's Office of Emergency Management has members who serve on both the Virginia Department of Emergency Management Hurricane Evacuation Coordination Group and the

Regional Catastrophic Planning team. York County has a Large Scale Emergency/disaster Traffic Management Plan (Annex) in the County Emergency Operations Plan as well.

Special Needs Program

As part of the enhanced 9-1-1 system, York County maintains a database of addresses for vulnerable populations. Residents voluntarily register for this service through the Department of Fire and Life Safety. Dispatchers notify first responders that they are responding to a residence that has a special needs resident and describe the type of special need. The database is geo-referenced, and dispatchers can sort for vulnerable populations in specific geographic areas of the County to notify or warn them of potential hazards or to check on them during disasters. York County is also a participant in the Hampton Roads Special Needs Registry. The County maintains a separate database of manufactured home parks.

Community Emergency Response Teams (CERT)

York County Department of Fire and Life Safety established CERT with an emphasis on building neighborhood teams. The purpose is to have neighborhoods and areas of the County better prepared and self-sufficient when disaster strikes. Currently the County is working with several neighborhoods to develop neighborhood emergency response plans and provide CERT training. The County has a neighborhood recognition program for those neighborhoods that organize CERTs and develop an emergency plan.

York County is in the process of developing an additional neighborhood program, the Community Animal Shelter Team.

Man-made/Technological Hazard Mitigation and Response Training - The York County Department of Fire and Life Safety in partnership with the Virginia Department of Emergency Management's (VDEM) Technological Hazards Division and the Virginia Association of Hazardous Materials Response Specialists is developing a Hazardous Materials-CBRNE Training Site in the Seaford area of York County. The site will serve as the primary training location for the VDEM advanced level training program. Advanced level hazardous materials training provided to responders from across the Commonwealth will be conducted at this site. The location of this site is of tremendous benefit to the York County Department of Fire and Life Safety as well as other Hampton Roads emergency responders because of the

immediate proximity of training and the avoidance of needing to send personnel elsewhere for this level of training. When completed, the site will include numerous industrial, commercial, transportation and household type training props which will simulate various emergency situations that typically involve hazardous materials, CBRNE incidents and/or WMD and terrorism responses. These props will primarily use water and compressed air to simulate chemicals, vapors and gases in a controlled environment. This state of the art facility and associated props will be an asset to both York County, the Virginia Peninsula and the entire Commonwealth of Virginia by providing a level of training and interactive hands-on practical application which typically requires travel to specialized training facilities out of state.

Other Mitigation Activities

In addition to the efforts noted above, the York County's Department of Fire and Life Safety is also working to develop public outreach materials to educate the community about the hazards of wildland/urban interface wildfire.

The County will also continue to develop new hazard related PSAs as needed and present them through various media outlets, such as the internet and television, to ensure the message is received by the community.

State, Regional, and Federal Capabilities

The section below presents State, Regional, and Federal mitigation capabilities that are common to all communities within the Peninsula planning area.

State Capabilities

Virginia Department of Emergency Management (VDEM)

VDEM's Strategic Plan 2004-2013

This plan recognizes and prepares for Virginia's changing demographics and increasing threats over the next 10-year period. Goals, strategies, and resources are built around the mission statement, which is "to protect the lives and property of Virginia's citizens from emergencies and disasters by coordinating the State's emergency preparedness, mitigation, response, and recovery efforts."

Commonwealth of Virginia Emergency Operations Plan (State EOP), September 2010

This plan consists of a Disaster Recovery Plan, a Hazard Mitigation Plan, and five hazard-specific volumes. The mitigation goals and project prioritization criteria from Section 4 of Virginia's Hazard Mitigation Plan are:

- Goal 1 - Structural Mitigation Projects - Maintenance of critical communication, transportation, and supply chain management operations, beneficial impacts for multiple agencies/organizations, feasibility, cost and funding, and multi-hazard mitigation;
- Goal 2 - Policy, Planning, and Funding Human health and safety, preparedness, economic recovery, multi-hazard mitigation, and health care and shelter;
- Goal 3 - Information and Data Development - Human health, safety and economic stability, multi-hazard mitigation, beneficial impacts for multiple agencies/organizations, feasibility, and information quality and security; and
- Goal 4 - Education and Outreach Activities – Number of people and property affected, beneficial impacts for multiple agencies/organization, multi-hazard mitigation, transferability and adaptability, and simplicity and consistency.

Virginia Emergency Alert Systems (EAS) Stations

Specific AM/FM radio stations provide updated disaster and directional information to listeners in the Commonwealth. Thirty-seven radio stations cover 14 regions in Virginia, including: Eastern Virginia (two FM stations), Southside (one AM station, one FM station), and the Richmond extended area (two AM stations, two FM stations), which provide coverage for the Peninsula planning area.

Virginia Department of Conservation and Recreation (VDCR)

Chesapeake Bay Regulations

As part of Virginia's commitment to help preserve and restore the resources of the Chesapeake Bay, the Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988. The Chesapeake Bay Preservation Area Designation and Management Regulations were adopted in 1990 and amended in December 2001. The revised regulations took effect in March 2002 and were adopted by all localities by December 2003 to revise local ordinances and become consistent with the new language.

The regulations require that communities east of Interstate 95, the "Tidewater" area of Virginia, regulate and enforce the use of RPAs and RMAs. The RPA is relevant to floodplain management because new development within the designated area must maintain a 100-foot buffer from the waterline of any perennial stream, as defined by the regulations. This includes all tidal water bodies in coastal areas. Both the Hampton Roads Planning District Commission and the VDCR provide technical assistance and guidance to communities for enforcing the regulations. In essence, this is a regulation that strengthens local floodplain management ordinances by exceeding the minimum NFIP standards.

Virginia Flood Damage Reduction Act

Virginia's General Assembly enacted the Virginia Flood Damage Reduction Act of 1989. The legislation was the result of several disastrous floods and coastal storms that impacted the State between 1969 and 1985. To improve Virginia's flood protection programs and organize related programs into one agency, responsibility for coordination of all State floodplain programs was transferred in 1987 from the Water Control Board to VDCR. The agency was named manager of the State's floodplain program and designated coordinating agency of the NFIP under the act.

Virginia Dam Safety Act

The Virginia Soil and Water Conservation Board established the State's dam safety regulations as a result of the passage of the Virginia Dam Safety Act. The Dam Safety Program's purpose is to provide for safe design, construction, operation, and maintenance of dams to protect public safety. The program enforces permit requirements related to the construction and alteration of impounding structures. All dams in Virginia are subject to the Dam Safety Act unless specifically excluded. Inundation mapping is required for all Class I and Class II dams in the Commonwealth. Dam Safety Program officials recommend mapping for all classified dams. Emergency Action Plans are required for all Class I, II, and III dams.

Shoreline Erosion Advisory Service (SEAS)

VDCR's Shoreline Erosion Advisory Service promotes environmentally acceptable shoreline and riverbank erosion control measures to protect private property and reduce sediment and nutrient loads to the Chesapeake Bay and other waters of the Commonwealth. In addition, the program promotes research for improved shoreline management techniques to protect and enhance Virginia's shoreline resources.

Since SEAS was created in 1980, VDCR has provided technical advice about tidal shoreline erosion problems to more than 7,000 clients. They include landowners, local governments, and environmental agencies. SEAS program activities also help local governments deal with sediment and nutrient loads from shoreline erosion and address the Commonwealth's obligation to reduce sediment and nutrient loads in the Chesapeake Bay and its tributaries. For example, following Hurricane Isabel, SEAS provided technical assistance to the residents of Hampton's Chesapeake Avenue to facilitate reconstruction of a seawall spanning numerous property owners. The complexity of the project permitting and the number of property owners involved required external assistance.

Virginia Marine Resources Commission (VMRC)

The Virginia Marine Resources Commission (VMRC) was established in 1875 as the Virginia Fish Commission. The Virginia Wetlands Act was passed in 1972 and placed under the management of VMRC, as was the 1980 Coastal Primary Sand Dune Protection Act. In 1982, the General Assembly broadened the 1972 Wetlands Act to include non-vegetated wetlands. The Habitat Management Division issues three types of Environmental Permits: subaqueous or bottomlands, tidal wetlands, and coastal primary sand dunes.

The division's authority specifically regulates physical encroachment into these valuable resource areas.

The permit process relies on a single Virginia joint local/State/Federal permit application. The review process takes into account various local, State, and Federal statutes governing the disturbance or alteration of environmental resources. The Marine Resources Commission plays a central role as an information clearinghouse for all three levels of review. Applications receive independent yet concurrent review by the community's Wetlands Board, the VMRC, the Virginia Department of Environmental Quality, and USACE.

Department of Housing and Community Development

The Commonwealth of Virginia is responsible for enacting the VUSBC, and each county or city is responsible for enforcing the code locally. As of May 2008, the VUSBC is based on the 2006 International family of Codes, including the International Building Code, the International Residential Code, the International Mechanical Code, the International Plumbing Code, the International Fuel Gas Code, the International Energy Conservation Code, as well as the 2005 National Electric Code. The code contains the building regulations that must be complied with when constructing a new building or structure, or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. All Peninsula communities charge fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the VUSBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and State agencies, related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The VUSBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

Regional Capabilities

The Hampton Roads Planning District Commission (HRPDC), one of 21 Planning District Commissions in the Commonwealth of Virginia, is a regional organization representing 16 local governments, including Hampton, Newport News, Williamsburg, James City County, and York County. Planning District Commissions are voluntary associations that were created in 1969 pursuant to the *Virginia Area Development Act.* The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance." The HRPDC serves as a resource of technical expertise to its member local governments. Specific programs related to the HRPDC include HR STORM/HR CLEAN, HREMC, and REMTAC, which are described below.

Regional Stormwater Management Program

Regional governments are developing and implementing stormwater management programs that include construction of BMPs, system maintenance, water quality testing, enforcement of program standards, and public education. Significant results and cost cuts are achieved through regional cooperation. These regional efforts are coordinated through the HRPDC, which conducts and manages technical studies to support the Regional Stormwater Management Committee. The HRPDC facilities the monthly meetings of the Committee where program staff members from 14 localities in Hampton Roads coordinate efforts in stormwater program development, water quality data gathering, pollutant loading studies and development of policy recommendations and supporting technical information. This data enable localities to better target future program dollars to improve management of stormwater quantity and quality and satisfy regulatory requirements. HR STORM, the HRPDC stormwater education program, is a coalition of local government staff members who share ideas and pool resources for targeted educational program efforts about stormwater management and water quality. HR CLEAN is the recycling and litter prevention education program of the HRPDC.

Hampton Roads Emergency Management Committee (HREMC)

The objective of the HREMC is to promote the inter-jurisdictional and inter-agency coordination of emergency management issues and foster

emergency preparedness in the Hampton Roads area, including the Peninsula communities. The purpose is to provide a working group for the exchange of information, experience, and technology among Hampton Roads Emergency Management officials and individuals with responsibilities in emergency management. Participants include community officials, American Red Cross, military liaisons, State and Federal agency representatives, Verizon, Virginia Natural Gas, and Dominion Power. Public information materials include *Is Your Family Prepared for Hurricanes?,* a detailed family preparedness booklet focusing on Hampton Roads' procedures for evacuation and readiness.

Regional Emergency Management Technical Advisory Committee (REMTAC)

Established in 1998, this organizational, policy-making group is composed of HRPDC staff, Emergency Management staff from local communities including the Peninsula, and VDEM staff. REMTAC works to enhance emergency management plans on a regional level. The HRPDC provides support to REMTAC and local jurisdictions on a variety of emergency management issues, including: hurricane evacuation planning; emergency shelter planning; debris management resource planning; disaster planning for populations with special needs; and public education awareness and hurricane preparedness programs. REMTAC members have access to a secure online forum among registered participants, in addition to monthly meetings.

Surry Power Station Emergency Public Information

Surry Power Station, located on the James River about 7 miles south of Williamsburg, can generate 1,625 megawatts of electric power from its two nuclear reactors and supplies more than 30 percent of Virginia Power's electric power requirements.[8] Surry is linked to the Dominion Virginia Power transmission portfolio servicing the Peninsula. Although the power station would not normally be included in natural hazard mitigation planning, the facility represents a noteworthy manmade hazard and area emergency management plans pay considerable attention to the siren warning system. Cities and counties in the Surry Power Station Planning Area include: James City County, York County, Newport News, Williamsburg, Isle of Wight County, and Surry County. The Peninsula communities exclude all other hazard siren systems to avoid confusion over multiple siren tones and signals in the region.

Federal Capabilities

The National Flood Insurance Program (NFIP)

Established in 1968, the NFIP provides flood insurance in communities that agree to regulate new development in identified SFHAs through the adoption and enforcement of a minimum Flood Damage Prevention Ordinance. The program also requires, as a condition of every Federally-backed mortgage within an identified SFHA, the purchase and maintenance of a flood insurance policy for the life of the loan.

The Coastal Barrier Resources Act (CBRA)

Established in 1982, the Coastal Barrier Resources Act (CBRA) is environmental legislation administered by the U.S. Fish and Wildlife Service. The legislation provides for the identification and protection of Coastal Barrier Resources. The act further prohibits the availability of federally-backed assistance within identified areas, including grants, loans, mortgages and Federal flood insurance. The Coastal Barrier Resources Reauthorization Act of 2005 reauthorized the CBRA and directed the U.S. Fish and Wildlife Service to finalize the Digital Mapping Pilot initiated by the Coastal Barrier Resources Reauthorization Act of 2000.[9] For the Peninsula communities, only the City of Hampton has areas designated as part of the Coastal Barrier Resource System (Units VA-60 and VA-60P).

Coastal Zone Management Act

Established in 1972, and amended by the Coastal Zone Protection Act of 1996, the Coastal Zone Management Act defines a national interest in the effective management, beneficial use, protection, and development of the coastal zone and identifies the urgent need to protect the natural system from these competing interests.

The Virginia Department of Environmental Quality oversees the Virginia Coastal Resources Management Program, established to protect and manage an area known as Virginia's "coastal zone." All five of the Peninsula communities are located in the coastal zone. The program has produced a large number of publications and assisted in the development of numerous projects to support their nine primary goals, available online at http://www.deq.virginia.gov/coastal/goals.html.

Examples of the program's accomplishments impacting the Peninsula include:

- Coastal Dune Resources Inventory - Virginia has coastal dune resources on about 48 miles of shoreline. An inventory, now underway by the Virginia Institute of Marine Science, is part of an ongoing Virginia Coastal Program effort to establish a better understanding of dune systems, including primary, secondary, coastal, and riverine dunes in coastal Virginia. The inventory includes where dunes are located, how they should be defined, and how they function in the natural environment. The goal is improved management to ensure that both the habitat and flood protection benefits derived from these naturally occurring and rare systems are maintained.
- Riparian Buffer Sign Program - The Virginia Coastal Program designed a riparian buffer sign to emphasize the importance of riparian buffer restoration in the coastal watershed. The sign, available to all groups and organizations planting buffers in Virginia's coastal zone, links buffer restoration sites throughout Tidewater Virginia, providing the public with a consistent message on the benefits of riparian buffers. At York River State Park, a new buffer, planted on a steep denuded slope, protects the park's marsh and the York River beyond.
- Virginia Clean Marina Program - In 2001, marina operators, marine industry representatives, and State officials launched the program, which is a voluntary initiative designed to educate and give technical support and special recognition to marinas that implement BMPs that go above and beyond regulatory requirements, minimizing potentially negative impacts on water quality and coastal resources. Clean Marinas on the Peninsula include: Hampton Public Piers, Old Point Comfort Marina at Fort Monroe, Bluewater Yachting Center in Hampton, Southhall Landings Marina in Hampton, Salt Ponds Marina in Hampton, Leeward Municipal Marina in Newport News, Two Rivers Yacht Club in Williamsburg; and the Wormley Creek Marina, Seaford Yacht Club and Riverwalk Landing in Yorktown.[10]
- Wetland Educational Materials - The Virginia Institute of Marine Science (VIMS) at the College of William and Mary, with Coastal Program funding, has developed legal and educational materials that are being used by all local wetlands boards. VIMS also produces a Wetlands Newsletter and holds regular workshops and seminars for board members, local governments, and others interested in wetland management.

Chapter 4: Hazard Identification and Risk Assessment

Introduction

Chapter 4 includes a discussion and analysis of natural hazards that could potentially impact the Virginia Peninsula region. The focus of the analysis is on those jurisdictions participating in the 2011 plan update which include: James City County, York County, City of Hampton, City of Newport News, and City of Williamsburg. For simplification, we refer to this collection of jurisdictions as "the Peninsula" or "the planning area" throughout the Hazard Identification and Risk Assessment (HIRA). Figure 4-1 depicts the planning area for the 2011 Hazard Mitigation Plan Update.

General hazard histories and vulnerability across the entire region as well as a detailed analysis and comparison of vulnerability and risk across individual jurisdictions is provided. For the purposes of mitigation planning, critical hazards are defined as those hazards for which historical data exists to document impacts that have resulted in losses to the community and its citizens. Non-critical hazards are hazards that have occurred very infrequently or have not occurred at all in the historical data. Non-critical hazards are not considered a widespread threat resulting in significant losses of property or life. Hazard losses, historical data, projections of future losses, and anecdotal evidence of severity are included in this chapter.

The vulnerability of critical facilities is also provided, when applicable. FEMA defines critical facilities as those facilities that warrant special attention in preparing for a disaster, and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. Capability assessment of existing programs and mechanisms in place to mitigate the effects of natural hazards completes the overall risk assessment. This helps determine appropriate mitigation actions by taking into account those measures that already exist.

In summary, the HIRA identifies hazards that have potential to adversely affect the Peninsula. By quantifying potential impacts through the vulnerability analyses, and outlining existing protective measures that lessen those impacts through the capability analysis, a net vulnerability is determined. The plan's goals and objectives are then based on this net vulnerability.

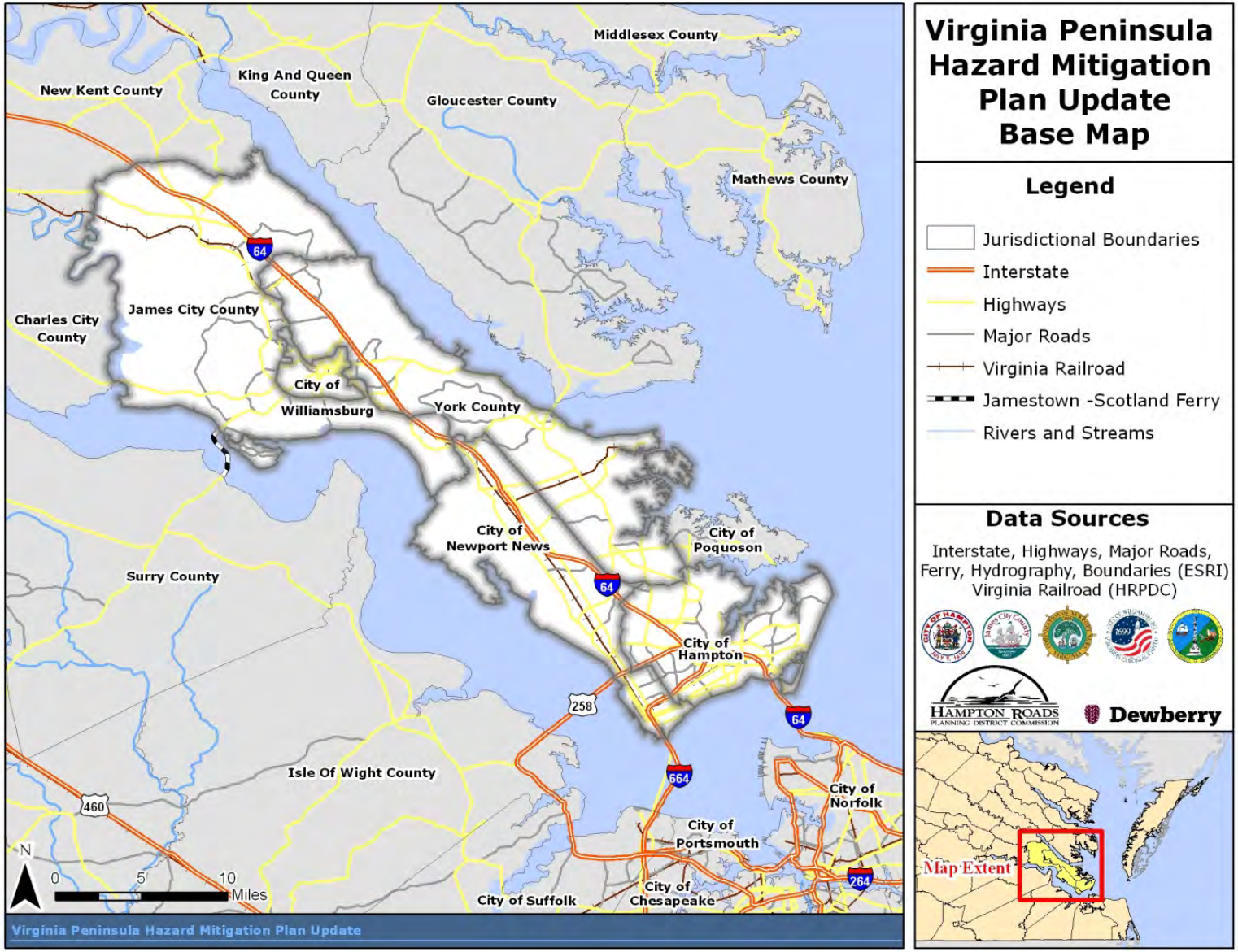

Figure 4-1: Planning Area for the Hazard Mitigation Plan Update

Hazard Identification

In 2006, the Peninsula Hazard Mitigation Planning Committee (PHMPC) conducted a Hazard Identification study to determine which hazards threaten the planning area communities. The natural hazards identified and investigated in the Peninsula region included the following:

- Flooding
- Hurricanes & Tropical Storms
- Tornadoes
- Nor'easters
- Thunderstorms
- Winter Storms
- Extreme Heat
- Dam Failure
- Wildfire
- Drought
- Earthquakes
- Biological Hazards/Epidemics
- Landslides
- Expansive Soils
- Tsunamis

Historical data was collected for all hazard types. By examining the historical occurrence of each hazard, along with the impacts, a determination can be made as to which pose the most significant risks to the region. Prioritizing or ranking the potential natural hazards that threaten the Peninsula area required analysis of two factors: the probability that a certain type of natural hazard will affect the region and the potential extent and severity of the damage caused by that hazard. The probability of occurrence for each hazard was determined using existing technical analyses, such as the FEMA Flood Insurance Study. When data was not available, the probability was based on the history of events.

2011 Plan Update

The 2011 update of the hazard mitigation plan re-examines and expands upon the analysis of those hazards listed above and includes an examination of man-made hazards.

The Hazard Identification, Risk Assessment and Vulnerability Analysis consolidates, updates, and streamlines content from the 2006 plan. The content has been restructured to address a broad range of emerging hazards, vulnerabilities, and risk issues. Significant changes have been made that include:

- Standardizing terminology and reformatting;
- Use of a new, GIS-based ranking methodology that assesses hazard risk by jurisdiction;
- New analyses for all major hazards which included:
    - refreshing the hazard profile;

- o updating the previous occurrences;
- o determining the annualized number of hazard events and losses by jurisdiction using National Climatic Data Center (NCDC) and other data sources where available;
- o updating the assessment of risk by jurisdiction based on new data;

- New maps and imagery.

Future Development

Due to the economic environment during the 2006-2011 planning cycle, urban development was minimal. For the plan 2011 iteration, data was not available on the projected impact on future buildings.

Federal Disaster Declarations

An important source for identifying hazards that can affect the Peninsula is the record of federal disaster declarations. Presidential disaster declarations are issued for county (including towns) or independent city jurisdictions when an event has been determined to be beyond the capabilities of state and local governments to respond. An emergency declaration is more limited in scope and does not provide the same long-term federal recovery programs as a presidential disaster declaration.

According to FEMA, there have been 42 major disaster declarations, five emergency declarations, and five fire management assistance declarations for a total of 53 declared disasters in the State of Virginia, dating back to 1957. Table 4-1 shows the federal disaster and emergency declarations in Virginia from 1957 through 2010. Local jurisdictions impacted are checked for those declarations in which that information was available.

Of the 42 presidential disaster and 5 emergency declarations in Virginia, 10 have had direct impacts on the Peninsula. The disasters declared for the Peninsula include damage caused by flooding, severe thunderstorms, hurricane winds and winter storms.

Table 4-1: Presidential Disaster Declarations in Virginia, 1957 –2010									
Declaration Number	Month	Year	Description	Impacted Peninsula	City of Newport News	City of Hampton	City of Williamsburg	York County	James City County
68	February	1957	Floods						
123	March	1962	Severe Storms, High Tides, Flooding						
149	March	1963	Floods						
274	August	1969	Hurricane Camille (flooding); 27 jurisdictions declared, but none on the Peninsula						
339	June	1972	Hurricane Agnes (flooding); 106 jurisdictions declared	✓					
358	September	1972	Storm/Flood; Hampton and Newport News declared	✓					
359	October	1972	Flood; Western, Central, Southeastern Virginia; 31 jurisdictions declared						
531	April	1977	Flash Flood; Southwestern Virginia; 16 jurisdictions declared						
543	November	1977	Flood; Southwestern Virginia; 8 jurisdictions declared						
593	July	1979	Flood; Buchanan County declared						
606	September	1979	Flood; Patrick County declared						
707	May	1984	Flood; Buchanan, Dickinson & Washington Counties declared						
755	November	1985	Flood; Western, Central Virginia; 52 jurisdictions declared						
847	October	1989	Flood; Buchanan County declared						
944	April	1992	Flood; Western Virginia; 24 jurisdictions declared						
1007	December	1993	Severe Storm; Tornado						

Table 4-1: Presidential Disaster Declarations in Virginia, 1957 –2010									
Declaration Number	Month	Year	Description	Impacted Peninsula	City of Newport News	City of Hampton	City of Williamsburg	York County	James City County
1014	February	1994	Ice Storm; Central, Western Virginia; 71 jurisdictions declared						
1021	March	1994	Ice Storm; Central, Western Virginia; 29 jurisdictions declared						
1059	June	1995	Flood; Central & Western Virginia; 24 jurisdictions declared						
1086	January	1996	Blizzard; all counties and cities in state declared.	✓	✓	✓	✓	✓	✓
1098	January	1996	Flood; 27 jurisdictions declared						
1135	September	1996	Hurricane Fran (flooding); 88 jurisdictions declared						
1242	August	1998	Hurricane Bonnie (flooding); 5 jurisdictions declared						
1290	September	1999	Tropical Storm Dennis (including tornadoes)	✓		✓			
1293	September	1999	Hurricane Floyd (flooding); 48 jurisdictions declared, including Peninsula communities	✓	✓	✓	✓	✓	✓
1318	February	2000	Winter Storms; 107 jurisdictions declared.	✓	✓		✓	✓	✓
1386	July	2001	Flood; Southwestern Virginia; 10 jurisdictions declared						
1392	September	2001	Pentagon Attack; 1 jurisdiction declared						
1406	March	2002	Flood; Southwestern Virginia; 10 jurisdictions declared						
1411	April/May	2002	Flood; Southwestern Virginia; 9 jurisdictions declared						
1458	February	2003	Winter Storms/Flooding; 39 jurisdictions declared						
1491	September	2003	Hurricane Isabel (winds, flooding); 100 jurisdictions declared, including Peninsula	✓	✓	✓	✓	✓	✓

Table 4-1: Presidential Disaster Declarations in Virginia, 1957 –2010

Declaration Number	Month	Year	Description	Impacted Peninsula	City of Newport News	City of Hampton	City of Williamsburg	York County	James City County
			communities						
1502	November	2003	Flood; Southwestern Virginia; 6 jurisdictions declared						
1525	May	2004	Flood; Southwestern Virginia; 3 jurisdictions declared						
1544	September	2004	Flood; Central Virginia; 12 jurisdictions declared						
1570	October	2004	Flood; Southwestern Virginia; 10 jurisdictions declared						
3240	September	2005	Hurricane Katrina Evacuation; all Peninsula communities declared	✓	✓	✓	✓	✓	✓
1655	July	2006	Severe Storms, Tornadoes, and Flooding; 13 jurisdictions declared						
1661	September	2006	Severe Storms and Flooding, Including Severe Storms and Flooding Associated with Tropical Depression Ernesto; 21 jurisdictions declared	✓				✓	✓
1862	December	2009	Severe Storms and Flooding Associated with Tropical Depression Ida and a Nor'easter; 12 jurisdictions declared	✓	✓	✓			
1874	February	2010	Severe Winter Storm and Snowstorm; 40 jurisdictions declared						
1905	April	2010	Severe Winter Storms and Snowstorm; 38 jurisdictions declared						

Source: VDEM and FEMA web sites.

National Climatic Data Center (NCDC) Storm Events Database

NCDC *Storm Data* is published by the National Oceanic and Atmospheric Administration (NOAA), part of the U.S. Department of Commerce. The storm events database contains information on storms and weather phenomena that have caused loss of life, injuries, significant property damage, and/or disruption to commerce. Efforts are made to collect the best available information, but because of time and resource constraints, information may be unverified by the National Weather Service (NWS). The NWS does not guarantee the accuracy or validity of the information. Although the historical records in the database often vary widely in their level of detail, the NWS does have a set of guidelines used in the preparation of event descriptions.[11]

It should be noted that NCDC has very limited records of geological hazards (i.e., earthquake, landslide, and karst). In the absence of better data, it was decided to proceed with the records available in NCDC for these events, with supplemental information and data coming from the United States Geological Survey (USGS) as well as the Commonwealth of Virginia's 2010 Emergency Operations Plan update. NCDC records for these types of hazard events are likely significant under-representations of what has happened in the Peninsula in the past. To date, no comprehensive digital databases exist for these hazards. A comparison of NCDC storm events and NWS warnings issued for Severe Thunderstorms, Tornadoes, and Flash Flooding was also performed as part of the 2011 plan update and results are presented in Table 4-2. Although the criteria (thresholds) differ between the data contained within these two data sources, some generalizations can be made from their examination.

In general, there were more NWS warnings issued than there were NCDC storm event records for the Peninsula for flood, tornado, and thunderstorm related hazards. There are a number of possibilities that might explain this finding. For instance, NWS warnings are usually issued based on spotter or public reports and/or Doppler radar observations. Although it is possible that NWS warnings were issued for events that did not occur or were not significant, it is more likely that Doppler radar was able to detect significant events that occurred but were not officially reported and therefore did not make it into the NCDC database. This comparison suggests that the NCDC database may be an underrepresentation of the actual number of significant hazard events. Despite this potential limitation, the NCDC database is the most comprehensive data set currently available for most natural hazards, and it forms the basis for much of the analysis performed in the HIRA.

Table 4-2: Comparison of NCDC Storm Events and NWS Warnings

Jurisdiction	Thunderstorm (Years of record: 1990 - July 2010)		Tornado (Years of record: 1991 - July 2010)		Flood (Years of record: 1994 - 2010)	
	NCDC Significant Thunderstorm Events	NWS Severe Thunderstorm Warnings*	NCDC Tornado Events	NWS Tornado Warnings	NCDC Flood Events	NWS Flash Flood Warnings
James City County	57	94	8	12	4	15
York County	79	97	6	8	5	22
City of Hampton	59	65	6	11	9	26
City of Newport News	41	65	2	4	12	27
City of Williamsburg	26	42	0	3	0	8

*NOTE: The National Weather Service criteria for a Severe Thunderstorm Warning includes winds of 58 mph or greater and/or hail size 1 inch diameter or larger. Prior to January 5, 2010, Severe Thunderstorm Warnings were issued when storms producing hail size ¾ inch diameter or greater and/or winds of 58 mph or greater.

Event records from February 1, 1951, through July 31, 2010, have been used for the HIRA analysis.

The damages entered into the NCDC Storm Events database portray how much damage was incurred in the year of the event. Due to inflation and the changing value of money, the values of damages incurred have been adjusted so that they reflect their worth in 2010. This process was done by obtaining information from the Bureau of Labor Statistics, which provides a yearly index of Consumer Prices. Each value was multiplied by the index of its year of occurrence and subsequently divided by the index value in 2010, the target year.

NCDC Annualizing Data

After the data was normalized, inflation accounted for, and summary statistics calculated, the data was annualized in order to be able to compare the results on a common system (i.e., ranking the hazards). In general, this was completed by taking the parameter of interest and dividing by the length of record for each hazard. The annualized value should only be utilized as an estimate of what can be expected in a given year. Deaths/injuries, property and crop damage, and events were all annualized in this fashion, on a per-jurisdiction basis.

Multi-Hazard Correlation

While this plan investigates individual hazard history and occurrence, it should be noted that many hazards occur simultaneously or in sequences that result in other subsequent hazards. For example, hurricanes are defined by sustained wind speed but not all hurricane damage is from wind. Heavy rains associated with these storms and storm surge generated by waters piled up on shore result in devastating flooding. The effects of natural hazards can last years after the initial damage events. High wind events blow down trees, which can increase the wildfire hazard for years to come due to an increase in downed dead or dying woody debris. In addition, uprooted trees in low-lying or typically damp areas can cause other problems. For example, the root bulb from the fallen tree can excavate large holes in the landscape, which, when filled the rainwater, can provide breeding grounds for mosquitoes. Another example would be the clogging of drainage ways and culverts by the fallen trees.

Although the effects of storm surge can be the most devastating of a tropical system, storm surge is unlikely to occur without the existence of a tropical storm or hurricane. Therefore, storm surge is discussed below as a secondary hazard associated with tropical systems. Erosion in the Peninsula region is typically associated with nor'easters and can also be a secondary effect of sea level rise. Additional detail on the erosion hazard is included in the nor'easter and sea level rise descriptions below.

The NCDC Storm Events database uses very detailed event categories, sometimes naming the category after a specific event (e.g., a hurricane name). The NCDC-reported storm events were summarized in simplified classifications to correspond to the major hazard types considered in this plan. Table 4-3 shows how the NCDC event types were grouped into the HIRA hazard categories. The ranking methodologies, explained later in this section, summarize how the NCDC data was used in ranking the hazards.

Table 4-3: Hazard Grouping for Analysis

HIRA Grouping	*NCDC Event Type*
Flooding	ASTRONOMICAL HIGH TIDE
	COASTAL FLOOD
	COASTAL FLOODING
	FLASH FLOOD
	FLOOD
	HEAVY RAIN

Table 4-3: Hazard Grouping for Analysis	
HIRA Grouping	***NCDC Event Type***
Thunderstorm	HAIL
	LIGHTNING
	THUNDERSTORM WIND
	THUNDERSTORM WINDS
	TSTM WIND
Tornado	FUNNEL CLOUD
	TORNADO
	WATERSPOUT
Tropical Storm/Hurricane	HURRICANE
	HURRICANE/TYPHOON
	TROPICAL STORM
Winter Weather	HEAVY SNOW
	ICE STORM
	SNOW
	WINTER STORM
	WINTER WEATHER
	WINTER WEATHER/MIX

Hazard Ranking Methodology

To compare the risk of different hazards, and prioritize which are more significant, requires a system for equalizing the units of analysis. Under ideal conditions, this common unit of analysis would be "annualized dollars." However, such an analysis requires reliable probability and impact data for all the hazards to be compared. As this data is often not available, many hazard prioritization methods are based on scoring systems, which allow greater flexibility, and more room for expert judgment.

As some of the hazards assessed in this plan did not have precisely quantifiable probability or impact data, a semi-quantitative scoring system was used to compare all of the hazards. This method prioritizes hazard risk based on a blend of quantitative factors from the available data and is based on a similar methodology used for the Commonwealth of Virginia 2010 Hazard Mitigation Plan update. A number of parameters have been considered in this methodology, including:

- History of occurrence;
- Vulnerability of people in the hazard area;
- Probable geographic extent of the hazard area; and
- Historical impact, in terms of human lives and property.

The ranking methodology tries to balance these factors, whose reliability varies from hazard to hazard due to the nature of the underlying data. Each parameter was rated on a scale of one (1) through four (4). The population vulnerability and density would each be weighted at 0.5 and geographic extent at 1.5, relative to the other parameters. These scores are summed at a jurisdictional level for each hazard separately, permitting comparison between jurisdictions for each hazard type. A summation of all the scores from all hazards in each jurisdiction provides an overall, "all-hazards" risk prioritization. The following sections provide an overview of the six parameters that were used in ranking the hazards that impact the Peninsula.

The NCDC data, as described above, is far from a complete data source. This data was used for the ranking because of its standardized collection of many of the hazards of interest. The data only partially represents the geological hazards, and, as a result the ranking, can only characterize the current form of the data. As other data sources become available, the ranking will need to be reassessed to make sure the parameters are still valid for ranking the hazards.

Population Vulnerability and Density

Population vulnerability and density are simple, yet important, factors in the risk ranking assigned to a jurisdiction. In general, a hazard event that occurs in a highly populated area has a much higher impact than a comparable event that occurs in a remote, unpopulated area. Two population parameters were used, to account for jurisdictions with high populations and jurisdictions with densely populated areas. Each parameter was given a weighting of 0.5 in an effort to avoid overwhelming the overall ranking methodology with pure population data.

Population vulnerability was calculated as the percent of the total population of the planning area present in each jurisdiction. The 2009 Weldon Cooper Center estimates, described in Section 2 Regional Profiles, (2010 Census population data was not yet available when the analysis was completed) for each jurisdiction were divided by the total population for the Peninsula; a value between one and four was assigned based on a geometrical interval. By ranking jurisdictions this way, those cities and counties with significantly larger populations have effectively been given extra weight. Table 4-4 describes the ranking intervals and assigned scores for population vulnerability.

Table 4-4: Population Vulnerability (percentage of people that will be affected by the occurrence of the hazard)	
Population Vulnerability	
Rank	***Definition***
1	<= 0.12 % of the total population of the Planning Area
2	0.13% - 0.22% of the total population of the Planning Area
3	0.23% - 0.30% of the total population of the Planning Area
4	> = .31% of the total population of the Planning Area

Population density was based on the population per square mile for each jurisdiction. The 2009 Weldon Cooper Center estimates, described in Section 2 Regional Profiles, for each jurisdiction were divided by the total area for the jurisdiction; a value between one and four was assigned based on geometrical intervals. By ranking jurisdictions this way, those cities and counties with densely populated areas have effectively been given extra weight. Table 4-5 describes the breaks and assigned scores for population density.

Table 4-5: Population Density (people per square mile that will be affected by the occurrence of the hazard)	
Population Density	
Rank	***Definition***
1	<= 603.2 people/sq mi
2	603.3 – 920.6 people/sq mi
3	920.7 - 1,534.5 people/sq mi
4	>= 1,534.6 people/sq mi

Geographic Extent

Probable geographic extent would ideally be measured consistently for each hazard; however, the available data sources vary widely in their depiction of hazard geography. As a result, one uniform ranking system could not be accomplished at this time. In this version of the plan, each hazard has been assigned individual category break points based on the available hazard data. In the overall scoring system, geographic extent was given a 1.5 weighting relative to the other parameters, as geographic extent was deemed to be critically important, and more reliable than some of the other

parameters. Geographic extent data sources, ranking criteria, and category breaks are summarized in Table 4-6.

Table 4-6: Geographic Extent (percentage of jurisdiction impacted by hazard)

Geographic Extent					
Hazard	**Description**	**Category Breaks**			
		Rank	Definition		
Flood	Percent of a jurisdiction that falls within FEMA Special Flood Hazard Area (SFHA). Data: FEMA Floodplains (DFIRMs)	1	<=1.99%		
		2	2.00-4.99%		
		3	5.00 -6.99%		
		4	>=7.00%		
Hurricane/Tropical Storm	HAZUS 100-year average maximum 3-second wind speed throughout the entire jurisdiction Data: HAZUS-MH MR4	1	<= 59.9		
		2	60.0 – 73.9		
		3	74.0 – 94.9		
		4	>= 95.0		
Significant Thunderstorm	Those thunderstorm events on the Peninsula that produced: • 3/4" or greater diameter hail size for hail; and/or • 58 mph or greater wind gusts; and/or • lightning events with damages, deaths or injuries. Data: NCDC Storm Events		Hail	Lightning	Thunder storm Wind
		1	<= 10	<=2	<= 10
		2	10.1 – 15	2.1 – 3	10.1 - 20
		3	15.1 – 20	3.1 – 4	20.1 - 30
		4	>=20.1	>= 4.1	>= 30.1
Winter Storm	Average annual number of days receiving at least 3 inches of snow, calculated as an area-weighted average for each jurisdiction. Data: NWS snowfall statistics	1	<= 1.49		
		2	1.50 - 1.99		
		3	2.00 - 2.99		
		4	>= 3.0		
Tornado	Annual tornado hazard frequency (times one million), calculated as an area-weighted average for each jurisdiction. Data: NCDC tornado frequency statistics	1	<= 1.24		
		2	1.25 - 9.99		
		3	10.00 - 99.9		
		4	>= 100.00		
Drought	Geographic extent assumed to be uniform throughout the planning area for drought events.	1	Entire planning area		
		2	NA for this update		
		3			

Table 4-6: Geographic Extent (percentage of jurisdiction impacted by hazard)			
Geographic Extent			
Hazard	Description	Category Breaks	
		Rank	Definition
	Data: NCDC Storm Events	4	

Annualizing the Data for Analysis

Data from the NCDC database was annualized so that the results could be compared in a common system. In general, this was completed by taking the parameter of interest and dividing by the length of record for each hazard. The annualized value should only be utilized as an estimate of what can be expected in a given year. Property and crop damage, and events were all annualized in this fashion.

Factoring Deaths and Injuries

Deaths and Injuries are also an important factor to evaluate when determining risk ranking. These were not, however, annualized when using for hazard ranking calculations. Using NCDC data, past deaths and injuries were computed for Flood, Thunderstorm, Tornado, Tropical Storm/Hurricane, Winter Weather, and Drought. The remaining hazards have no reported deaths or injuries in this database and, as a result, were assigned a ranking of one (1).

The injury/death values were added for each event category and scored, using natural breaks as shown in Table 4-7. A summary of deaths/injuries and the period of record used for each hazard can be found in the description of the NCDC data.

Table 4-7: Total Deaths and Injuries (number of deaths or injuries that a hazard event would likely cause in a given year)	
Deaths and Injuries	
Rank	Definition
1	No deaths or injuries
4	>= 1 death and/or injury

Annualized Crop and Property Damage

Crop damage and property damage were also analyzed separately in order to give each jurisdiction a score of one to four. This data was obtained from the NCDC storm events database and annualized according to the period of record for each event category, as shown in Table 4-8.

Table 4-8: Annualized Crop and Property Damage (the estimated damages that a hazard event will likely cause in a given year)

Annualized Crop and Property Damage		
Rank	***Definition: Crop Damage***	***Definition: Property Damage***
1	*<= $4,956.39 per year*	*<= $65,485.39 per year*
2	*$4,956.40 – $27,017.39 per year*	*$65,485.40 - $315,695.39 per year*
3	*$27,017.40 - $255,038.09 per year*	*$315,695.40 - $800,407.49 per year*
4	*>= $255,038.10 per year*	*>= $800,407.50 per year*

Annualized Events

While each hazard may not have a comprehensive database of past historical occurrences, the record of historical occurrences is still an important factor in determining where hazards are likely to occur in the future. Annualizing the NCDC storm events data yields a rough estimate of the number of times a jurisdiction might experience a similar hazard event in any given year. To do this, the total number of events in the NCDC database, for each specific hazard in each jurisdiction, was divided by the total years of record for that hazard to calculate an “annualized events” value.

It should be noted that there were no significant events reported for land subsidence (karst), earthquake, and landslide in the NCDC database; as a result, the events for these hazards all received a rank of one (1). Table 4-9 describes the annual frequency breaks for events.

Table 4-9: Annualized Events (number of times that a hazard event would likely happen in a given year)	
Annualized Events	
Rank	***Definition***
1	<= 0.10 events per year
2	0.11 – 1.0 events per year
3	1.01 – 2.5 events per year
4	>= 2.51 events per year

Overall Hazard Ranking

The scores from each of the categories were added together for each hazard to estimate the total jurisdictional risk due to that hazard. As discussed previously, the population parameters were each given a weighting of 0.5 (for a total of 1.0 for all population parameters), and geographic extent was given a weighting of 1.5 relative to the other factors. The total scores were broken into five categories to better illustrate the distribution of risk scores. Those jurisdictions with scores from 0 to 8.49 were determined to have a low risk in that hazard category; jurisdictions with scores 8.50 through 11.49 were considered medium-low risk; jurisdictions with scores between 11.50 and 14.49 were considered medium risk; jurisdictions with scores between 14.50 and 18.99 were considered medium-high risk; and jurisdictional hazard scores greater than 19.0 were given a high rating.

Climate Change

Climate change is both a present threat and a slow-onset disaster. It acts as an amplifier of existing hazards. Extreme weather events have become more frequent over the past 40 to 50 years and this trend is projected to continue.[12] Rising sea levels, coupled with potentially higher hurricane wind speeds, rainfall intensity, and storm surges are expected to have a significant impact on coastal communities, including those of the Peninsula. More intense heat waves may mean more heat-related illnesses, droughts, and wildfires. This plan update includes a discussion of how climate change might impact the frequency, intensity, and distribution of specific hazards. As climate science evolves and improves, future updates to this plan might consider including climate change as a parameter in the ranking or scoring of natural hazards.

Datasets for Analysis

Locality Provided Datasets

Critical Facilities

In preparing the inventory of critical facilities for the Peninsula, each participating jurisdiction was asked to submit best available GIS data layers for their primary critical facilities. The Data Matrix, Appendix E1, contains the populated data matrices for each of the localities that provided them during the data collection phase of this update. This resulted in the identification of hundreds of critical facilities for the Peninsula. Data gaps were supplemented with data from the Virginia Economic Development Partnership (VEDP) and the Hampton Roads Planning District Commission (HRPDC). Table 4-10 summarizes the main critical facility types provided. Figure 4-2 shows the provided critical facility locations within each of the jurisdictions.

The City of Newport News provided critical facility GIS data. The data did not include libraries or schools, so these were supplemented from VEDP. York County also provided critical facility GIS data; however, military installations were not included in this data. Polygon military installation data from HRPDC was used to create centroid data in order to map these facilities and to overlay them with hazard layers. Critical facility data was not available from the City of Williamsburg GIS department; however, building data was. Government buildings were derived from this data, while schools were supplemented by VEDP. James City County and the City of Hampton provided critical facility GIS data. Both of these data sets were regarded to be complete and were not supplemented by any other data sources.

The types of critical facilities included in this analysis vary by jurisdiction as a result of varying definitions among the jurisdictions as to what is considered a critical facility. The common facilities include Law Enforcement, Fire/EMS, Hospital/Medical, Schools/Education, Emergency Management, and Federal Buildings. Table 4-10 highlights the number of facilities in each of these categories. Future plan updates should investigate a regional definition of critical facilities to ensure analysis for each of the jurisdictions is consistent and complete.

In addition to the common facilities listed above, and in Table 4-10, additional “critical” facilities were provided by each of the jurisdictions. A summary of these types is given below.

Facilities unique to the City of Hampton include:

- Military Bases
- Communication
- Pump Stations
- Community Centers

Facilities unique to James City County include:

- Airport
- Military Bases
- Transportation

Facilities unique to the City of Newport News include:

- Adult Care Centers
- Communications
- Fuel Centers
- Group Homes
- Industry
- Public Utilities
- Transportation
- Fort Eustis

Facilities unique to the City of Williamsburg include:

- Pump Stations
- Water Storage Tanks

Facilities unique to York County include:

- Retirement Facilities
- Sewers
- Communication Towers
- Water Locations
- Military Bases
- Fuel
- Transportation

It is understood that this listing is incomplete due to data limitations associated with both the local GIS and national datasets, but that further enhancements to the data will be made over time and incorporated during future plan updates. When analysis for critical facilities was performed, the supplemented local summary results are presented in the hazard specific sections.

Table 4-10: Critical Facilities for the Peninsula							
Jurisdiction	***Law Enforcement (Including Police)***	***Fire/EMS***	***Hospital/ Medical***	***Schools/ Education***	***Emergency Management***	***Other***	***Total***
James City County	3	6	1	9	1	11	31
York County	2	7	1	17	2	153	182
City of Hampton	2	11	1	11	1	42	68
City of Newport News	13	13	4	38	1	112	181
City of Williamsburg	1	1	1	3	1	21	28
Totals	**21**	**38**	**8**	**78**	**6**	339	490

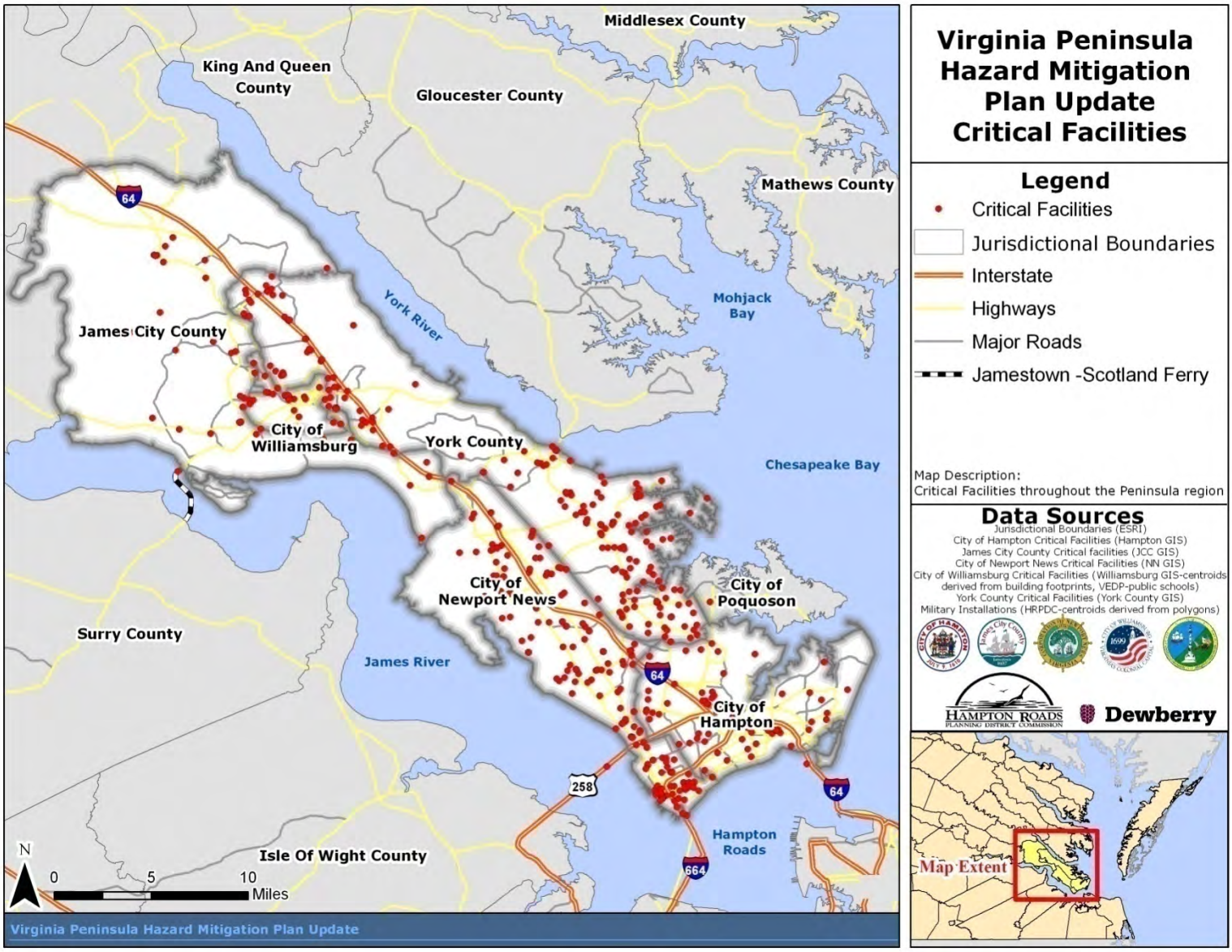

Figure 4-2: Critical Facility Locations

Building Footprints

Building footprint data, as mentioned above, was provided for each of the participating jurisdictions. Additional attributes for in-depth analysis were not available for each of the jurisdictions. As a result, when applicable, the count of buildings in the hazard areas are provided in the individual hazard sections that follow.

The Peninsula currently has over 237,303 mapped building footprints. Similar to the HAZUS-MH building stock data presented below, residential buildings represent the majority (57%) of the buildings on the Peninsula. The Cities of Hampton and Newport News have the largest number of structures mapped for the region. Table 4-11 below summarizes the number of residential and total number of buildings by jurisdiction.

Table 4-11: Building Footprint Data Provided

Jurisdiction	Residential Buildings	Total Number of Buildings
City of Hampton	43,190	81, 838
James City County	21,596	34, 816
City of Newport News	49,940	79, 794
City of Williamsburg	3,410	6, 433
York County	18,919	34, 422
Total	**137,055**	**237,303**

Zoning

Zoning is also a critical indicator to review in considering local development trends. Zoning GIS data was provided by all of the jurisdictions participating in the plan update. In some cases, zoning generalizations were made to be able to compare the jurisdictions to each other. In all of the jurisdictions residential zoning is the largest classification, often followed by commercial.

Over 40% of the area of the City of Williamsburg has been zoned as single-family dwelling residential and 5.2% as multi-family residential. The College of William and Mary accounts for 18.5% of the city's area followed by 9% zoned as museum support.

The majority of James City County has been zoned as general agriculture (42.9%). When all of the various types of residential zones are added together they account for over 33% of the area of the county. The residential zones include general, limited, low density, multi-family, planned unites, planned communities, and rural residential. The remaining zones are distributed to business, industrial, mixed use and planned commercial development.

The City of Hampton has 13 residential zoning classes, accounting for 65.4% of the area of the city. Three commercial zones make up 25.9% of the area, followed by 4.4% in Special Public Interest zones. The remaining area is made up of manufacturing, Langley Flight Approach, and miscellaneous use zones.

There are five main zoning classes in the City of Newport News that are broken down into multiple subclasses. Residential makes up 62.7% of the zoning area for the city, followed by over 12% in both the park and industrial districts. The business district makes up 10.4% of the area. The Resource Conservation District in York County accounts for 45.8% of the zoning area. Five residential classes make up 24.2% of the area, followed by 4.6% industrial. The remaining area is made up of economic opportunity, water oriented commercial and industrial district, and the Yorktown Village Activity district.

Regional & National Datasets Utilized

Utilities

VEDP lists six main types of utilities on the Peninsula. These included electric, natural gas, solid waste disposal, telecommunications, waste water treatment, and water. Table 4-12 lists the utility type and supplier, and which jurisdictions are supplied to. Dominion Virginia Power is the only electric utility company that supplies the Peninsula. Columbia Gas of Virginia and Virginia Natural Gas are the natural gas suppliers for the region.

Figure 4-3 shows the locations of the major pipelines and utilities on the Peninsula. Pipelines and utilities displayed on this map are from the City of Newport News. Based on this data, the following companies/agencies are responsible for the facilities on the Peninsula:

- Columbia Gas
- VA Natural Gas
- Colonial Petroleum.

Pipelines and utilities are vulnerable to many of the hazards that could impact the Peninsula. For example, a major earthquake could cause significant damage to pipelines and utilities. However, the intensity of earthquakes that have previously impacted the area suggests that only minor damage, if any, would be experienced by these and other types of critical facilities and infrastructure. Treatment plants and other facilities and infrastructure may be vulnerable to inundation during flood events or other damages during periods of high wind. Icing from winter storms and/or strong winds from hurricanes, tornadoes, thunderstorms, or other storm systems can bring down power, telephone, and cable lines as well as impact communication towers, potentially disrupting communications and a variety of utility services. The Human-caused Hazard Appendix provides additional insight into utility and infrastructure risk associated with human-caused hazards.

Table 4-12: Major utilities and suppliers for the Peninsula from Virginia Economic Development Partnership (VEDP)

Utility Type	Utility Name	City of Hampton	City of Newport News	James City County	City of Williamsburg	York County
Electric	Dominion Virginia Power	X	X	X	X	X
Natural Gas	Columbia Gas of Virginia		X			
	Virginia Natural Gas	X	X	X	X	X
Solid Waste Disposal	Hampton City Landfill	X				
	Hampton/NASA Steam Generation Facility	X				
	James City County Service Authority			X		
	USA Waste	X	X		X	
	Virginia Peninsula Public Service Authority			X		
	York County Sanitary Landfill					X
Telecommunications	Cavalier Telephone Company	X	X	X	X	X
	Cox Communications	X	X	X	X	X
	Verizon South	X		X	X	X
	Verizon-Virginia	X	X		X	X
Waste Water Treatment	Hampton Roads Sanitation District	X	X	X	X	X
	James City County Transfer Station			X		
Water	City of Williamsburg				X	
	James City County Service Authority			X		X
	Newport News Waterworks	X	X	X		X
	York County					X

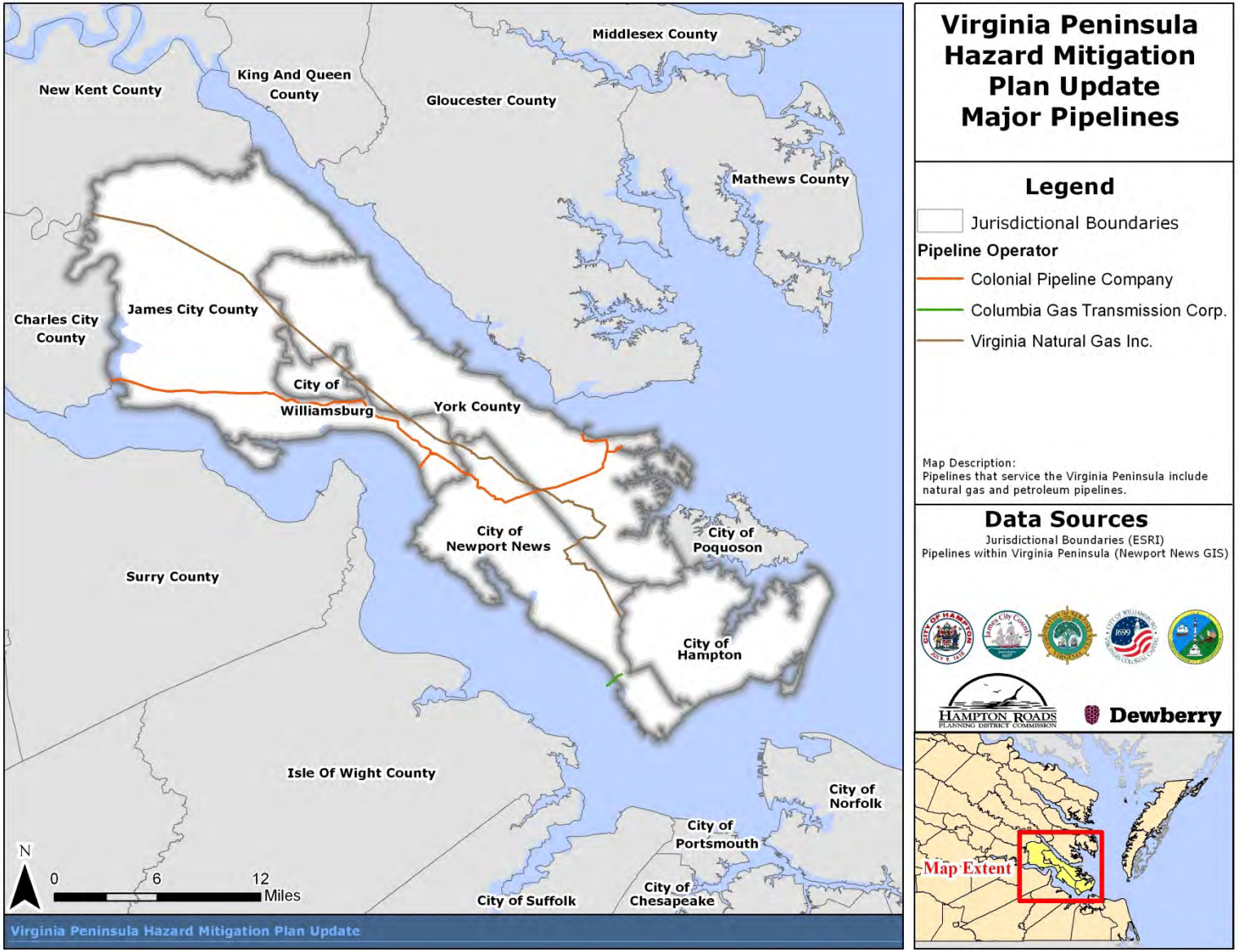

Figure 4-3: Major pipelines and utilities on the Peninsula

HAZUS General Building Stock Data

The HAZUS building stock for the Peninsula contains 152,936 structures with an estimated exposure value of approximately $28.5 million (2006 dollars) excluding contents. HAZUS estimates 93% of the region's general occupancy is residential, which represents 77% of the building value. The City of Newport News represents over 38% of the region's total building value, as summarized in Table 4-13.

Table 4-13: Total Building Exposure by Occupancy Type (in Thousands of Dollars)

Jurisdiction	Number of Buildings	Residential	Non-Residential	Building Stock Exposure (2006$)
City of Hampton	51,091	$6,653,712	$1,703,655	$8,357,367
City of Newport News	57,116	$8,382,649	$2,682,002	$11,064,651
City of Williamsburg	3,351	$737,872	$284,951	$1,022,823
James City County	20,564	$3,094,676	$1,067,302	$4,161,978
York County	20,814	$3,202,851	$744,038	$3,946,889
Total	**152,936**	**$22,071,760**	**$6,481,948**	**$28,553,708**

Table 4-14 shows the estimated total exposure values by jurisdiction. Residential housing represents 77% of the building value in the region, followed by commercial properties representing over 15%. The remaining occupancy types (industrial, non-profit, government, and education) account for the remaining 8% of the region's building value.

Table 4-14: Building stock exposure for general occupancy type by jurisdiction (in Thousands of Dollars)								
Jurisdiction	Residential	Commercial	Industrial	Agri-culture	Non-Profit	Gov't	Educ-ation	Total
City of Hampton	$6,653,712	$1,102,288	$233,508	$11,032	$160,154	$90,903	$105,770	**$8,357,367**
City of Newport News	$8,382,649	$1,775,948	$405,183	$18,681	$255,712	$58,929	$167,549	**$11,064,651**
City of Williamsburg	737872	233173	7102	646	15648	11911	16471	**$1,022,823**
James City County	$3,094,676	$865,545	$100,239	$9,782	$49,335	$18,194	$24,207	**$4,161,978**
York County	$3,202,851	$492,974	$106,058	$10,406	$79,170	$22,389	$33,041	**$3,946,889**
Total	**$22,071,760**	**$4,469,928**	**$852,090**	**$50,547**	**$560,019**	**$202,326**	**$347,038**	**$28,553,708**

Building stock exposure is also classified by building type. General Building Types have been developed as a means to classify different building construction types. This provides an ability to differentiate between buildings with substantially different damage and loss characteristics. Model building types represent the average characteristics of buildings in a class. The damage and loss prediction models are developed for model building types and the estimated performance is based upon the "average characteristics" of the total population of buildings within each class. Five general classifications have been established, including wood, masonry, concrete, steel, and manufactured homes (MH). A brief description of the building types is available in Table 4-15. The HAZUS inventory serves as the default when a user does not have better data available.

Table 4-15: HAZUS General Building Type Classes

General Building Type	Description
Wood	Wood frame construction
Masonry	Reinforced or unreinforced masonry construction
Steel	Steel frame construction
Concrete	Cast-in-place or pre-cast reinforced concrete construction
MH	Factory-built residential construction

Wood construction represents the majority (56.6%) of building types in the region, followed by masonry that represents almost 27% of building stock exposure. The remaining percentage is distributed among other building types. Table 4-16 provides building stock exposure for the five main building types. *The differences in the building stock tables are a result of aggregation by HAZUS and rounding.*

Table 4-16: Building Stock Exposure for General Building Type by Jurisdiction (in Thousands of Dollars)						
Jurisdiction	Wood	Masonry	Concrete	Steel	Manu-factured Homes	Total
James City County	$2,401,103	$1,088,572	$470,179	$149,420	$52,715	$4,161,989
York County	$2,451,891	$1,024,803	$347,687	$106,886	$15,662	$3,946,929
City of Hampton	$4,862,253	$2,256,318	$836,194	$365,984	$36,642	$8,357,391
City of Newport News	$6,036,648	$3,027,238	$1,332,743	$586,675	$81,385	$11,064,689
City of Williamsburg	$406,129	$284,430	$184,357	$145,753	$2,163	$1,022,832
Total	**$16,158,024**	**$7,681,361**	**$3,171,160**	**$1,354,718**	**$188,567**	**$28,553,830**

Hampton Roads Sanitation District

GIS and tabular data were provided by Hampton Roads Sanitation District. The data includes the location and quantity of facility and infrastructure assets as well as asset values.

Table 4-17 summarizes, by jurisdiction, the length of and number of pump stations as well as the value associated with the sanitation district infrastructure. The City of Newport News occupies over 48% of the total value of the sanitation district and 36% of the interceptor length for the region. James City County follows with 21% of total value and 17% of the interceptor length for the Peninsula.

This data has been utilized in the flood and hurricane hazard specific sections. Analysis includes information on the infrastructure and value of infrastructure and facilities in the high risk hazard areas.

Newport News Waterworks

Tabular data was provided by Newport News Waterworks. The data includes the location and quantity of facility and infrastructure assets as well as asset values and is summarized in Table 4-18. It should be noted that Pipes includes the total of Distribution, Raw, Facility, Residual, and BGD sub-categories.

The City of Newport News contains approximately 46% of the total value of the Newport News Waterworks assets located within the participating jurisdictions. The City of Hampton follows with 30% of total value.

This data has been utilized in the flood and hurricane hazard specific sections. Analysis includes information on the infrastructure and value of infrastructure and facilities in the high risk hazard areas.

Table 4-17: Hampton Roads Sanitation District Data								
Jurisdiction	Infrastructure				Value			
	Interceptor Length (LF)	Pump Stations (PS)	Pressure Reduction Station (PRS)	Treat-ment Plants	Interceptor	PS/PRS	Treatment Plant	Total
City of Hampton	250,090.58	10	1	0	$142,801,724	$38,500,000		**$181,301,724**
James City County	157,800.48	3	0	1	$90,104,076	$10,500,000	$202,500,000	**$303,104,076**
City of Newport News	329,045.82	13	1	2	$187,885,166	$49,000,000	$450,000,000	**$686,885,166**
City of Williamsburg	45,958.21	1	0	0	$26,242,138	$3,500,000		**$29,742,138**
York County	123,227.46	3	0	1	$70,362,880	$10,500,000	$135,000,000	**$215,862,880**
Total	**906,122.56**	**30**	**2**	**4**	**$517,395,982**	**$112,000,000**	**$787,500,000**	**$1,416,895,982**

Table 4-18: Newport News Waterworks Data									
Jurisdiction	Infrastructure				Value				
	Hydrants and hydrant values (quant)	Lateral (mi)	Pipes (mi)	Valves (quant)	Hydrant and hydrant values	Lateral	Pipes	Valves	Total
James City County	798	15	99	645	$1,765,851	$1,024,556	$2,315,974	$2,315,974	**$7,422,355**
York County	4,578	93	349	3,219	$10,130,413	$6,047,464	$120,309,895	$10,395,458	**$146,883,230**
City of Hampton	6,544	202	561	7,141	$14,480,870	$13,424,528	$150,172,619	$17,468,426	**$195,546,443**
City of Newport News	8,718	228	745	9,432	$19,291,598	$15,414,409	$238,332,739	$26,763,502	**$299,802,248**
City of Williamsburg	4	0	4	0	$8,851	$3,598	$4,062,526		**$4,074,975**
Total	**20,642**	**538**	**1,758**	**20,437**	**$45,677,583**	**$35,914,555**	**$515,193,753**	**$56,943,360**	**$653,729,251**

Hazard Specific Datasets

As described earlier in this section, multiple hazard datasets were utilized for the Geographic Extent ranking parameter. Table 4-19 provides a breakdown, by hazard, of the hazard datasets used for analysis and mapping in the hazard specific sections that follow. Some of the non-critical hazards were not addressed in the ranking but still include maps of hazard zones and some analysis in the hazard specific sections.

Table 4-19: Hazard Specific Data Utilized for Analysis and Mapping

Hazard	Dataset	Source
Flood	• Digital Flood Insurance Rate Maps (DFIRMs) • Watersheds • Annualized, 100 & 500-year Loss Estimates • Repetitive & Severe Repetitive Loss Properties	• FEMA • Dept of Conservation and Recreation/USDA-NRCS • HAZUS-MH MR4 • FEMA via Virginia Department of Emergency Management (VDEM)
Hurricane/ Tropical Storm	• 3-second Peak Gust Wind Speeds • Annualized Loss Estimates • Tropical Cyclones • Storm Surge Inundation Zones • Historic hurricane data	• HAZUS-MH MR4 • HAZUS-MH MR4 • Commonwealth of Virginia EOP 2010 • VDEM/ACOE 2003-2009 dataset • National Hurricane Center
Significant Thunderstorm	• Significant Storm Events for Hail, Wind and Lightning • Significant Storm Events for Hail, Wind and Lightning • Local Storm Reports	• NCDC Storm Events Database • SVRGIS (based on NCDC) • National Weather Service
Winter Storm	• NWS snowfall statistics • NCDC total events	• Commonwealth of Virginia EOP 2010 • NCDC Storm Events Database
Tornado	• NCDC tornado frequency statistics • NCDC total events • Tornado Tracks and Touchdowns	• Commonwealth of Virginia EOP 2010 • NCDC Storm Events Database • SVRGIS
Wildfire	• Risk Assessment • Woodland Communities • Wildfire Incidents 1995-2006	• Virginia Department of Forestry (VDOF) • VDOF • VDOF
Drought	• NCDC Storm Events for Drought • U.S. Drought Monitor archives	• NCDC Storm Events Database • U.S. Drought Monitor

Table 4-19: Hazard Specific Data Utilized for Analysis and Mapping		
Hazard	**Dataset**	**Source**
Earthquake	• Significant US Earthquakes 1568 – 2009 • Peak Ground Acceleration • Annualized Loss Estimates	• USGS Earthquake Hazard Program via National Atlas • HAZUS-MH MR3 via Commonwealth of Virginia EOP 2010 • HAZUS-MH MR3
Land Subsidence	• USGS Landslide Incidence and Susceptibility	• USGS National Landslide Hazard Program via National Atlas
Dam Failure	• Online Database of dams in Virginia, as of 2009 no current mapping available to non-government users	• US Army Corps of Engineers National Inventory of Dams Database

Land Use

FEMA requires that state and local plans evaluate land use and development trends so that mitigation options can be considered in future land use decisions. Changes in urban and agricultural land cover may help to highlight areas within the state that should be considered in long-term comprehensive plans.

To identify these areas, land cover change was assessed using the NLCD. This dataset is produced by the MRLC, a collection of federal agencies that pool resources to map land cover across the nation. Using satellite imagery, the MRLC produced datasets for 1992 and 2001 that include 16 land cover classes for various types of urban, agricultural, forested, and other natural areas. It is important to note that the MRLC revised the classification system for 2001. In order to assess change consistently, the 1992 land cover classes were cross referenced to 2001 according to the MRLC 1992-2001 Retrofit Change Product.[13]

The majority of change in the Peninsula from 1992 to 2001 has been from forested land cover to urban land. In the City of Hampton, the western portion of the City has experienced change from forest to urban land and also from wetlands to forest. The conversion to urban land seems to also be a trend in the City of Newport News. Both forest and agricultural lands have been converted to urban land. A majority of this change has occurred in the northwest portion of the jurisdiction. On Fort Eustis, there has been change both to and from wetlands to agriculture. The eastern portion of James City County, near the border of Williamsburg and York County, has experienced the most change from forest to urban land. A small concentration of

agricultural land to forested land has occurred in the Midwest part of the County. In the City of Williamsburg, the greatest amount of change has been from forest to urban land; however, land has also been converted from forest to both agriculture and wetlands throughout the City. The southeastern portion of York County, near the cities of Hampton and Newport News, has experienced the most change, a majority of which is forest to urban, agriculture to urban, and wetlands to forest.

Figure 4-4 was created using the NLCD 1992/2001 Retrofit Land Cover Change Product, which was developed to offer users more accurate direct change analysis between the 1992 NLCD and 2001 NLCD. Areas shown in pink in the map below are where land cover changed between 1992 and 2001. The NLCD Change Product uses a specially developed methodology to provide land cover change information at the Anderson Level I classification scale. Unchanged pixels between the two dates are coded with the NLCD 2001 Anderson Level 1 class code for land cover.

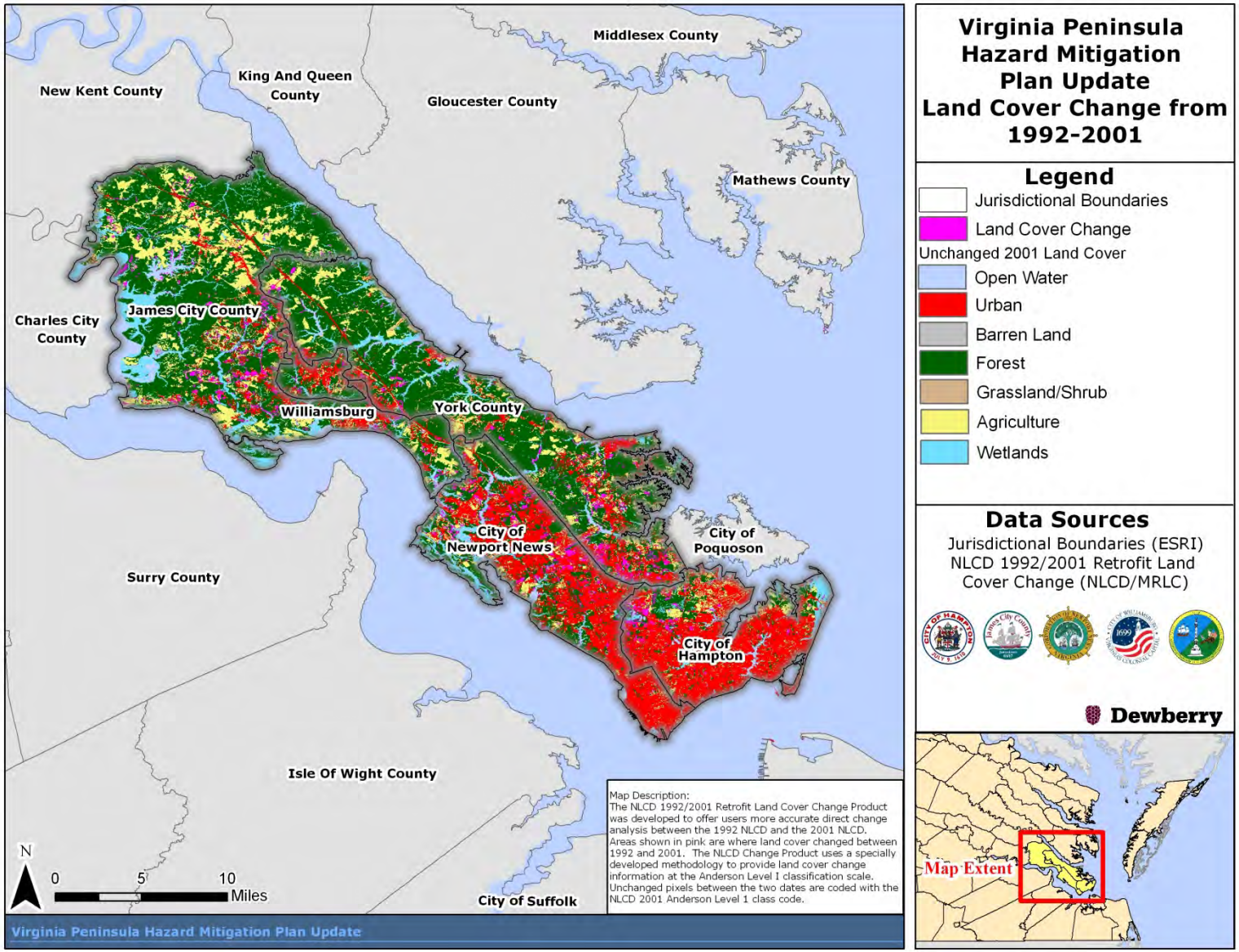

Figure 4-4: National Land Cover Dataset (NLCD) Change 1992 – 2001

Hurricanes and Tropical Storms

Hazard Profile

NOTE: As part of the 2011 plan update, the Hurricanes and Tropical Storms hazard was reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; and 5) ranking of the hazard by jurisdiction using the methodology described in detail in HIRA Introduction section. Each section of the plan was also reformatted for improved clarity, and new maps and imagery, when available and appropriate, were inserted.

Description

A hurricane is a type of low-pressure system, which generally forms in the tropics; similarly, a tropical storm is a low-pressure system of less intensity than a hurricane. Tropical systems are an important part of the atmospheric circulation system, distributing heat from the equatorial region to the higher latitudes. Hurricane season in the North Atlantic generally runs from June 1st until November 30th, with the peak season between August 15th and October 15th. Winds of a hurricane blow in a large, counter-clockwise spiral around a relatively calm center of extremely low pressure known as the eye. Around the rim of the eye, winds are most intense and may gust to more than 200 mph in a very strong storm.

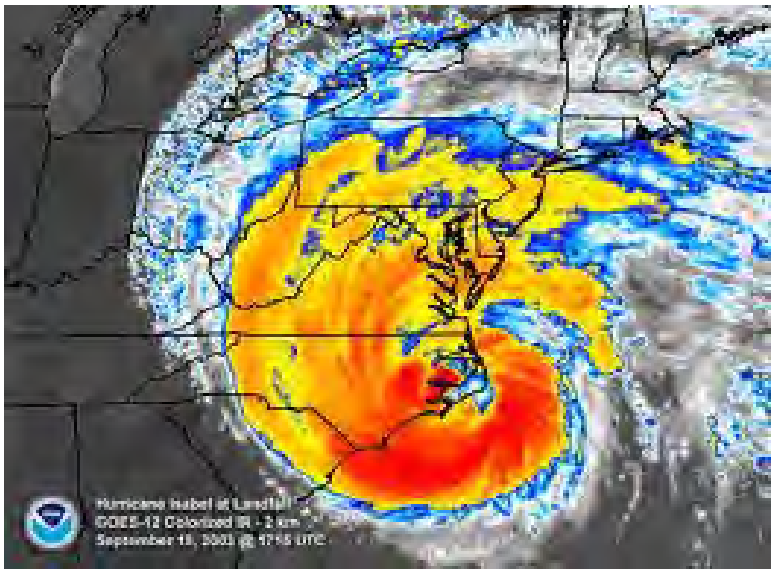

Figure 4-5: Infrared satellite image of Hurricane Isabel at the time of landfall on September 18, 2003 (NOAA)

Once a hurricane has formed, it maintains itself by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms are violent systems that bring heavy rainfall, storm surge, and high winds, and may spawn tornadoes, all of which can cause significant damage.

Geographic Location / Extent

Hurricanes and tropical storms have impacted all portions of the Peninsula at some point in the past. Which areas are most directly impacted depends on the track of any particular storm as well as its associated wind and precipitation fields, which could extend on the order of tens, to, in some cases, even hundreds, of miles from the storm's center. Coastal areas are most likely to be impacted by storm surge and storm surge flooding, while all portions of the Peninsula, including interior areas, may see hurricane force winds, torrential rainfall, and flooding.

Figure 4-6 depicts the paths (of the centers of circulation) of tropical depressions and storms and hurricanes that tracked over or near the Commonwealth of Virginia during the period from 1851 to 2008. Several of these systems impacted the Peninsula and are detailed below in the Previous Occurrences discussion.

Storm surge modeling completed as part of the Virginia Hurricane Evacuation Study, indicates that significant portions of the Peninsula are at risk of inundation under various hurricane category scenarios (See Figure 4-7). A Category 1 hurricane storm surge could impact a considerable portion of the City of Hampton and southeastern portions of York County with impacts into other jurisdictions as well. A Category 4 hurricane surge has the potential to reach further inland and cause devastating inundation through much of the City of Hampton, and adjoining portions of Newport News and York County.

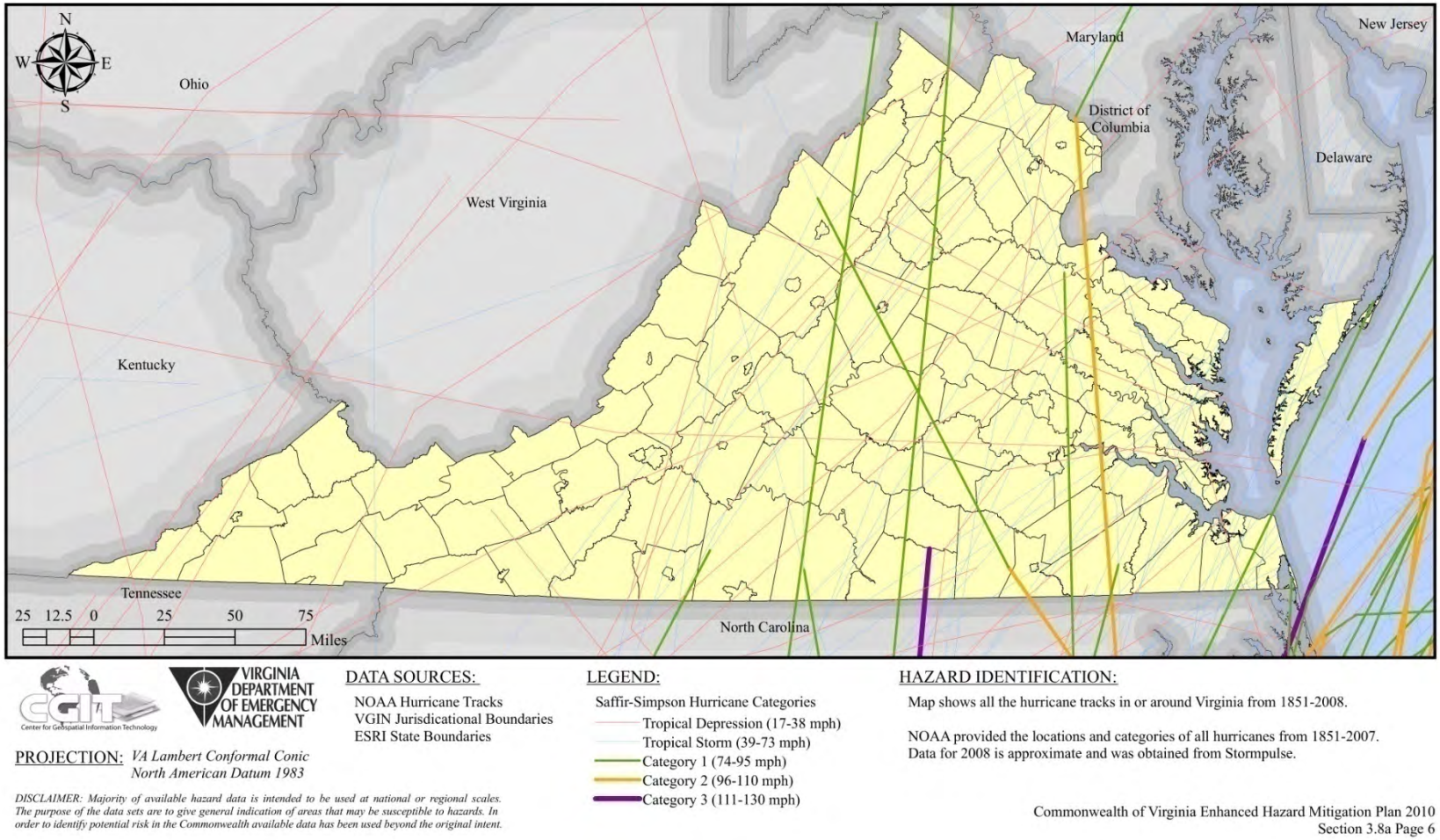

Figure 4-6: Tropical Storm and Hurricane Tracks 1851-2008 (VDEM)

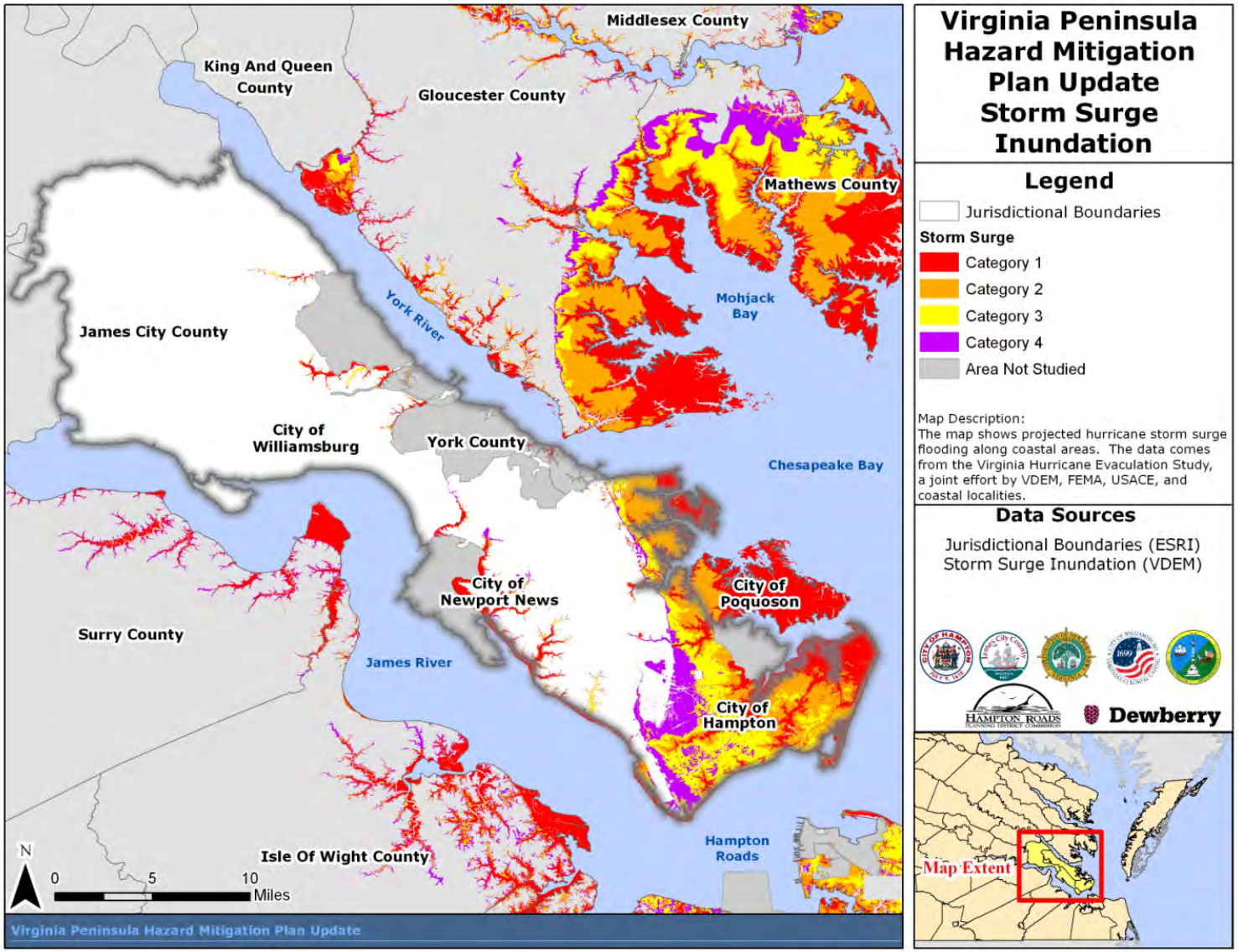

Figure 4-7: Storm Surge Inundation Map showing inundation by hurricane category (VDEM)

Magnitude or Severity

Hurricanes and tropical storms can last for several days; however, the average hurricane duration is 12 to 18 hours. The duration and vast area impacted create the potential for sustained flooding, high wind, and erosion conditions across several states. While wind speeds can be expected to reduce by 50% within 12 hours of landfall, these storms are capable of producing a large amount of rain in a short period over a wide area.

Figure 4-8: Flooding in Hampton the result of Tropical Storm Ernesto, September 1, 2006

Residents and emergency managers on the Peninsula are particularly interested in the track of any approaching storm. Proximity, direction, and strength are important factors when determining response measures, evacuation needs, and potential damage from the storm. When hurricanes approach land, forecasters often describe them as having four distinct quadrants: right-front, right-rear, left-front, and left-rear. The quadrants are relative to the hurricane's overall direction of motion and are significant in evaluating damage potential. The right-front quadrant generally causes the most destruction at the coast because the winds have an additive effect of sustained on-shore winds plus the motion of the hurricane. Onshore winds are strongest in the right-front quadrant; therefore, the surge and waves in that section are also the highest.

Figure 4-9: Tree damage in James City County the result of Hurricane Isabel September 18, 2003

In 1971, wind engineer Herbert Saffir and hurricane expert Dr. Robert Simpson developed a scale to classify hurricanes. The Saffir-Simpson scale (Table 4-20) rates the intensity of hurricanes based on wind speed and barometric pressure measurements. The NWS uses the scale to predict potential property damage and flooding levels from imminent storms. Although the scale assigns a wind speed and surge level to each category of storm, in recent years, there has been more and more recognition of the fact that wind speed, storm surge, and inland rainfall are not necessarily of the same intensity for a given storm. Therefore, there is some interest in classifying hurricanes by separate scales according to each of these risks. However, the Saffir-Simpson Scale is still the most widely used classification tool for hurricanes. Over time, researchers and meteorologists have further refined the analysis of wind damage that hurricanes can produce by differentiating the concept of sustained winds from peak gusts. Sustained winds are measured over longer periods of time, typically a minute. A peak gust is the highest 2- to 5-second wind speed.

Table 4-20: Saffir-Simpson Hurricane Scale

Category	Sustained Wind Speeds (mph)	Tidal Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane Category 1	74-95	4-5	> 980	*Minimal* – Damage is done primarily to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations.
Hurricane Category 2	96-110	6-8	965-980	*Moderate* – Some trees are toppled, some roof coverings are damaged, major damage is done to manufactured homes.
Hurricane Category 3	111-130	9-12	945-965	*Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, and structural damage is done to small homes and utility buildings.
Hurricane Category 4	131-155	13-18	920-945	*Extreme Damage* – Extensive damage is done to roofs, windows, and doors, roof systems on small buildings completely fail, some curtain walls fail.
Hurricane Category 5	> 155	> 18	< 920	*Catastrophic Damage* – Roof damage is considerable and widespread; window and door damage is severe; there are extensive glass failures; some buildings fail completely.

Storm Surge

The communities involved in this planning effort are particularly exposed to the high winds and storm surge associated with hurricanes due to the coastal topography and the large bodies of water surrounding the Peninsula. The greatest potential for loss of life related to a hurricane is from the storm surge. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. In addition, wind waves are superimposed on the storm tide. This rise in water level can cause severe flooding on the Peninsula, particularly when the storm tide coincides with the normal high tides.

Surge maps are based upon a Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model and are the basis for the "hazard analysis" portion of the area's hurricane evacuation plans. SLOSH is a computerized model run by the National Hurricane Center (NHC) to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account: pressure, size, forward speed, track, and winds. The Virginia Department of Emergency Management (VDEM) provided storm surge mapping for the 2011 update; analysis was completed by the U.S. Army Corps of Engineers between 2003 and 2009.

Hundreds of hypothetical hurricanes are simulated with various Saffir-Simpson categories, forward speeds, landfall directions, and landfall locations. An envelope of high water containing the maximum value a grid cell attains is generated at the end of each model run. These envelopes are combined by the NHC into various composites that depict possible flooding. One useful composite is the MEOW (Maximum Envelopes of Water), which incorporates all the envelopes for a particular category, speed, and landfall direction. Another composite that is useful to emergency managers is the MOM (Maximum of the MEOWs), which combines all the MEOWs of a

Figure 4-10: Structural damage in York County due to Hurricane Isabel

particular category.

To provide some tools to emergency managers, regional evacuation studies have been completed using the SLOSH models. The MEOW maps are produced for all five levels of hurricane intensity and for many directions of storm motion, and they depict the "worse case" scenario for all categories of storms and all potential storm tracks. MEOW maps are just one tool an emergency manager will use to determine risk areas and evacuation recommendations.

The MOM storm surge maps for the Peninsula depict the "worst of the worst", and not the results of any one storm. There are no surge heights for Category 5 storms because the region is considered to have a very low probability of experiencing storms of that intensity.

Previous Occurrences

Since 1851, 36 tropical systems have passed within 25 nautical miles of some portion of the Peninsula. Hurricane Isabel is the most significant hurricane to have directly impacted the Peninsula in recent memory. The storm brought the Peninsula damaging winds gusting at times to over 75 mph, a storm surge of 5 to 8 feet, and rainfall of 2 to 6 inches. Table 4-21 details selected previous hurricane/tropical storm occurrences that impacted the Peninsula.

Table 4-21: Previous Significant Hurricane/Tropical Storm Events

Date	Event	Comments
October 19, 1749	Unnamed hurricane	The Bay rose 15 feet above normal. In Williamsburg, a family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Bodies washed ashore from shipwrecks for days afterward. The hurricane wiped out Ft. Monroe's predecessor, Ft. George.

Table 4-21: Previous Significant Hurricane/Tropical Storm Events		
Date	Event	Comments
August 23, 1933	Chesapeake-Potomac Hurricane	This hurricane contributed to record high tides in many locations; approximately 9.8 feet above mean lower water. There were four casualties on the Peninsula: two in Hampton, one in James City County, and one in York County. At Buckroe Beach in Hampton, and at Yorktown, martial law was declared and National Guard troops were brought in to prevent looting. Flooding was severe in low-lying parts of Hampton (Fox Hill and Buckroe), York County (Goodwin Neck), and Newport News (Small Boat Basin). Jamestown Island was severely damaged.
October 15, 1954	Hurricane Hazel	Hazel inflicted 130mph winds on Hampton and blew apart at least one anemometer there. There was one casualty on the Peninsula in the Dare section of York County.
September 6, 1999	Hurricane Floyd	Floyd passed directly over Virginia Beach as a Category 1 hurricane. Rainfall amounts in areas west of the Peninsula reached staggering amounts in excess of 15 inches. Prior rainfall created wet conditions that led to flooding in some parts of Newport News and Hampton.
September 18, 2003	Hurricane Isabel	Isabel made landfall near Ocracoke, North Carolina as a Category 2 hurricane, and the center passed west of Emporia. Isabel brought hurricane conditions to the Peninsula and caused significant flooding, with highest tide at Sewells Point of 7.9 feet above mean lower low water, a 5 foot storm surge. There was significant beach and shore erosion along much of the Peninsula's shoreline. Grandview and Buckroe areas of Hampton, Newport News/James River waterfront, Seaford area of York County and Yorktown waterfront had many structures severely damaged by storm surge. On the Peninsula, Isabel indirectly caused one drowning death in Newport News and one debris cleanup accident fatality in York County. Statewide, the storm resulted in

Table 4-21: Previous Significant Hurricane/Tropical Storm Events		
Date	Event	Comments
		$1.6 billion in damages with over 1,186 homes and 77 businesses completely destroyed, 9,110 homes and 333 businesses with major damage, and over 107,000 homes and 1,000 businesses with minor damage. Hundreds of power lines were blown down leaving almost two million electrical customers without power. Crop losses were calculated to be $59.3 million with another $57.6 million in damages to farming infrastructure.
September 1, 2006	Tropical Storm Ernesto	Ernesto made landfall as a strong tropical storm just west of Cape Fear, NC. Torrential rainfall of between 5 and 10 inches was common across the Peninsula and resulted in flooding of roadways. Storm surge of 2 to 4 feet was reported over the eastern portion of the Peninsula Maximum sustained winds reached to over 40 mph and gusts of over 60 mph were observed. Power lines and trees were downed as a result.
September 6, 2008	Tropical Storm Hanna	Hanna made landfall near the North Carolina – South Carolina border. The system tracked northeast and into southeastern Virginia spreading heavy rainfall and gusty winds across the region, before continuing on into the Northeast and New England. Rainfall of between 1 and 4 inches and wind gusts of 40 to 50 mph were reported. Numerous trees were downed on the Peninsula as a result of the storm.

Risk Assessment

Probability of Future Occurrences

Based on historical frequency of occurrence using NCDC and NWS data, a determination of probability of future tropical storm and hurricane events can be made. The data indicates that on average, tropical storm/hurricane events impact the Peninsula every 6 to 7 years. In annualized terms, there are 0.15 to 0.16 tropical storm/hurricane events annually. The entire Peninsula has been impacted by such events in the past, and, by inference,

it can be expected that tropical storms and hurricanes will continue to be a threat into the future. Table 4-22 summarizes the number of annualized hurricane/tropical storm events based on NCDC historical data.

Based on a range of long-term global climate models under Intergovernmental Panel on Climate Change (IPCC) warming scenarios, it is possible that hurricanes will become more intense, with stronger winds and heavier precipitation through the 21st century. Using an ensemble-mean of 18 climate models, IPCC A1B emissions scenario,[14] and operational hurricane forecast models, one study[15] showed a decrease in the total number of tropical storms and hurricanes, but an increase in the number of intense hurricanes, particularly Category 4 or 5 hurricanes. Future plan updates should consider a review of the latest climate science to determine what impact, if any, climate change might have on the future frequency or intensity of hurricanes and tropical storms and how this might apply to the Peninsula.

Table 4-22: Annualized Hurricane/Tropical Storm Events from NCDC Storm Events Data

Jurisdiction	NCDC Annualized Events (Events Per Year)
James City County	0.15
York County	0.15
City of Hampton	0.15
City of Newport News	0.16
City of Williamsburg	0.16

Impact & Vulnerability

Tropical storms and hurricanes have the potential to significantly impact (impair) a wide range of sectors including transportation, utilities, and emergency management. Higher profile structures, infrastructure, and vehicles are most vulnerable to destructive hurricane winds. Damage to above-ground power and communication lines and towers could potentially lead to outages that last for days, weeks, and, in a worst-case scenario, months.

A structure's hurricane vulnerability is based in large part on building construction and standards. Other factors, such as location, condition, and maintenance of trees also plays a significant role in determining vulnerability.

Human vulnerability is based on the availability, reception, and understanding of warnings and other official information regarding impending hurricanes and tropical storms, and access to substantial indoor shelter resistant to hurricane wind and storm surge.

Risk

Hurricane risk is quantified using both NCDC data and HAZUS analysis. A summary of this loss analysis is found in Table 4-23.

The NCDC database indicates that approximately $194 million in losses have been felt in the participating Peninsula jurisdictions since the mid 1990s. The losses experienced by each jurisdiction have been calculated to range from roughly $38.4 million to $44 million. On an annualized basis, losses due to hurricanes and tropical storms are approximately $14.3 million annually for all of the jurisdictions, or roughly $2.6 million to $3 million per jurisdiction.

Table 4-23: Annualized Hurricane/Tropical Storm Impacts

Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Total Annualized Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
James City County	$39,443,085	$2,629,539	$2,383,613	$245,926
York County	$43,903,966	$2,926,931	$2,646,364	$280,567
City of Hampton	$43,903,243	$2,926,883	$2,646,316	$280,567
City of Newport News	$43,903,243	$2,926,883	$2,646,316	$280,567
City of Williamsburg	$43,903,966	$2,926,931	$2,646,364	$280,567
TOTAL	**$194,534,620**	**$14,337,167**	**$12,968,975**	**$1,368,192**

HAZUS Hurricane Wind Analysis

Hurricane wind risk analysis for the HIRA was completed using the Federal Emergency Management Agency (FEMA) HAZUS – MH MR4 software. HAZUS is a regional, multi-hazard, loss estimation model that was developed by FEMA and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to

develop multi-hazard losses at a regional scale. The model uses state of the art wind field models, and calibrated and validated hurricane data as well as statistical methods in producing its outputs. Wind speed has been calculated as a function of central pressure, translation speed, and surface roughness. This assessment has been completed for Level 1 analysis only. Level 1 analysis involves using the provided data with no local data inputs. This is an acceptable level of information for mitigation planning; future versions of this plan can be enhanced with Level 2 and 3 analysis. Dollar values shown in this report should only be used to represent the cost of large aggregations of building types. Highly detailed, building-specific loss estimations have not been completed for this analysis as they require additional local data inputs.

Loss estimation for this HAZUS module is based on specific input data. The first type of data includes square footage of buildings for specified types or population. The second type of data includes information on the local economy that is used in estimating losses. Table 4-24 displays the economic loss categories used to calculate annualized losses by HAZUS.

Table 4-24: HAZUS Direct Economic Loss Categories and Descriptions

Category Name	Description of Data Input into Model	HAZUS Output
Building	Cost per sq ft to repair damage by structural type and occupancy for each level of damage	Cost of building repair or replacement of damaged and destroyed buildings
Contents	Replacement value by occupancy	Cost of damage to building contents
Inventory	Annual gross sales in $ per sq ft	Loss of building inventory as contents related to business activities
Relocation	Rental costs per month per sq ft by occupancy	Relocation expenses (for businesses and institutions)
Income	Income in $ per sq ft per month by occupancy	Capital-related incomes losses as a measure of the loss of productivity, services, or sales
Rental	Rental costs per month per sq ft by occupancy	Loss of rental income to building owners
Wage	Wages in $ per sq ft per month by occupancy	Employee wage loss as described in income loss

Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities for the 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year return periods. HAZUS estimates direct and indirect economic losses due to hurricane wind speeds that include:

- Damage to buildings and contents
- Economic loss (business interruptions)
- Social Impacts

Figures 4-11 and 4-12 illustrate the 3-second peak wind gust speeds for the 100- and 1,000-year return periods, based on HAZUS analysis. This analysis includes consideration of historical hurricane data as well as modeling and other statistical analysis for projecting return periods. A 100-year hurricane is roughly a strong Category 1 or possibly lower-end Category 2 hurricane with winds between 80 and 90 mph, and possibly higher, impacting the Peninsula. A 1000-year hurricane is roughly a Category 3 hurricane with winds of up to 120 mph. Wind speeds are based on estimated 3-second gusts in open terrain at 10 meters above ground at the centroid of each census track. Buildings that must be designed for a 100-year mean recurrence interval wind event include[16]:

- Buildings where more than 300 people congregate in one area
- Buildings that will be used for hurricane or other emergency shelter
- Buildings housing a day care center with capacity greater than 150 occupants
- Buildings designed for emergency preparedness, communication, or emergency operation center or response
- Buildings housing critical national defense functions
- Buildings containing sufficient quantities of hazardous materials

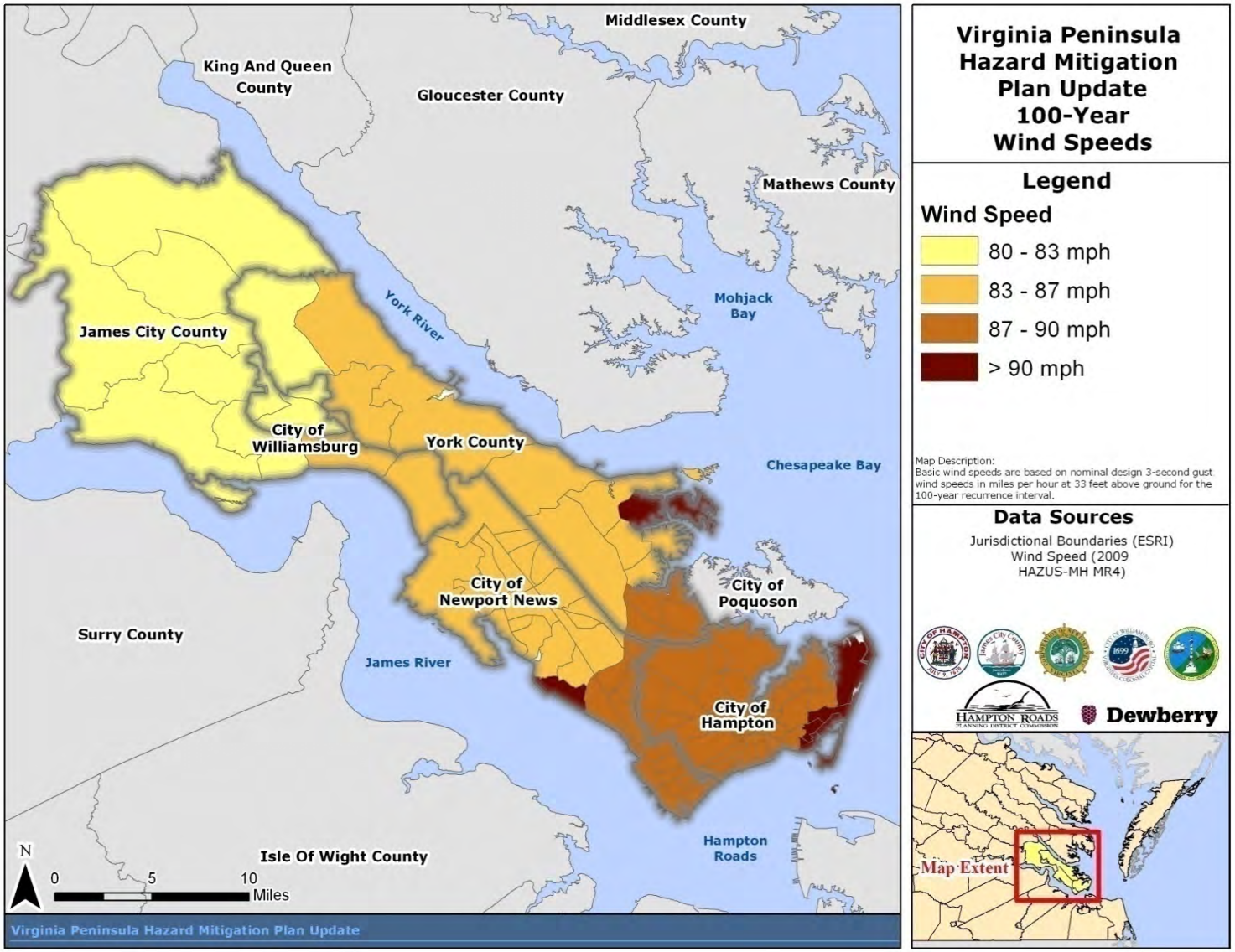

Figure 4-11: HAZUS 100-Year Hurricane Wind Speed

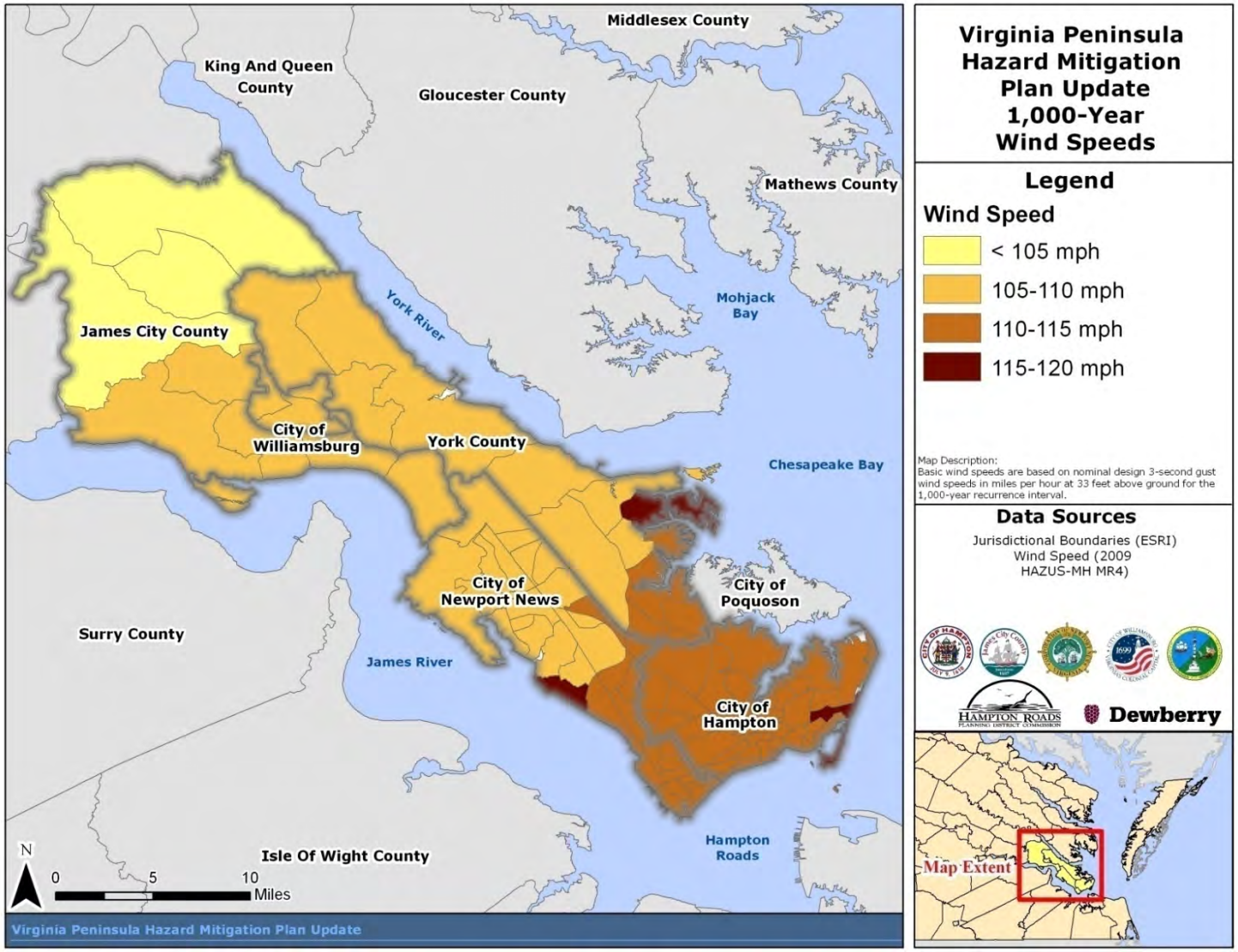

Figure 4-12: HAZUS 1000-Year Hurricane Wind Speed

Table 4-25 compares the HAZUS estimates of the number of residential and non-residential buildings in the five Peninsula jurisdictions participating in this hazard mitigation plan update that would be damaged in 100-year and 1,000-year hurricane/tropical storm events, and the extent of the damage. While a 100-year storm produces considerable minor damage, a much more powerful 1,000-year storm has the potential to be very destructive with possibly over 1,600 buildings being destroyed.

Table 4-25: HAZUS Estimated Number of Buildings Damaged

Category Name	100-Year Storm			1,000-Year Storm		
	Minor	Severe	Destroyed	Minor	Severe	Destroyed
Residential	7,258	15	16	34,943	1,909	1,625
Non-Residential	7,615	20	16	36,786	2,283	1,635

Overall HAZUS Results

The probabilistic HAZUS-MH hurricane analysis predicts that the Peninsula can expect $9,666,524 in damages due annually to hurricane wind events. Table 4-26 illustrates the expected annualized losses from hurricane wind broken down by jurisdiction.

Of the five Peninsula jurisdictions participating in this plan update, the annualized hurricane wind losses are estimated to be highest for the City of Hampton ($4,050,425), followed by City of Newport News ($3,799,682). As a result of their being located further inland, relatively lower annualized hurricane wind losses are estimated for the City of Williamsburg ($128,236) and James City County ($695,747). York County is estimated to experience approximately $993,434 in annualized losses due to hurricane wind. Tables 4-27 through 4-30 show detailed, alternative break-downs of the HAZUS estimated losses and include losses listed by jurisdiction, building type, and occupancy type.

For example, property or “capital stock” losses make up about $8,325,914 of the damages. This includes the values for buildings, contents, and inventory. Business interruption accounts for nearly $1,340,609 of the annualized losses and includes income, rental, wage, and relocation costs.

Building value accounts for approximately 70% of the expected annualized damages. It is very apparent that residential occupancy makes up the vast majority of these losses (over 85%; See Table 4-28 and Figure 4-14). More than 63% of the buildings are categorized as wood frame and 27% masonry

construction. Tables 4-27 and 4-28 summarize the property losses and business interruption losses shown by building type and occupancy. The slight differences in the annualized losses for building type and occupancy can be attributed to the HAZUS classification methodology.

Table 4-26: Jurisdiction-based HAZUS Hurricane Wind Annualized Loss								
Jurisdiction	Building	Content	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
James City County	$520.219	$93.232	$1.220	$50.478	$4.987	$20.231	$5.380	$695.747
York County	$731.545	$141.748	$1.440	$73.770	$6.343	$28.842	$8.745	$992.434
City of Hampton	$2,804.220	$668.902	$7.863	$344.155	$29.089	$153.660	$42.535	$4,050.425
City of Newport News	$2,658.293	$578.773	$9.669	$299.077	$37.338	$164.729	$51.802	$3,799.682
City of Williamsburg	$92.567	$16.137	$0.085	$8.717	$1.789	$6.318	$2.622	$128.236
Total Annualized Loss	$6,806.84	$1,498.79	$20.27	$776.19	$79.54	$373.78	$111.08	**$9,666.52**

Values in Thousands of Dollars

Table 4-27: HAZUS Hurricane Wind Annualized Loss by Building Type								
General Building Type	Building	Content	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
CONCRETE	$83.107	$31.125	$2.517	$20.034	$6.821	$17.070	$11.008	$171.682
MASONRY	$1,905.301	$413.021	$4.190	$204.954	$22.181	$103.794	$31.710	$2,685.150
MH	$68.399	$12.218	$0.000	$8.338	$0.000	$1.263	$0.000	$90.219
STEEL	$306.969	$140.680	$11.781	$59.215	$32.934	$32.722	$45.713	$630.014
WOOD	$4,443.068	$901.748	$1.788	$483.657	$17.610	$218.930	$22.654	$6,089.458
Total Annualized Loss	$6,806.84	$1,498.79	$20.27	$776.19	$79.546	$373.78	$111.08	**$9,666.52**

Values in Thousands of Dollars

Table 4-28: HAZUS Hurricane Wind Annualized Loss by Occupancy Type								
Occupancy Type	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Residential	$6,126.499	$1,184.604	$0.000	$647.610	$1.936	$316.183	$4.563	$8,281.395
Commercial	$442.574	$186.791	$4.909	$92.521	$67.718	$52.564	$69.949	$917.025
Industrial	$102.522	$71.750	$14.788	$8.602	$1.781	$1.470	$2.933	$203.845
Non-Profit	$62.612	$22.273	$0.000	$11.192	$5.669	$0.981	$13.328	$116.055
Education	$33.899	$15.866	$0.000	$8.108	$2.001	$0.432	$4.709	$65.015
Government	$22.500	$10.845	$0.000	$6.724	$0.355	$2.092	$15.569	$58.085
Agricultural	$7.214	$3.628	$0.580	$1.441	$0.087	$0.057	$0.034	$13.041
Total Annualized Loss	$6,797.820	$1,495.755	$20.277	$776.198	$79.546	$373.780	$111.085	**$9,654.461**

Values in Thousands of Dollars

Figure 4-13 graphically shows the HAZUS hurricane wind annualized loss results for the Peninsula by census tract. The darkest brown color on the figure over easternmost portions of the City of Hampton indicates loss by tract of greater than $300,000 annually, while the next lightest shade of brown shows that annualized losses of $200,000 to $300,000 by census tract would be possible over other sections of the Cities of Hampton and Newport News. Figure 4-14 breaks the analysis down further and shows annualized residential losses due to hurricane wind. The figure clearly illustrates that residential buildings would bear the brunt of the total annualized loss due to hurricane winds. Jurisdiction specific loss HAZUS maps are available in Appendix E2.

Tables 4-29 and 4-30 summarize the annualized loss values by jurisdiction. These values are broken down by building type and general occupancy for comparison. Total exposure has been included as a reference point for damages. Newport News, for instance, has approximately $9.7 billion in building assets at risk, while annualized hurricane wind losses for that jurisdiction are estimated at $3.8 million.

Table 4-31 presents a comparison of annualized losses by jurisdiction found by using NCDC data and those estimated as a result of running a HAZUS hurricane wind analysis. Total annualized losses calculated using NCDC historical data totals to approximately $14.3 million for the five participating Peninsula jurisdictions, while annualized losses estimated by HAZUS total approximately $9.7 million. NCDC annualized loss calculations are based on loss estimates for tropical storms and hurricanes that have occurred since the mid 1990s. HAZUS annualized loss, on the other hand, is developed by aggregating the losses and exceedance probabilities for the 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year return periods for hurricane winds.

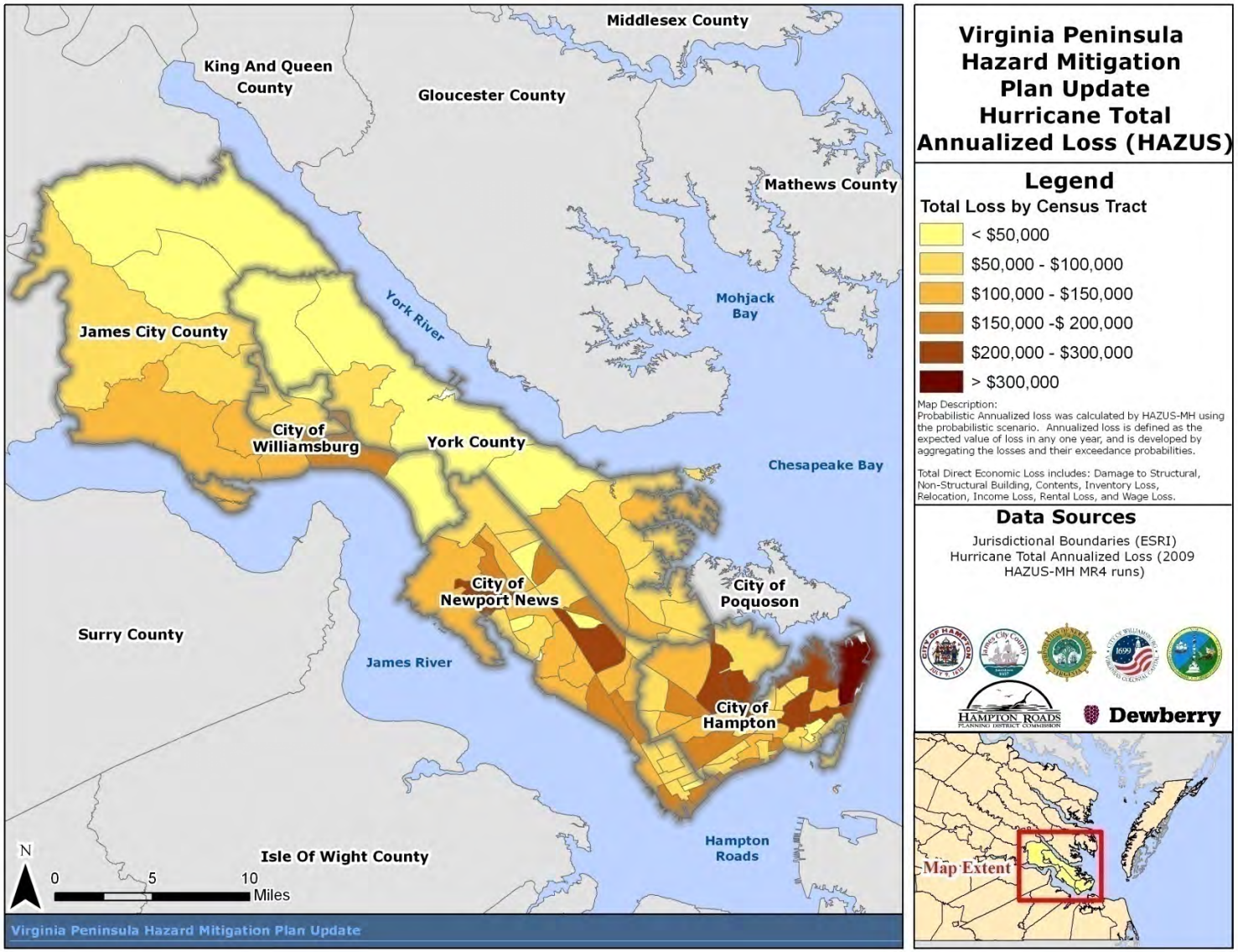

Figure 4-13: HAZUS Hurricane Wind Total Annualized Loss

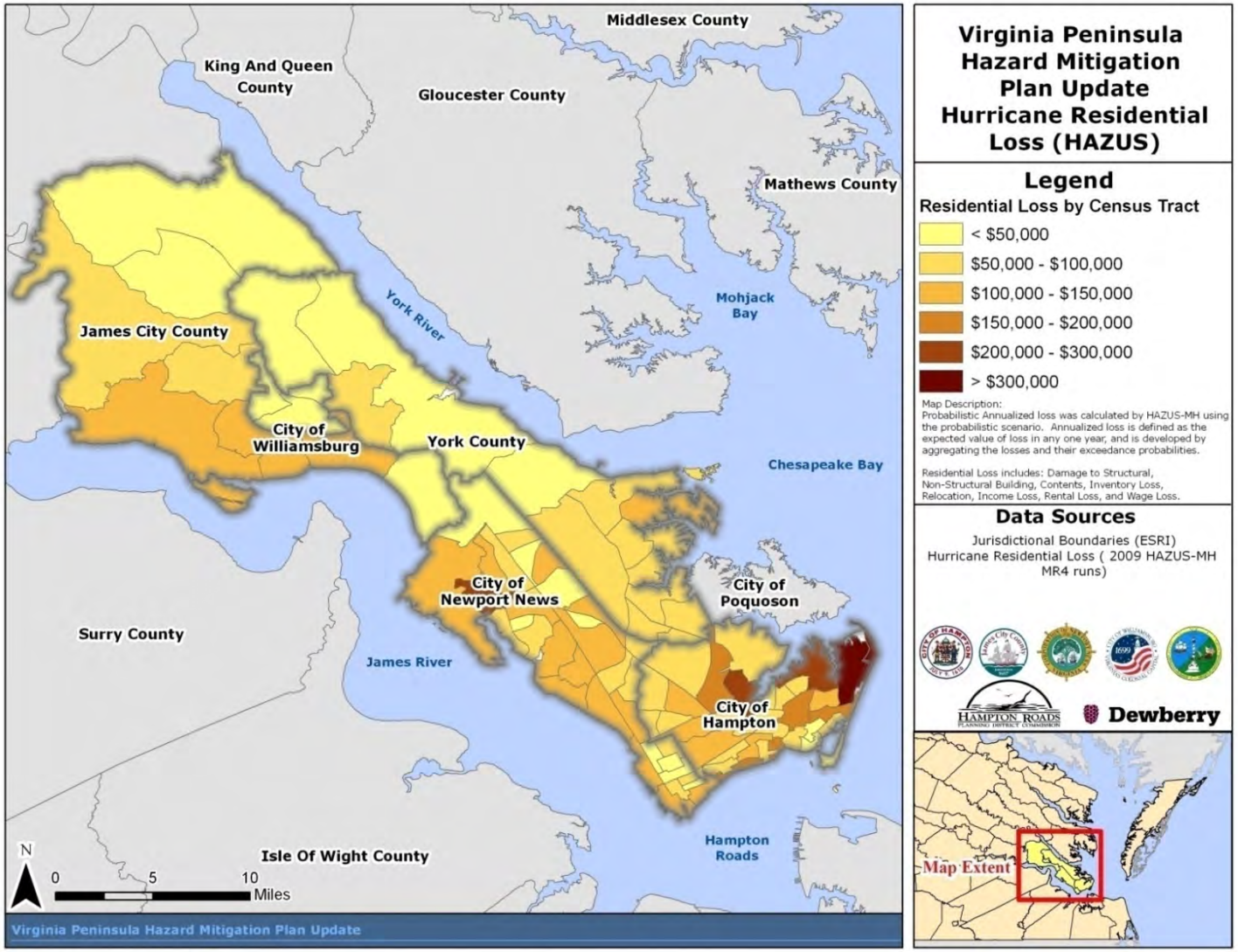

Figure 4-14: HAZUS Hurricane Wind Annualized Residential Loss

Table 4-29: Jurisdiction-based HAZUS Hurricane Wind Annualized Loss by Building Type							
Jurisdiction	Total Exposure*	Concrete	Masonry	Manufactured Homes	Steel	Wood	Annualized Loss
James City County	$3,688,648	$9.310	$187.254	$15.356	$41.838	$441.989	$695.747
York County	$3,597,294	$9.724	$260.931	$5.900	$45.415	$670.464	$992.434
City of Hampton	$7,515,154	$63.343	$1,108.545	$28.355	$236.724	$2,613.458	$4,050.425
City of Newport News	$9,720,792	$82.754	$1,086.439	$40.073	$290.135	$2,300.281	$3,799.682
City of Williamsburg	$836,787	$6.551	$41.981	$0.534	$15.903	$63.267	$128.236
Annualized Loss		$171.682	$2,685.150	$90.219	$630.014	$6,089.458	**$9,666.524**

Values in Thousands of Dollars

**Based on General Building Type Exposure*

Table 4-30: Jurisdiction-based HAZUS Hurricane Wind Annualized Loss by Occupancy Type									
Jurisdiction	Total Exposure	Residential	Comm-ercial	Indust-rial	Non-Profit	Education	Govern-ment	Agri-culture	Annualized Loss
James City County	$6,845,383	$596.298	$82.244	$10.546	$3.874	$1.795	$1.868	$1.258	$697.883
York County	$6,339,849	$883.621	$71.496	$14.054	$11.556	$4.077	$3.120	$2.270	$990.194
City of Hampton	$13,538,018	$3,530.251	$332.945	$77.933	$43.364	$24.449	$31.754	$4.499	$4,045.195
City of Newport News	$18,264,166	$3,167.013	$410.010	$100.718	$56.072	$33.546	$20.235	$4.929	$3,792.523
City of Williamsburg	$1,719,510	$104.212	$20.331	$0.594	$1.189	$1.149	$1.107	$0.085	$128.667
Annualized Loss		$8,281.395	$917.025	$203.845	$116.055	$65.015	$58.085	$13.041	**$9,654.461**

Values in Thousands of Dollars

**Based on General Occupancy Exposure*

Table 4-31: NCDC Versus HAZUS Hurricane Wind Annualized Loss						
Jurisdiction	NCDC Total Annualized Losses	NCDC Annualized Property Losses	NCDC Annualized Crop Losses	HAZUS Total Annualized Losses	HAZUS Annualized Building Losses (Building and Contents)	HAZUS Annualized Agricultural Losses
James City County	$2,629,539	2,383,613	$245,926	$697,883	$613,451	$1,258
York County	$2,926,931	2,646,364	$280,567	$990,194	$873,293	$2,270
City of Hampton	$2,926,883	2,646,316	$280,567	$4,045,195	$3,473,122	$4,499
City of Newport News	$2,926,883	2,646,316	$280,567	$3,792,523	$3,237,066	$4,929
City of Williamsburg	$2,926,931	2,646,364	$280,567	$128,667	$108,704	$85
TOTALS	**$14,337,167**	**12,968,975**	**$1,368,192**	**$9,654,461**	**$8,305,636**	**$13,041**

Hazard Ranking

Based on the ranking methodology used for this plan update, Hurricane/Tropical Storm risk is considered to be High for all five participating jurisdictions (see Table 4-35 and Figure 4-16).

Critical Facility Risk

Critical facilities were intersected with the HAZUS 1,000-year wind speeds. All of the critical facilities were located within Category 2 or 3 wind speed zones for the 1,000-year scenario. The results, summarized by sustained wind speed, of this are shown in Table 4-32. The facilities located within Category 3 wind speeds are summarized below with the estimated wind speed also shown. York County has the highest number of facilities within the 111 – 130 zone; it should be noted that the majority of these facilities are categorized as sewers.

City of Hampton:

- Hampton Fire Station #4 (116.20 mph)
- Dry Pit 011-PS (114.80 mph)
- Langley Square Field Office (114.40 mph)

City of Newport News:

- Conway Place (115.10 mph)
- Hidenwood Elementary (115.10 mph)
- Riverside Elementary (115.10 mph)

York County:

- Station #6 Seaford Fire Station (116.10 mph)
- Sprintcom Tower (116.10 mph)
- Seaford Baptist Church Tower (116.10 mph)
- Hampton Roads Sanitary District Treatment Plant(116.10 mph)
- York County School Division/Seaford Elementary backup shelter (116.10 mph)
- Seaford Vac Station Sewer(116.10 mph)
- Sommerville Sewer (116.10 mph)
- Moss Avenue Sewer (116.10 mph)
- York Point Vacuum Sewer (116.10 mph)
- Baytree Beach Road Lift Station Sewer (116.10 mph)

Table 4-32: Number of Critical Facilities located within 1000-year Hurricane Wind Speeds			
Jurisdiction	Number of Facilities	1,000-year Wind Speeds	
		Category 2 (96 - 110 mph)	Category 3 (111 - 130mph)
City of Hampton	68	67	
James City County	31	30	
City of Newport News	181	103	76
City of Williamsburg	28	2	
York County	182	157	25
Total	**490**	**359**	**101**

Table 4-33 shows the number of critical facilities at risk of storm surge inundation by jurisdiction and hurricane category. It should be noted that the totals depicted in the table are cumulative. For instance, all the critical facilities at risk of Category 4 storm surge are also at risk of inundation in Category 1, 2 and 3 events as well. Also, storm surge zones were not delineated for a number of facilities, each of which is listed in the far right column of the table.

There are approximately 146 critical facilities at risk of Category 4 hurricane storm surge. On the other end of the scale, there are approximately 19 critical facilities in danger of inundation from a Category 1 hurricane storm surge. Figure 4-15 is a graphical representation of the various storm surge zones with critical facilities locations overlaid. Jurisdiction specific mapping of storm surge and critical facilities is available in Appendix E3.

There are a total of 491 critical facilities (as identified through GIS data provided by each jurisdiction) located within the participating jurisdictions and, thereby, within the “High” risk hazard area. In addition to police, fire, hospitals, and other facilities, utility companies and the services they provide also have significant potentially vulnerable assets. For instance, Hampton Roads Sanitation District has over $1.4 billion in infrastructure (pipes, stations, treatment plants, etc.) exposure. Newport News Waterworks has approximately $715 million in infrastructure exposure. It is clear from this analysis that significant tropical storm/hurricane events have the potential to be very disruptive in terms of potentially knocking a considerable number of critical facilities and the services they provide offline.

Table 4-33: Cumulative Number of Critical Facilities in Mapped Storm Surge Zones					
	Hurricane Storm Surge Category				
Jurisdiction	1	2	3	4	Facilities Not Studied
City of Hampton	7	36	54	57	1 (Langley Air Force Base)
City of Newport News	2	7	24	41	2 (Fort Eustis & General Stanford Elementary School)
York County	10	39	45	48	5 (Camp Peary, Naval Supply Center Cheatham Annex, U.S. Coast Guard Training Center, Naval Weapon Station Yorktown)
Total	**19**	**82**	**123**	**146**	**8**

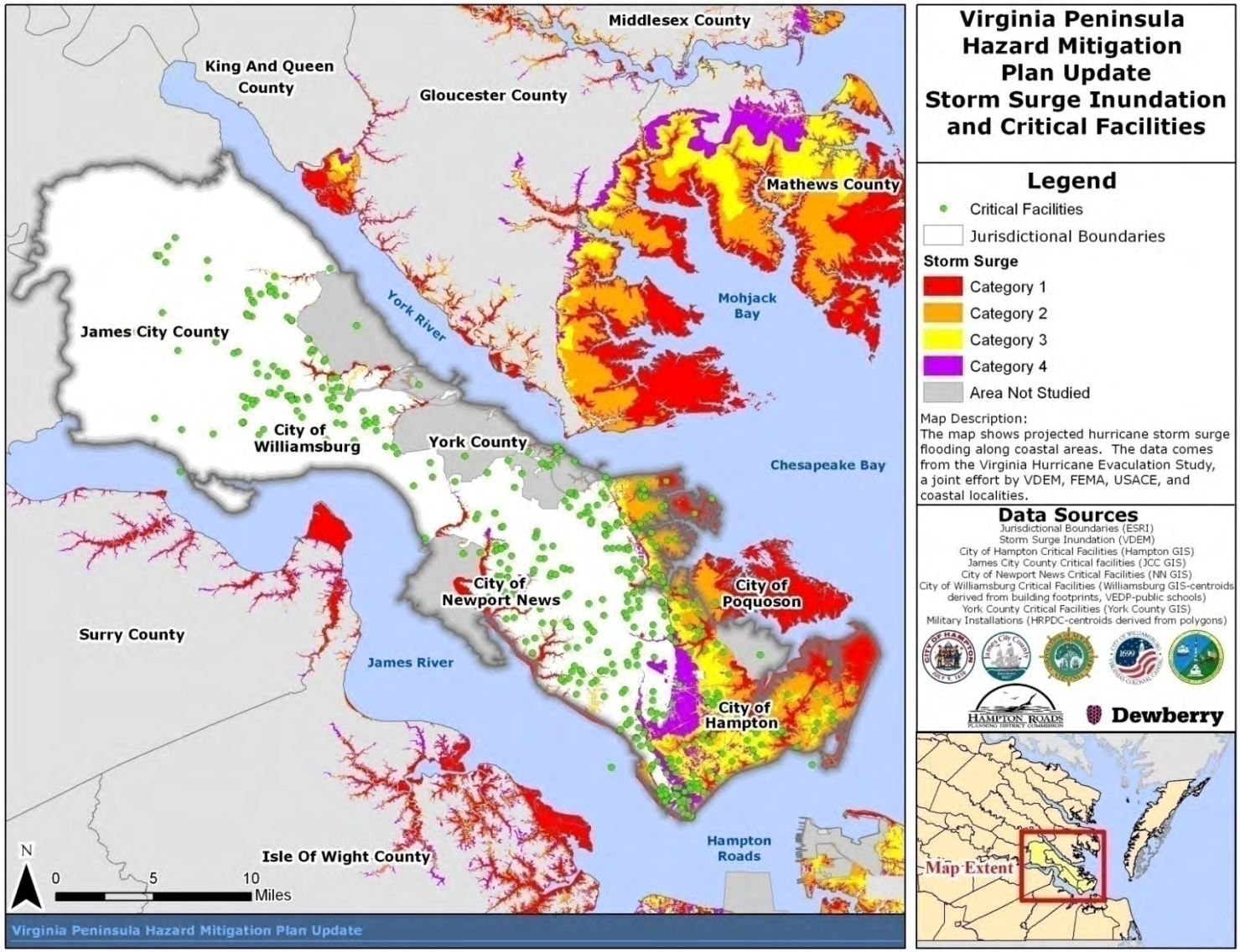

Figure 4-15: Storm Surge Inundation and Critical Facilities

Existing Buildings and Infrastructure Risk

The most at-risk buildings to high wind events are assumed to include manufactured homes, along with residential structures that were built many years ago (due to probable deterioration and less stringent building code enforcement during original construction).

Apparent in the HAZUS analysis, residential buildings make up the majority of damages due to hurricane winds. The more frequent return periods result in fewer damages that fall within the moderate to destruction classifications. The 1,000-year return period results in severe damage and destruction to thousands of buildings in the Peninsula region (see Table 4-34).

Building footprint locations were provided by each of the participating jurisdictions. This GIS data was utilized to determine the number of buildings located within the mapped storm surge categories by intersecting the two layers. The building data provided for the 2011 update did not contain information of building improvement value or total property value.

The Peninsula has over 237,303 mapped building footprints.

Approximately 43% of the buildings on the Peninsula are located, cumulatively, within Category 4 storm surge.

The majority of the buildings located within Category 4 storm surge reside in the City of Hampton. Over 54% of the buildings on the Peninsula are located in areas where there is currently no mapped storm surge. Table 4-34 below summarizes the number of buildings mapped for each jurisdiction and the cumulative number of buildings located within mapped storm surge categories.

Table 4-34: Cumulative Building Footprints in Mapped Storm Surge Zones						
Jurisdiction	Hurricane Storm Surge Category					
	Number of Buildings	1	2	3	4	Non-Surge Zone / Not Studied
City of Hampton	81,838	7,098	40,229	61,893	73,953	7,885
James City County	34,816	-	-	-	-	34,816
City of Newport News	79,794	624	3,727	9,753	16,807	62,987
City of Williamsburg	6,433	-	-	-	-	-
York County	34,422	3,162	8,766	11,299	12,058	22,364
Total	**237,303**	**10,884**	**52,722**	**82,945**	**102,818**	**128,052**

Hazard Summary

Winds associated with tropical storms and hurricanes pose a significant threat to the Peninsula. Annualized total losses for the Peninsula range from $9.7 million based on HAZUS analysis to $14.3 million based on historical NCDC data. HAZUS estimates annualized losses to be highest in the City of Hampton at $4.1 million, followed closely behind by the City of Newport News at $3.8 million.

Based on the ranking methodology used for this plan update, Hurricane/Tropical Storm risk is considered to be High for all five participating jurisdictions (see Table 4-35 and Figure 4-16).

Table 4-35: Hurricane / Tropical Storm Summary			
Jurisdiction	Hazard Ranking	HAZUS Potential Annualized Losses	NCDC Potential Annualized Losses
James City County	High	$695,747	$2,629,539
York County	High	$992,434	$2,926,931
City of Hampton	High	$4,050,425	$2,926,883
City of Newport News	High	$3,799,682	$2,926,883
City of Williamsburg	High	$128,236	$2,926,931
	TOTAL	**$9,666,524**	**$14,337,167**

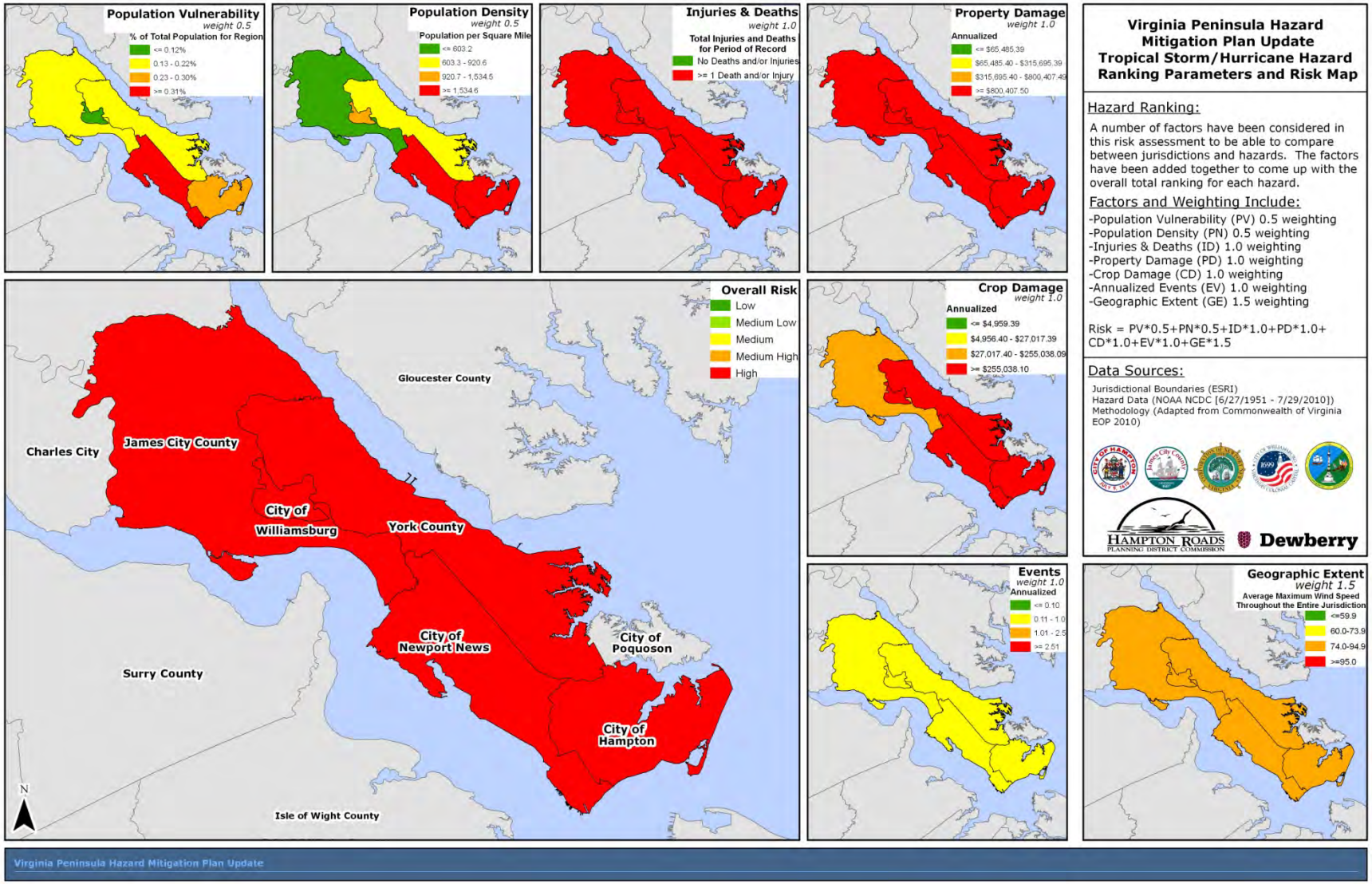

Figure 4-16: Hurricane/Tropical Storm Ranking

Flooding

Hazard Profile

NOTE: As part of the 2011 plan update, the flood, coastal flooding, urban flooding, flash flooding, riverine flooding coastal erosion, sea level rise, tsunami and dam inundation hazards were consolidated, reexamined, and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profiles; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the flood hazard by jurisdiction using the methodology described in detail in the HIRA Introduction section. Each section of the plan was also reformatted for improved clarity, and new maps and imagery were inserted when available and appropriate.

Description

Flooding is the most frequent and costly natural hazard in the United States. The majority of presidential disaster declarations result from natural events, in which flooding is a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains—lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods. While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP) (Figure 4-19), floods can go beyond the mapped floodplains or change courses due to natural processes (e.g., accretion, erosion, sedimentation) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness within the watershed from new development, or waterway blockage from debris including trees, cars, trailers, and propane tanks).

There are four types of flooding in Virginia: coastal flooding, urban flooding, flash flooding, and riverine flooding. Due to its geographic location within the coastal plain and its rapid population growth, the Peninsula area is susceptible to all four types of flooding.

Coastal erosion, sea level rise, tsunami, and dam inundation have also been included as separate descriptions in this sub-section. When applicable, additional analysis is presented later in the risk assessment sub-section.

The majority of watersheds of the Peninsula are part of the Chesapeake Bay (Figure 4-17). About 60% of the Commonwealth drains into the Chesapeake, the world's most productive estuary.[17] James City County and

the City of Williamsburg are completely within the James River and York River watersheds. York County has three watersheds, York River, James River, and Chesapeake Bay Coastal, within its boundaries. The cities of Newport News and Hampton are contained within the James River and Chesapeake Bay Coastal watersheds.

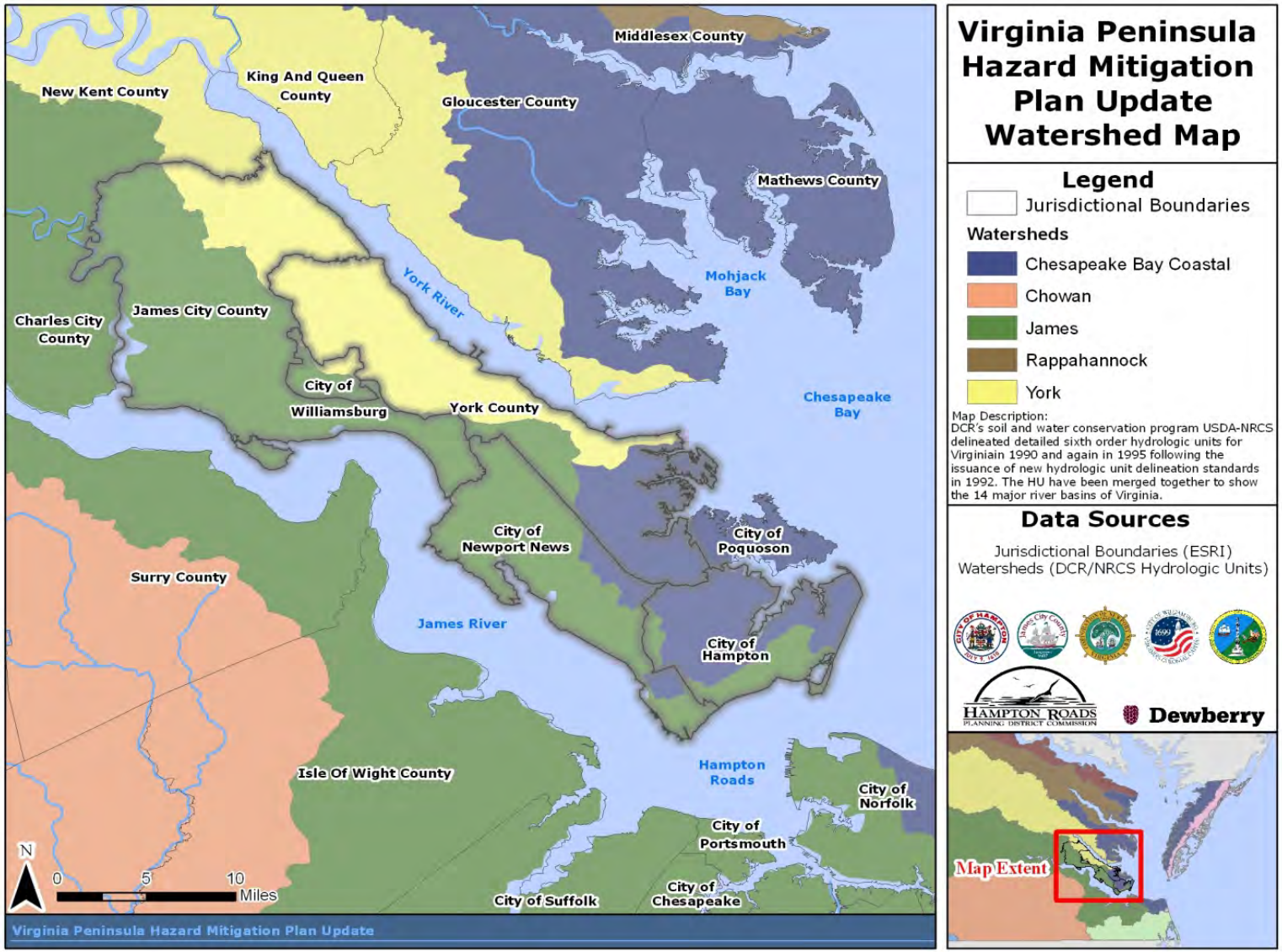

Figure 4-17: Watersheds of the Peninsula

Coastal Flooding

Coastal flooding (or tidal flooding) results from higher than average tides along coastal areas. This usually occurs during passing tropical systems and nor'easters. The high winds produced by these events can pile water on the shorelines. If this occurs at the time of the astronomical high tide, the flooding is amplified and will inundate low-lying areas along the shorelines.

Urban Flooding

Urban flooding occurs in heavily developed areas where impervious surfaces do not allow water to be absorbed into the ground, thereby increasing the amount of water runoff. If areas are without proper drainage, or storm drains become clogged, then streets become streams and water will gather in low-lying areas. If it rains hard enough, underpasses can rapidly fill, trapping motorists, and streets can accumulate enough water to submerge cars or carry them wherever the water flows.

Flash Flooding

Flash floods occur in a short period of time, or in a "flash." Rain falls at such a high rate that water does not have time to soak into the ground. Runoff flows downhill into ditches, lowlands, and small streams. As the heavy rain continues, ditches overflow, drains backup, water ponds in lowlands, and streams rise over their banks. Streams and creeks can become raging rivers in just minutes. People are often caught off guard, especially motorists. Half of flash flood deaths in the United States are in automobiles.

Riverine Flooding

Riverine floods occur when heavy rains fall over a large area. In many cases in Virginia, it begins as widespread flash flooding of small streams. About 60% of Virginia's river floods begin with flash flooding from tropical systems passing over or near the state. River flooding also occurs as a result of successive rainstorms. Rainfall from any one storm is generally not enough to cause a problem, but with each successive storm's passage over the basin, the river rises until eventually it overflows its banks. If it is late winter or spring, melting snow in the mountains can produce added runoff that can compound flood problems downstream.

Frequent flash flooding and urban flooding on the Peninsula is often caused by powerful thunderstorms that can dump 1 to 4 inches of rain in a few hours. Small creeks and streams as well as over-burdened drainage systems often cannot cope with the rapid influx of rain waters, especially

when runoff is increased through urbanization of the watershed, or poor infiltration of precipitation due to overly wet or dry soils. The banks of non-tidal streams may quickly overtop, resulting in flooded roads and intersections and occasional property damage. The topography of much of the Peninsula is relatively flat and low-lying, which further hinders effective disbursement of runoff.

Coastal Erosion

Mechanical, chemical, and biological agents contribute to the wearing away or removal of coastal lands, resulting in a landward retreat of the shore. This process is known as erosion. The exposed coastline of the Peninsula is subject to severe erosion during tropical storms, nor'easters, and winter storms. High waves and strong currents initiate coastal erosion, while breaking waves contribute to the process by suspending sediment particles and dislodging rocks. When the forces causing erosion occur at high tide, and especially during spring high tide, the resultant flooding and overwash can significantly increase the land loss and property damage.[18] The erosion of unconsolidated sediments and tidal wetlands throughout the Peninsula is a recurring hazard; however, private property losses and shoreline erosion are rarely quantified. The Virginia Institute of Marine Science continues to research the hazard and maintains much data for the Gloucester Point area north of the Peninsula.

Tropical systems, nor'easters, and winter storms generate breaking waves and strong currents that have the effect of contributing new sediment to the littoral system and redistribute pre-existing sediments over large areas of the shoreface. A variety of factors, including beach composition and storm characteristics, determine how beaches are affected by storms. For example, retreat of bluffs and muddy shores occurs in an episodic, stepwise pattern without any seaward advancement between retreat events, as has historically occurred along the York River near Yorktown. Sandy beaches, like Buckroe Beach and Grandview in Hampton, tend to partially recover after storms.[19]

The impacts of natural and human activities on the shoreline can be measured by erosion rates, which are used to determine the most appropriate method to address erosion. The Chesapeake Bay Local Assistance Department suggests classifying eroding shorelines as slight (less than 1 foot per year), moderate (1 to 3 feet per year), or severe (more than 3 feet per year.)

York County is unique among Peninsula communities because the shoreline erosion hazard has historically caused more damage and has the potential

for additional damage in the future. The hazard, however, is pertinent from a land use perspective only, and poses little threat to human life, health, or safety. Furthermore, the erosion hazard is a secondary hazard caused by storms and sea level rise. The uniqueness of York County's erosion hazard merits additional consideration in this section, and is also discussed and mapped in detail in the County's 2025 Comprehensive Plan, which should be referenced for additional information and graphics. The information below is taken primarily from the Comprehensive Plan.

York County's shoreline consists of sheltered fine sand beaches, coarse sand beaches, exposed tidal flats, sheltered tidal flats, fringing intertidal marshes, supra-tidal marshes partially protected by elevation, and freshwater marshes and swamps. There are approximately 2,308 acres of marshes in the County.

York County encompasses approximately 207 miles of shoreline. The upper County drains via a system of streams and rivers, to the southern reach of the York River. This area is characterized by rolling terrain with well-drained soils and elevations up to 100 feet above mean sea level. In isolated areas, moderate to severe erosion has been noted. The lower County drains via a system of creeks and rivers to the Chesapeake Bay. The lower County section of shoreline includes Wormley Creek, Back Creek, Chisman Creek, a portion of the Poquoson River, and the western shore of the Chesapeake Bay. Low flat lands with a relatively high water table characterize the topography of the lower County.

In York County, the western shore of the Chesapeake Bay presents a unique challenge. The two areas with severe erosion are Reach 109 (the Bay Tree Beach/York Point area) and Reach 30 (the Waterview Road area west of the entrance to the Thorofare), both of which historically experience moderate to severe erosion rates of up to 3.5 feet per year. Although there is residential and industrial development along both of these shorelines, the erosion does not appear to be associated with the development. Most of the homes were built more than 10 years ago and are set back from the shoreline, although some homes along Dandy View Lane and Waterview Road are endangered. The erosion is due in large part to wave action associated with the physical alignment of the shore and prevailing storms. The York County Wetlands Board has approved several permits along Reach 30 for riprap, breakwaters, and marsh toe stabilization structures. The Bay Tree Beach area is much less developed than the Sandbox area. Most of these properties are not developed because the soils and high water table preclude on-site sewage disposal systems.

The rate of erosion in the remainder of the County along the York River is slight to moderate. The shoreline at the mouth of the river is vulnerable to the high-energy waves generated by the dominant northeast storms. The Yorktown historical area and recreational beach are along this shoreline. There is an ongoing project to stabilize the beach with a combination of methods, including riprap, breakwaters, beach nourishment, and vegetation. In addition, just south of Yorktown, the National Park Service is pursuing a project to stabilize the shoreline at the base of the significant bluff in the Moore House Road area.

Sea Level Rise

Rising sea levels pose a significant threat to coastal areas. Sea level rise can occur through one or more of three processes that include land subsidence, the melting of ice sheets and thermal expansion of water as a result of warming.

Protecting tidal structures and wetlands against sea level rise may mean more active management at the local level, including techniques to ensure adequate elevation of structures and adequate erosion and sediment control measures. FEMA estimates that, the number of households subject to flooding would increase from about 2.7 million now, to 5.7 million by 2100, as a result of the combination of a 1-foot sea level rise and projected coastal population growth. Under a 3-foot sea level rise scenario, the estimate increases to 6.8 million households impacted by flooding.[20]

Over time, sea level may also change the physical characteristics of the region's floodplains. One way in which Peninsula communities may wish to address this gradual threat is by examining floodplain management ordinances to consider the inclusion of more stringent freeboard requirements for new development or substantial improvements in the floodplain. Sea level rise further exacerbates coastal erosion by causing the boundary between land and water to recede and move inland. Examination of current land use and land use planning and consideration of sea level rise in coastal projects will become increasingly important.

Sea level rise can be expected to have a major impact, over time, in the region. Because much of the coastal land area in the region lies at elevations at or below seven feet mean sea level, any increase in the mean low water level of the Chesapeake Bay and surrounding tidal rivers and estuaries has a direct impact on coastal lands. These impacts may include the potential for increased erosion, loss of coastal zone lands through permanent inundation, including wetlands, and a potential for increased damages from coastal storms.

Research conducted by NOAA indicates that, during the period 1854 to 1999, sea level in the Chesapeake Bay region has risen from 1.30 to 1.45 feet.[21] The monthly mean sea level and sea level trend at Sewells Point, Virginia, from 1928 through 2007 indicates a rise of 4.42 millimeters per year or approximately 1.45 feet per century.[22] The rising sea level trend is attributed to two primary sources: a slow, gradual rise in ocean levels, and land subsidence caused primarily by natural geologic processes and, in localized areas, by groundwater withdrawal.[23] By weighing the impact of future potential sea level rise, as well as the future storm impacts when making future land use decisions, the region has the opportunity to take a more proactive approach to regulatory protections. Sea level rise can be expected to continue through the foreseeable future, which warrants continued vigilance at the local level; however, reducing the rate of sea level rise is outside the realm of local control (Boesch *et al*, undated).

As part of a study conducted by the Environmental Protection Agency,[24] land use planning data and input from local planners along with relevant government policies were examined in order to divide coastal land (dry) into four different likelihoods of shoreline protection. The result is mapping that indicates which coastal areas are most likely to see active protective measures put into place to prevent reclamation of the land due to sea level rise and which areas are likely to be lost to it. The study assumed the continuation of current policies and practices. A map produced as part of the study may be found in Appendix E3.

At least two major climate change study efforts are currently underway in the region. A 3-year study to examine the impacts of climate change in Hampton Roads is ongoing. The study, led by the Hampton Roads Planning District Commission, is being funded in part by the Virginia Coastal Zone Management Program through a NOAA grant. In addition, the Department of Defense through its Strategic Environmental Research and Development Program (SERDP) is developing a multi-criteria, multi-hazard risk assessment framework for evaluating changes in risk to its coastal military installations in the Hampton Roads region due to climate change, focusing on sea level rise. The project, termed Risk Quantification for Sustaining Coastal Military Installation Assets and Mission Capabilities RC-1701 is expected to be complete in 2012. Future hazard mitigation plan updates should look to the results of these and other studies as a resource for providing current, localized insight into climate change, its potential impacts on the region as well as possible mitigation and adaptation options.

Tsunami

"Tsunami" is a Japanese word meaning "harbor wave" and is a water wave or a series of waves generated by an impulsive vertical displacement of the surface of the ocean or other body of water.[25] A tsunami can occur when a series of ocean waves are generated by a sudden displacement in the sea floor, landslides, or volcanic activity. In the ocean, the tsunami wave may only be a few inches high. The wave may come gently ashore or may increase in height to become a fast moving wall of turbulent water several meters high.[26]

Tsunamis, commonly called seismic sea waves-or incorrectly, tidal waves, have been responsible for at least 470 fatalities and several hundred million dollars in property damage in the United States and its territories. These events are somewhat rare and major tsunamis occur in the Pacific Ocean region only about once per decade.[27]

Tsunamis have occurred only rarely along the Atlantic Coast. The National Geophysical Data Center (NGDC) administered by NOAA maintains a database of worldwide tsunami events recorded since 2000 B.C. According to the NGDC database, there have been 39 events along the North American Atlantic coast that have generated tsunamis.

According to the most recent data, in order for a tsunami to impact the East Coast, an earthquake with a magnitude of 9.0 or greater would need to take place north of Puerto Rico. Although the chances of a tsunami impacting the coast are minute, it could potentially produce waves from four to six feet along the coast.[28] Klaus Jacob of the Lamont-Doherty Earth Observatory in New York estimated that a tsunami "has a lower than 1 in 1000 chance of occurring in eastern North America in any given year."[29]

Because of the irregularity of the Peninsula's coastline, a tsunami's effects would vary geographically. Along the Chesapeake Bay coastline, the effect would be similar to that of a nor'easter at high tide, with shoreline erosion and damage to docks and piers. Other effects would be beach erosion, dune and seawall overwash, coastal flooding and damage to low-lying properties. Along inner creeks and rivers that narrow in width inland, flooding would be amplified as the wave is confined to a more narrow space.[30]

Although earthquake-driven tsunamis pose some risk to the Peninsula, another source of tsunami action exists closer to home. Driscoll and

others[31] documented a large submarine landslide off the coast of Virginia. The Albemarle-Currituck Slide occurred approximately 18,000 years ago, involving over 33 cubic miles of material which slid seaward from the edge of the continental shelf, most likely causing a tsunami. Cracks in the continental shelf exist in this area, which may indicate slope failure and potential for another submarine landslide and subsequent tsunami of several meters in height. Impacts from a tsunami of this height would be similar to storm surge from a Category 3 or 4 hurricane.

Dam Inundation

For the purposes of this plan, dam failure is addressed as a natural hazard resulting in a flooding condition. Dam failure can occur if hydrostatic pressure behind a dam exceeds design capacity or the crest of the dam is over-topped and rushing flood water scours the base of the dam.

Dams that meet regulatory criteria in Virginia are regulated under the Dam Safety Act established by the Virginia Soil and Water Conservation Board (VSWCB) and administered by Virginia Department of Conservation and Recreation's (DCR) Division of Dam Safety and Floodplain Management Virginia Dam Safety Program.

Dams are assigned a hazard classification based on the downstream loss anticipated in the event of dam failure. Hazard potential is not related to the structural integrity of the dam. The hazard potential classification speaks to the level of risk to life and economic loss the dam imposes on downstream properties and facilities. Regulatory requirements, such as the frequency of dam inspection, the standards for spillway design, and the extent of emergency operations plans, are dependent upon the dam classification.

High Hazard Potential: Failure will cause probable loss of life or serious economic damage (to buildings, facilities, major roadways, etc.). Inspection by a professional engineer every 2 years.

Significant Hazard Potential: Failure may cause loss of human life or appreciable economic damage (to buildings, secondary roadways, etc.). Inspection by a professional engineer every 3 years.

Low Hazard Potential: Failure would result in no expected loss of human life, and cause no more than minimal economic damage Inspection by a professional engineer every 6 years.

The owner of each regulated high, significant, or low hazard dam is required to apply to the board for an Operation and Maintenance Certificate. The

application must include an assessment of the dam by a licensed professional, an Emergency Action Plan and the appropriate fee(s), submitted under separate cover. An executed copy of the Emergency Action Plan or Emergency Preparedness Plan must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management.[1]

The VSWCB issues Regular Operation and Maintenance Certificates to the dam owner for a period of six years. If a dam has a deficiency but does not pose imminent danger, the board may issue a Conditional Operation and Maintenance Certificate, during which time the dam owner is to correct the deficiency. After a dam is certified by the board, annual inspections are required either by a professional engineer or the dam owner, and the Annual Inspection Report is submitted to the regional dam safety engineer.

The Army Corps of Engineers (ACOE) currently maintains the National Inventory of Dams (NID)[32] which is also an online database that includes dams that **meet at least one** of the following criteria:

- high hazard classification
- significant hazard classification
- height of greater than 25 feet/15 acre-feet storage or
- 50 acre-feet storage/6 feet height.

There are 1,642 dams in the Commonwealth of Virginia, 184 are categorized as high hazard potential, 305 as significant hazard potential and 1,153 as low hazard potential in the ACOE NID database. There are currently 48 dams listed for the Peninsula in the NID database. Figure 4-18 shows the general locations of the dams located on and near the Peninsula. Information on downstream hazard potential and distance to the nearest downstream city/town is no longer available for query at the city/county level; this information can be obtained through local emergency management personnel. General information on dams on the Peninsula is available in Appendix E4.

Although the entire Peninsula could be affected by a catastrophic dam failure, those areas closest to the 48 dams in the region are more likely to feel the impacts of a dam failure. These dams are all located in York County, City of Newport News, and James City County. No dams were listed for the cities of Hampton and Williamsburg. Table 4-36 below highlights the main usage type for each of the dams. As shown in the table, the dams in the region are primarily used for recreation or water supply.

[1] Virginia DCR Dam Safety and Floodplain Management http://www.dcr.virginia.gov/dam_safety_and_floodplains/

Table 4-36: Dam Primary Purpose

Source: ACOE NID online database

Jurisdiction	Recreation	Water Supply	Flood Control	Irrigation	Other	Total
James City County	19	1	2	-	1	**25**
City of Newport News	3	3	-	2	-	**6**
York County	10	5	-	-	2	**17**
Total	**32**	**9**	**2**	**2**	**3**	**48**

The majority (52%) of the dams in the area are privately owned, followed by federally owned (29%) and local government (13%). Nine of the dams are greater than 25 feet in height. These include:

- Beechwood Dam (James City County)
- Brewery Road Dam (James City County)
- Jones Mill Pond Dam and Parkway (York County)
- Lake Nice (James City County)
- Little Creek Dam (James City County)
- Massie Farm Pond (James City County)
- Rennicks Pond (James City County)
- Upper Big Bethel Dam (York County)
- Waller Mill Dam (York County)

There are four dams with greater than 4,000 acre/feet storage and are primarily used for water supply. Newport News Waterworks owns three of the four dams; these include:

- Lee Hall Upper Dam Outlet (City of Newport News)
- Harwood Mills Dam (York County)
- Waller Mill Dam (York County)
- Little Creek Dam (James City County)

At the time of this update, there have been no major dam failures on the Peninsula.

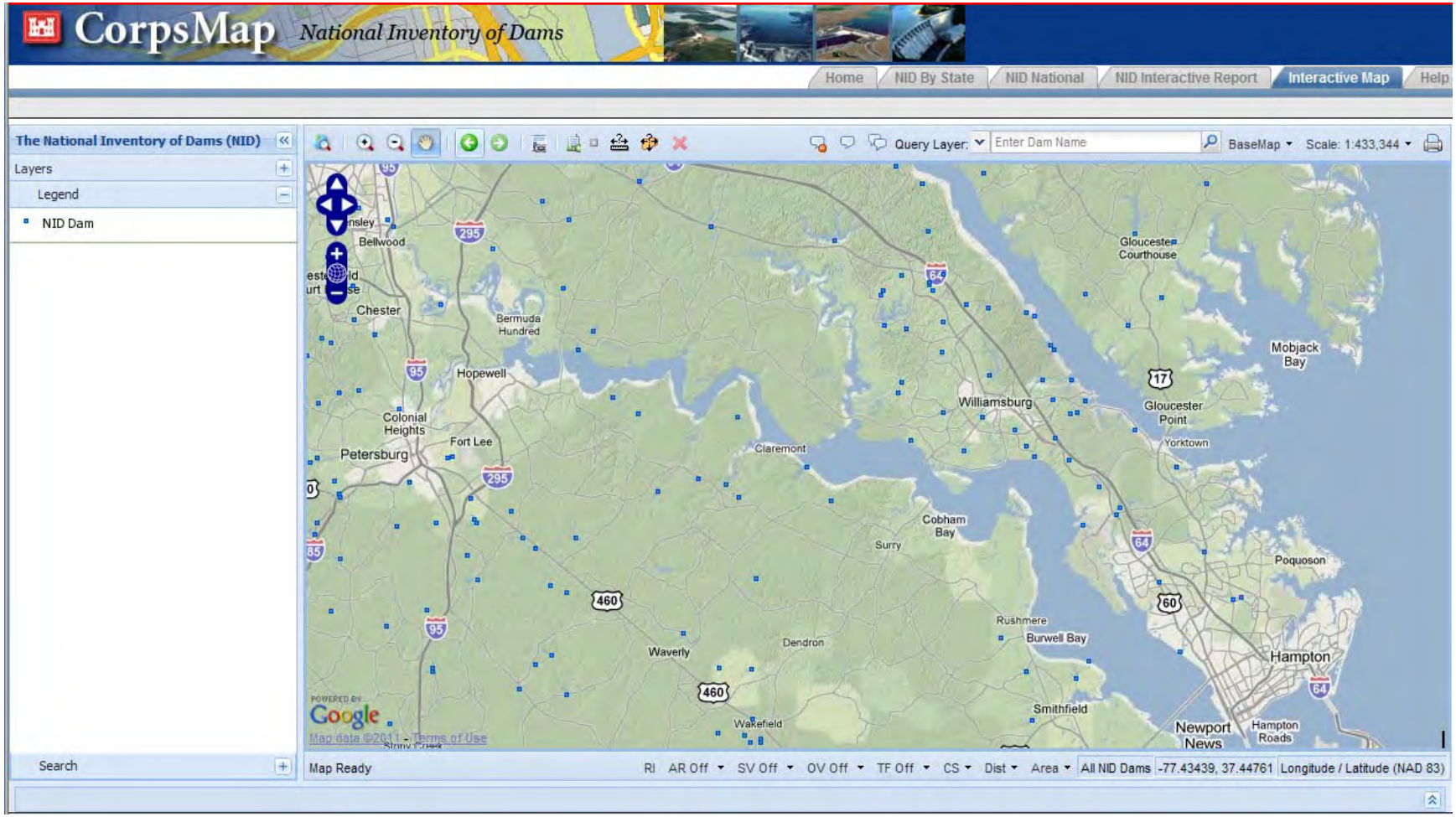

Figure 4-18: NID dam locations on and near the Peninsula.

Geographic Location / Extent

The Peninsula's geographic location makes it extremely susceptible to coastal flooding and non-tidal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independently of climactic conditions. Depending on the tide level at the time of landfall, storm surge may be elevated due to high tides or spring high tides. Flash flooding and urban flooding are also a concern on the Peninsula. Figure 4-19 shows the extent of the mapped FEMA Special Flood Hazard Areas (SFHA). Jurisdiction specific maps are available in Appendix E3.

Table 4-37 summarizes the number of events and the total damages recorded in the NCDC storm events database. During the past 16 years of record, the Peninsula has experienced over $43.9 million in property and crop damages due to flooding. The number of events does not indicate the total number for the Peninsula, the events listed for each jurisdiction may be the same event (i.e., Hurricane Isabel impacted each of the jurisdictions and would count as one event per jurisdiction).

Table 4-37: Flood Events on the Peninsula, 1994–2010 based on NCDC storm events data

Jurisdiction	# of Flood Events	Property Damage	Crop Damage	Property + Crop Damage
James City County	12	$486,313	$432,279	$918,592
York County	24	$12,806,520	$0	$12,806,520
City of Hampton	26	$8,963,749	$0	$8,963,749
City of Newport News	27	$8,520,927	$0	$8,520,927
City of Williamsburg	18	$12,733,015	$0	$12,733,015
	Total	**$43,510,524**	**$432,279**	**$43,942,802**

**does not represent total events for Peninsula but events recorded by jurisdiction.*

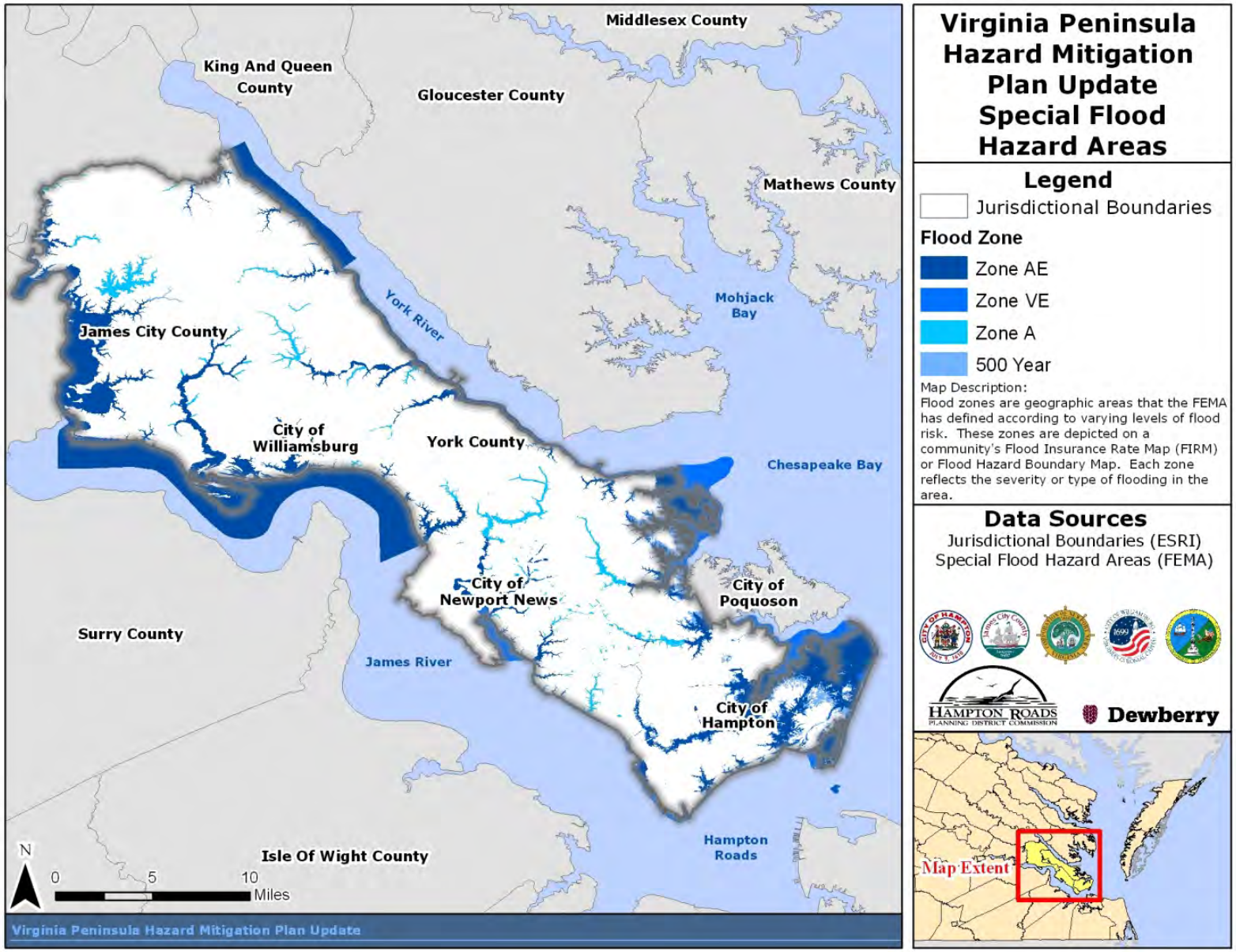

Figure 4-19: Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

Magnitude or Severity

Flooding only impacts a community to the degree it affects the lives of its citizens and the community functions overall. Therefore, the most vulnerable areas of a community will be those most affected by floodwaters in terms of potential loss of life, damages to homes and businesses, and disruption of community services and utilities. For example, an area with a highly developed floodplain is significantly more vulnerable to the impacts of flooding then a rural or undeveloped floodplain where potential floodwaters would have little impact on the community.

The impacts of floodwaters on critical facilities, such as police and fire stations, hospitals, and water or wastewater treatment facilities, can greatly increase the overall effect of a flood event on a community. In general, relatively few of these facilities are located in areas with a high risk to flooding.

As discussed above, relative sea-level rise due to land subsidence and global sea level changes that are projected to occur in association with climate change and the possibility of more intense precipitation events, which may translate into greater stormwater run-off into the future, are expected to exacerbate flooding hazards.

Previous Occurrences

The NOAA NCDC database keeps a record of significant weather-related events and damage estimates for the entire country. As discussed in the ranking methodology section, several of the NCDC event types were combined together for flooding analysis. These included:

- Coastal Flood/Flooding
- Flash Flood
- Flood
- Heavy Rain

There have been 87 flood events listed in the NCDC database for the Peninsula, of which several of these events were recorded for multiple counties and cities (zonal events). The first flooding event recorded for the Peninsula, in NCDC, is September 22, 1994. The last event recorded in the database, for this update, is July 29, 2010 as a result in the lag time needed in updating the database and receiving it from the NWS. On the Peninsula, eleven of these events have caused property damages, totaling over $13.7 million and one event resulting in $432,278 in crop damages.

Table 4-38 provides a summary of some of the significant events that have affected the region, according to the NDCD storm events database, FIS reports, and community official accounts. The events updated for the 2010 plan include only those that resulted in property or crop damages and deaths or injuries. Damage estimates presented in the comments for zonal events are derived from the NCDC data based on the number of jurisdictions declared for the event (total damages/number of jurisdictions included in the event description).

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
August 1933	All Jurisdictions	Chesapeake - Potomac Hurricane	Max tide heights averaged 8 feet		2006 HMP reference FIS for all Jurisdictions
April 1956	All Jurisdictions	Nor'easter	Not provided		2006 HMP reference FIS for all Jurisdictions
October 1957	All Jurisdictions	Hurricane – Not named	Not provided		2006 HMP reference FIS for all Jurisdictions
September 1960	All Jurisdictions	Hurricane Donna	Not provided		2006 HMP reference FIS for all Jurisdictions
March 1962	All Jurisdictions	Nor'easter, Ash Wednesday Storm	Max tide heights averaged 6.8 feet		2006 HMP reference FIS for all Jurisdictions
June 1963	City of Williamsburg			Excessively heavy rains caused the original Waller Mill Dam to break, damaging homes and infrastructure in Williamsburg. The 270-foot dam was rebuilt, and currently retains a 343-acre reservoir.	2006 HMP reference Community officials
1989	York County	Thunderstorm with urban flooding	Not given	Urban flooding costs estimated at $500,000 in York County.	2006 HMP reference
August 18, 1989	City of Williamsburg			A remarkable rain cell unloaded 12 inches of precipitation on the City, flooding City Hall.	2006 HMP reference Community officials
Sept. 22, 1994	York County	Coastal Flooding	Not given	High tides of 5.1 feet above mean lower-low water levels, combined with average waves of 5 to 6 feet, caused minor local flooding along Water Street in Yorktown.	2010 NCDC Database

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
April 23, 1997	York County	Coastal Flooding	Not given	Minor coastal flooding was reported in portions of Newport News and York County.	2006 HMP reference NCDC since 1988 FIS
January 27, 1998	All Jurisdictions	Coastal Flooding and Heavy Rain (7 separate NCDC records)	Not given	A Nor'easter produced heavy rain and strong winds across central and eastern Virginia. Rainfall totals generally ranged from 2 to 4 inches. This rainfall caused street flooding and flooding of poor drainage areas throughout the region. The slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds.	2010 NCDC Database
February 4, 1998	York County	Coastal Flooding Nor'easter	Not given	Caused severe flooding Buildings were evacuated. Widely spread power outage. $314,000 in costs incurred by York County government.	2006 HMP reference NCDC since 1988 FIS
Sept. 15 to 17, 1999	All Jurisdictions	Hurricane Floyd	12-18 inches	Numerous roads washed out due to flooding. Flooding considered 500-year flood. Enormous crop damage. Numerous roads washed out due to flooding. Flooding considered 500-year flood. Enormous crop damage. Hurricane Floyd (1999) affected the neighborhoods of Tabb Lakes, Coventry, Running Man and Foxwood. Insufficiently sized culverts, culvert blockages, and intense rainfall contributed to the drainage problems. Road flooding and landslides.	2006 HMP reference NCDC since FIS and Community Officials

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
October 17 to 18, 1999	City of Hampton	Hurricane Irene	4-7 inches	Numerous flooded roads and road closures.	2006 HMP reference NCDC since 1987 FIS
July 19, 2000	City of Newport News James City County	Flash Flood	Not given	Heavy rain caused flooding and road closures. Heavy rain caused flooding and road closures of Routes 30 and 60 near Toano.	2006 HMP reference NCDC since 1986/1991 FIS
July 24, 2000	York County City of Hampton City of Newport News	Flash Flood	Torrential Rain	Extremely heavy rain fell across a large portion of southeast Virginia's Peninsula and resulted in widespread flooding of main and secondary roads in Newport News. Up to 35 residences of the Tabb Lakes and Coventry subdivisions had to be evacuated due to high water. In York County, three interstate off-ramps closed due to flooding. Up to 35 residences had to be evacuated due to high water on Scoggin Circle and Grimes Roadnear the Buckroe Beach section of Hampton. City of Hampton experienced over $442,821 in property damages.	2006 HMP reference supplemented with 2010 NCDC Database
June 14, 2002	City of Hampton	Flash Flood	Not provided	Numerous reports of street flooding Water shooting out of manholes	2006 HMP reference NCDC since 1987 FIS
August 28, 2002	City of Hampton	Flash Flood	2 to 3 inches in 3 hours	Caused road closures in the City of Hampton. York County experienced flooding of some streets and intersections in many of the same subdivisions listed above, but no significant flooding of structures was	2006 HMP reference NCDC since 1987 FIS and Community officials

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
				noted.	
Sept. 3, 2003	City of Hampton	Flash Flood	Not provided	Many roads flooded	2006 HMP reference NCDC since 1987 FIS
Sept. 18, 2003	City of Hampton	Hurricane Isabel	4-7 inches	Severe Flooding Trees down Power Outage	2006 HMP reference NCDC since 1987 FIS
August 30, 2004	City of Hampton	Tropical Storm Gaston	Not provided	Flooding occurred in the city	2006 HMP reference NCDC since 1987 FIS
Sept. 1, 2006	All Jurisdictions	Coastal Flood Flash Flood (5 separate NCDC records)	Not provided	Tides of 4 to 5 feet above normal combined with 6 to 8 foot waves caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Virginia Peninsula and Middle Peninsula near the Chesapeake Bay and adjacent tributaries. The coastal flooding event (zonal) may be attributed to $7.9 million in damages in York and Williamsburg. The zonal event accounted for $18.5 million damages.	2010 NCDC Database
October 6, 2006	York County City of Williamsburg	Coastal Flood	Not provided	A strong low pressure system off the North Carolina coast coupled with an upper level cutoff low to dump intense rainfall across portions of southeast Virginia. Rainfall amounts in excess of 10 inches resulted in numerous road closures and moderate to major river flooding. Up to 28,000 Dominion Virginia Power	2010 NCDC Database

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
				customers lost power during the event. Moderate to severe coastal flooding also resulted in western portions of the southern Chesapeake Bay. Tidal departures were 2.5 to 3.5 above normal during the event. The zonal event accounted for over $200 thousand in property damages.	
October 7, 2006	James City County	Flash Flood	Not provided	Rainfall amounts on 10/6/2006 resulted in Numerous roads closed. Water as high as 4 feet on roads. High water also resulted in significant crop damage. Crop damages for this event have been estimated at $486,313 (inflated to 2010).	2010 NCDC Database
Nov. 22, 2006	York County City of Williamsburg	Coastal Flood	Not provided	An intense low pressure system off the North Carolina coast combined with an upper level cutoff low to provide very strong winds, heavy rains, and moderate coastal flooding across portions of eastern and southeast Virginia. Strong onshore winds caused moderate coastal flooding during times of high tide. Tidal departures were about 3 feet above normal during the event. The coastal flooding event (zonal) may be attributed to $27,017 in damages in York and Williamsburg.	2010 NCDC Database

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
				The zonal event accounted for $50 thousand in damages.	
Nov. 12, 2009	All Jurisdictions	Heavy Rain Coastal Flood	Not provided	An intense Nor'easter produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. The coastal flooding event (zonal) may be attributed to over $250 thousand in damages in York and Williamsburg. The zonal event accounted for $1 million in damages.	2010 NCDC Database
Dec. 19, 2009	York County City of Williamsburg	Coastal Flood	Not provided	A strong coastal low pressure area produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. The coastal flooding event (zonal) may be attributed to over $2 thousand in damages in York and Williamsburg. The zonal event accounted for $10 thousand in damages.	2010 NCDC Database
March 28, 2010	All Jurisdictions	Heavy Rain (5 separate NCDC records)	2-3 inches across the Peninsula 2.74 inches in City of Hampton 1.85 inches in City	Showers and thunderstorms associated with low pressure and a cold front produced one to three inches of rain across portions of central and eastern Virginia.	2010 NCDC Database

Table 4-38: Previous Significant Flood Related Events					
Date	Jurisdiction(s) Impacted	Event	High Water Elevations/ Precipitation	Comments	Source
			of Williamsburg		
July 29, 2010	City of Newport News City of Hampton	Heavy Rain Flash Flood	2.86 inches was measured with an 1.5 hours in the City of Newport News	Showers and thunderstorms in advance of a cold front produced heavy rain across portions of southeast Virginia. Rainfall amounts ranged from two inches to near five inches over much of the region. Numerous roads were flooded in the City of Hampton.	2010 NCDC Database

National Flood Insurance Program (NFIP)

The Flood Insurance and Mitigation Administration (FIMA), a component of FEMA, manages the NFIP. The three components of the NFIP are:

- Flood Insurance
- Floodplain Management
- Flood Hazard Mapping

Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80% less damage annually than those not built in compliance.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Table 4-39 summarizes the dates for when each of the communities flood hazard boundaries were identified, the initial FIRMs mapped, date of emergency entry, and current effective map date. As shown, each locality has, or will have shortly, DFIRM maps available. Currently the cities of Hampton and Newport News have preliminary maps that were provided by FEMA for use in this plan. These maps are preliminary and are not final and are not be used for purposes outside of this plan.

Table 4-39: Communities participating in the NFIP.					
Community Name	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date	DFIRM Effective Date
City of Hampton	3/24/1970	5/28/1971	7/3/1995	1/15/1971	11/9/2010*
City of Newport News	8/16/1974	5/2/1977	1/17/1986	5/2/1977	9/17/2010*
York County	11/29/1974	12/16/1988	6/16/2009	12/16/1988	6/16/2009
James City County	7/18/1975	2/6/1991	9/28/2007	2/6/1991	9/28/2007
City of Williamsburg	3/28/1975	11/20/1981	9/28/2007	11/20/1981	9/28/2007
as of 10/5/2010 http://www.fema.gov/cis/VA.html					

*preliminary DFIRM data provided by FEMA

As of September 30, 2010, there was a total of 18,584 flood insurance policies in-force on the Peninsula, accounting for 16.8% of the total policies in the Commonwealth. These policies amounted more than $4.35 billion in total insurance coverage. Approximately 7,104 claims have been filed, accounting for $110 million in payments. The City of Hampton makes up more than 66% of the total claims payments and 11% of total payments. York County accounts for over 20% of the total claims and 6% of the total payments. Table 4-40 shows the NFIP policy statistics for each of the participating jurisdictions.

Table 4-40: NFIP Policy and Claim Statistics.				
	Policy Statistics (as of 9/30/2010)		Claim Statistics (1/1/1978 - 9/30/2010)	
County	Policies In-Force	Insurance In-Force	Total Claims/Losses	Total Payment
City of Hampton	11,424	$2,504,618,500	4,718	$61,879,725
City of Newport News	2,662	$602,321,300	582	$8,825,081
York County	3,508	$974,515,100	1,467	$33,311,277
James City County	942	$253,345,500	318	$5,994,028
City of Williamsburg	48	$12,789,700	19	$147,414
Region TOTAL	**18,584**	**$4,347,590,100**	**7,104**	**$110,157,524**
VIRGINIA TOTAL	**110,673**	**$26,108,197,900**	**38,209**	**$553,481,940**
Source: http://bsa.nfipstat.com from 12/15/2010				

Floodplain management regulations are the cornerstone of NFIP Participation. Communities which participate in the NFIP are expected to adopt and enforce floodplain management regulations. These regulations apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings are required to be elevated at or above the base flood elevation.

FEMA Repetitive Flood Claims Program

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

The Repetitive Flood Claims (RFC) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). Currently up to $10 million is available annually for FEMA to provide RFC funds to help States and communities reduce flood damages to insured properties that have had one or more claims to the NFIP.[33]

Repetitive Loss Properties

A Repetitive Loss (RL) Property is a property that is insured under the NFIP and has filed two or more claims in excess of $1,000 each, within a 10-year period. Nationwide, repetitive loss properties constitute 2% of all NFIP insured properties, but are responsible for 40% of all NFIP claims. Mitigation for repetitive loss properties is a high priority for FEMA, and the areas in which these properties are located typically represent the most flood prone areas of a community.

The identification of repetitive loss properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they will be threatened by continual losses. Repetitive loss properties are also important to the NFIP, since structures that flood frequently put a strain on the National Flood Insurance Fund. Under the NFIP, FEMA defines a repetitive loss property as “any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property.” A primary goal of FEMA is to reduce the numbers of structures

that meet these criteria, whether through elevation, acquisition, relocation or a flood control project that lessens the potential for continual losses.

According to FEMA, there are currently 1,128 repetitive loss properties on the Peninsula. The specific addresses of the properties are maintained by FEMA, VDEM, and local jurisdictions, but are deliberately not included in this Plan as required by law.[34] A general overview of the property locations and the SFHA locations is provided in Figure 4-20. General overview maps, by jurisdiction are also available in Appendix E3, but have been redacted to maintain privacy. Over $56 million has been paid in total repetitive losses (for 2,606 losses). Table 4-41 shows the total number of properties, total number of losses experienced and losses paid for all of the communities within the planning region, according to the VDEM.

The City of Hampton accounts for over 73% of the repetitive loss properties in the region, followed by York County (18.8%). As a whole, the region has experienced over $56.3 million in flood damages to repetitive and severe repetitive loss properties, the majority of the losses attributable to building damage. The total building value for repetitive and severe repetitive loss properties is over $229 million; total building losses account for almost 22% of the total building value for the region. York County has the highest percentage (25.6%) of losses compared to total building value impacted.
In October 2009, the City of Hampton completed repetitive flood loss analysis that presented information on repetitive flood losses and proposed actions for mitigating flood damage in repetitively flooded areas. This report has been updated with current NFIP statistics and is available in Appendix G.

Table 4-41: Repetitive Loss Properties. (from VDEM 10/1/2010)									
Community Name	Total Building Value	# of RL Properties		# of SRL Properties	# of Claims	Total Losses	Total Building Losses	Total Contents Losses	Average Claim
		Residential	Non-residential						
City of Hampton	$155,471,157	812	12	27	1,919	$36,692,712	$32,482,114	$4,210,598	$19,121
City of Newport News	$17,815,208	58	2	1	137	$4,575,167	$4,242,038	$333,129	$33,395
York County	$44,636,637	211	2	2	470	$13,240,242	$11,410,903	$1,829,338	$28,171
James City County	$7,485,232	26	1	2	71	$1,739,316	$1,538,677	$200,638	$24,497
City of Williamsburg	$3,748,646	2	2	0	9	$104,271	$95,389	$7,882	$11,586
Total	**$229,156,880**	**1,109**	**19**	**32**	**2,606**	**$56,351,708**	**$49,769,122**	**$6,581,585**	**$23,354**

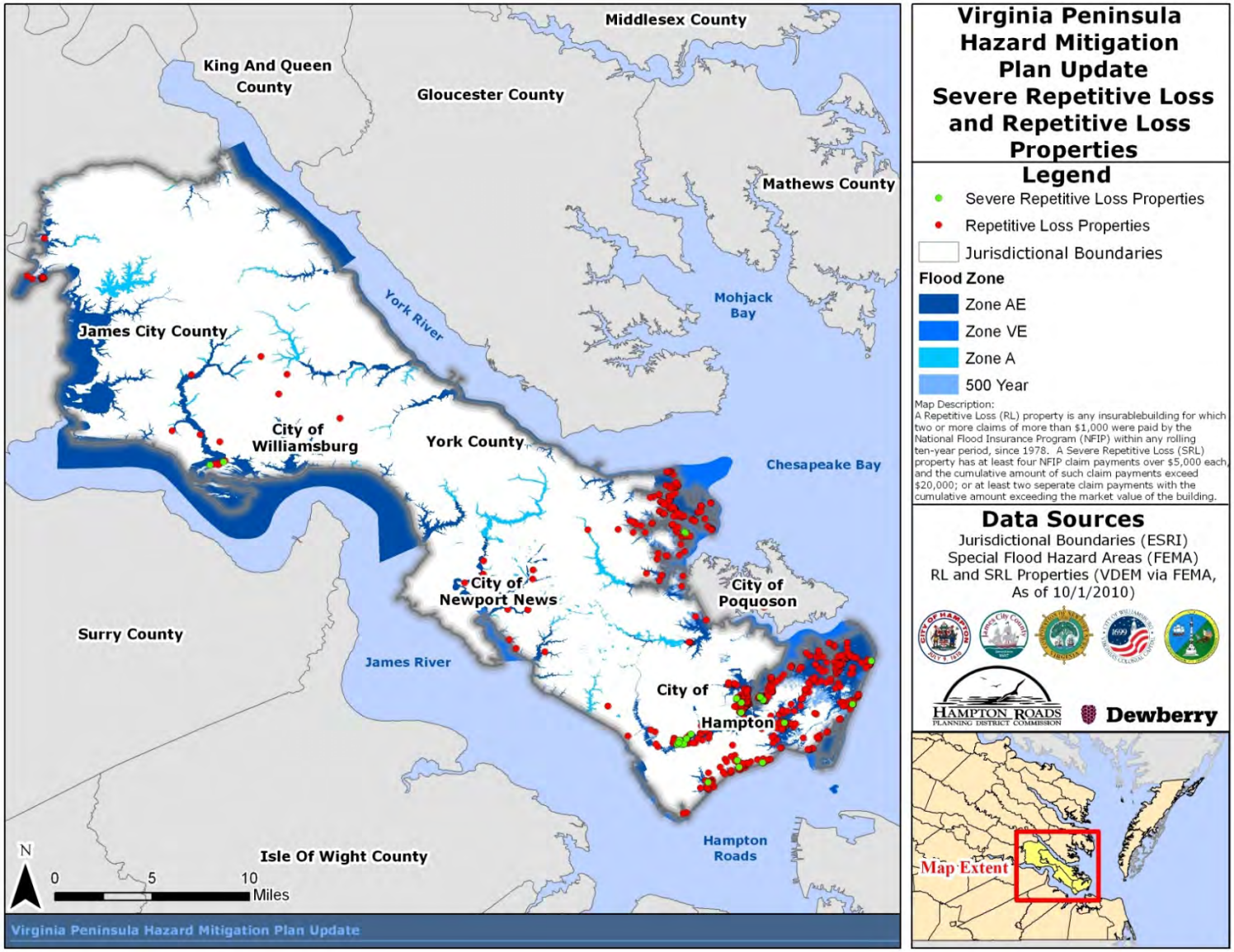

Figure 4-20: Repetitive and Severe Repetitive Loss Properties and FEMA DFIRMs on the Peninsula

Risk Assessment

Probability of Future Occurrences

Periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural 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.

A 100-year flood is not a flood that occurs every 100 years. In fact, the 100-year flood has a 26% chance of occurring during a 30 year period, the typical length of many mortgages. The 100-year flood is a regulatory standard used by Federal agencies, States, and NFIP-participating communities to administer and enforce floodplain management programs. The 100-year flood is also used by the NFIP as the basis for insurance requirements nationwide.[35] The main recurrence intervals used on the FIRMS are shown in Table 4-42 below.

Table 4-42: Annual probability based on flood recurrence intervals

Flood Recurrence Interval	Annual Chance of Occurrence
10 –year	10.0%
50–year	2.0%
100–year	1.0%
500–year	0.2%

The probability of a flood event happening on the Peninsula in any given year is a near certainty. Based on NCDC historical data (see Table 4-43), between one and two flood events impact the Peninsula every year. Based on past occurrences, flood events are generally considered equally likely for all jurisdictions on the Peninsula.

Table 4-43: Annualized Flood Events from NCDC Storm Events Data	
Jurisdiction	**NCDC Annualized Events (Events Per Year)**
James City County	0.8
York County	1.5
City of Hampton	1.6
City of Newport News	1.7
City of Williamsburg	1.1

Impact & Vulnerability

People and property are extremely vulnerable to flooding. Homes and business may suffer damage and be susceptible to collapse due to heavy flooding. Floodwaters can carry chemicals, sewage, and toxins from roads, factories, and farms; therefore any property affected by the flood may be contaminated with hazardous materials. Debris from vegetation and man-made structures may also be hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, as well as initiate power outages.

The Peninsula can expect to experience between one and two flood related events per year. The NCDC storm events database (1994 to July 31, 2010) does not include any injuries or deaths directly related to flooding on the Peninsula (see Table 4-44). *This may be a dramatic underrepresentation of past events as a consequence of the categorization of hazards. Injuries and deaths may have been a result of flooding conditions due to hurricane and, therefore, are accounted for in the hurricane/tropical storm analysis.*

Table 4-44: Annualized Flood Impacts			
Jurisdiction	**NCDC Annualized Events (Events Per Year)**	**NCDC Annualized Deaths**	**NCDC Annualized Injuries**
James City County	0.8	0	0
York County	1.5	0	0
City of Hampton	1.6	0	0
City of Newport News	1.7	0	0
City of Williamsburg	1.1	0	0

Risk

Riverine and Coastal HAZUS analysis was completed for the 2011 revision using the probabilistic, 100-year and 500-year scenarios; the information below summarizes the module and highlights the results and differences of the HAZUS runs.

HAZUS-MH MR4 is a regional multi-hazard loss estimation model that was developed by the FEMA and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide methodology and software application to develop multi-hazard losses at a regional scale. The loss estimates are used primarily by local, state and regional officials to plan and stimulate efforts to reduce risk from multi-hazards and prepare for emergency response and recovery.[36]

Potential loss estimates analyzed in HAZUS-MH include:

- Physical damage to residential and commercial buildings, schools, essential facilities, and infrastructure
- Economic loss including lost jobs, business interruptions, repair and reconstruction costs.

The HAZUS Flood Model analyzes both riverine and coastal flood hazards. Flood hazard is defined by a relationship between depth of flooding and the annual chance of inundation to that depth. Probabilistic events are modeled by looking at the damage caused by an event that is likely to occur over a given period of time, known as a return period or recurrence interval.

Depth, duration, and velocity of water in the floodplain are the primary factors contributing to flood losses. Other hazards associated with flooding that contribute to flood losses include channel erosion and migration, sediment deposition, bridge scour, and the impact of flood-born debris. The HAZUS Flood Model allows users to estimate flood losses due to flood velocity to the general building stock (GBS). Building stock exposure is discussed in detail in the HAZUS-MH MR4 building stock section of the HIRA methodology.

The flood analysis for the HIRA was completed using the FEMA HAZUS – MH MR4 software for riverine and coastal flood hazards. Flood hazard is defined by a relationship between depth of flooding and the annual chance of inundation to that depth. This assessment has been completed for Level 1 analysis.

Loss estimation for this HAZUS module is based on specific input data. The first type of data includes square footage of buildings for specified types or population. The second type of data includes information on the local economy that is used in estimating losses. Table 4-45 displays the economic loss categories used to calculate annualized losses by HAZUS. Data for this analysis has been provided at the census block level.

Table 4-45: HAZUS direct economic loss categories and descriptions.

Category Name	Description of Data Input into Model	HAZUS Output
Building	Cost per sq ft to repair damage by structural type and occupancy for each level of damage	Cost of building repair or replacement of damaged and destroyed buildings
Contents	Replacement value by occupancy	Cost of damage to building contents
Inventory	Annual gross sales in $ per sq ft	Loss of building inventory as contents related to business activities
Relocation	Rental costs per month per sq ft by occupancy	Relocation expenses (for businesses and institutions)
Income	Income in $ per sq ft per month by occupancy	Capital-related incomes losses as a measure of the loss of productivity, services, or sales
Rental	Rental costs per month per sq ft by occupancy	Loss of rental income to building owners
Wage	Wages in $ per sq ft per month by occupancy	Employee wage loss as described in income loss

Annualized loss is one way to determine the maximum potential annual loss. This is useful for creating a common denominator by which different types of hazards can be compared. Annualized losses are the summation of losses over all return periods multiplied by the probability of occurrence.

The probabilistic HAZUS-MH flood analysis predicts that the Peninsula can expect, annually, $94,507,000 in damages due to flood events. Property or "capital stock" losses make up about $94,389,000 of the damages (99.8%), which includes the values for building, content, and inventory. Business interruption accounts for 0.12% of the annualized losses and includes income, rental, wage, and relocation costs. The flood model incorporates NFIP entry dates to distinguish Pre-FIRM and Post-FIRM census blocks. The results provided in this report show the combined total losses for the pre- and post-FIRM census blocks.

Table 4-46 illustrates the expected annualized losses broken down by jurisdiction. The Peninsula can expect $94,507,000 in annualized flood damages; the majority of these damages are attributable to residential building occupancy. City of Hampton has the highest annualized loss, $71,978,000 accounting for 76% of the total annualized losses for the Peninsula and 1.2% of the total replacement value for the city. The majority of the expected damages for all jurisdictions can be attributed to building and content value.

The depth-grids created for the probabilistic runs were also utilized for the 1% Chance Annual Flood or 100-year and the 0.2% or 500-year analysis was completed in order to provide loss estimates for specific return periods. Similar to the annualized loss results, the City of Hampton represents the majority of damages for the 100- and 500-year scenarios. Loss type is divided almost equally among building and contents (property or capital stock losses). Table 4-46 summarizes annualized building loss to flooding. Tables 4-47 and Table 4-48 summarize the results of the 100- and 500-year HAZUS runs.

Figure 4-21 and Figure 4-22 show the total annualized loss for the Peninsula. Residential loss accounts for the majority of the loss for the region. Figure 4-23 and Figure 4-24 show the total loss for the 100- and 500-year flood events on the Peninsula. Appendix E3 includes jurisdiction specific loss maps, in addition to the DFIRM maps.

Future versions of this plan and mitigation actions may want to investigate using a smaller drainage threshold for analysis as compared to the HAZUS default 10-square mile drainage; for example, 1-square mile drainage would be comparable to the FEMA DFIRM maps.

Table 4-46: HAZUS-MH MR4 Flood Module Annualized Building Loss (in thousands of $)								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Loss
City of Hampton	$38,355	$33,163	$365	$14	$0	$4	$77	$71,978
James City County	$1,177	$887	$9	$0	$0	$0	$1	$2,074
City of Newport News	$4,333	$3,631	$80	$4	$0	$0	$4	$8,052
City of Williamsburg	$454	$490	$0	$0	$0	$0	$2	$946
York County	$6,387	$4,992	$66	$3	$0	$0	$9	$11,457
Total	**$50,706**	**$43,163**	**$520**	**$21**	**$0**	**$4**	**$93**	**$94,507**

Table 4-47: HAZUS-MH MR4 Flood Module 100-year Building Loss (in thousands of $)									
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Direct Loss	Total Loss
City of Hampton	$1,047,830	$1,034,356	$14,229	$2,996	$2,277	$1,179	$16,235	$12,141	$2,131,243
James City County	$24,342	$21,805	$576	$78	$35	$22	$93	$178	$47,129
City of Newport News	$154,736	$196,330	$2,786	$451	$519	$279	$3,648	$2,028	$360,777
City of Williamsburg	$2,313	$2,376	$9	$7	$3	$4	$14	$11	$4,726
York County	$130,001	$109,910	$1,998	$380	$180	$109	$953	$846	$244,377
Total	**$1,359,222**	**$1,364,777**	**$19,598**	**$3,912**	**$3,014**	**$1,593**	**$20,943**	**$15,204**	**$2,788,252**

Table 4-48: HAZUS-MH MR4 Flood Module 500-year Building Loss (in thousands of $)									
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Direct Loss	Total Loss
City of Hampton	$1,411,583	$1,393,093	$18,204	$4,346	$3,090	$1,772	$25,752	$17,127	$2,874,967
James City County	$40,962	$35,932	$929	$128	$59	$36	$138	$273	$78,457
City of Newport News	$220,154	$278,934	$3,597	$600	$627	$333	$4,338	$2,561	$511,144
City of Williamsburg	$3,543	$3,408	$11	$8	$4	$5	$17	$16	$6,996
York County	$240,660	$192,482	$3,047	$638	$272	$200	$1,305	$1,234	$439,838
Total	**$1,916,902**	**$1,903,849**	**$25,788**	**$5,720**	**$4,052**	**$2,346**	**$31,550**	**$21,211**	**$3,911,402**

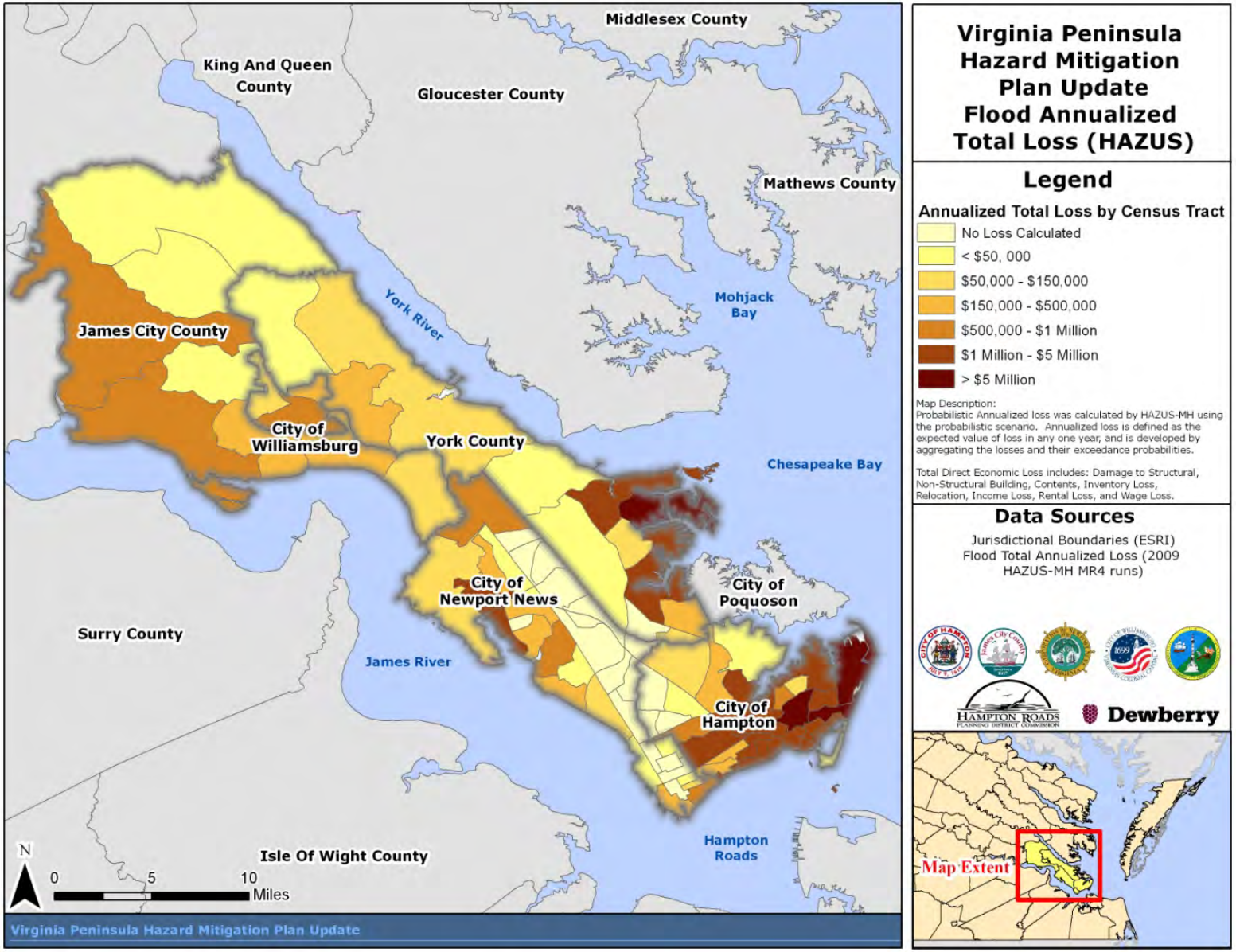

Figure 4-21: Total flood annualized loss, by census tract, based on HAZUS-MH MR4 flood module

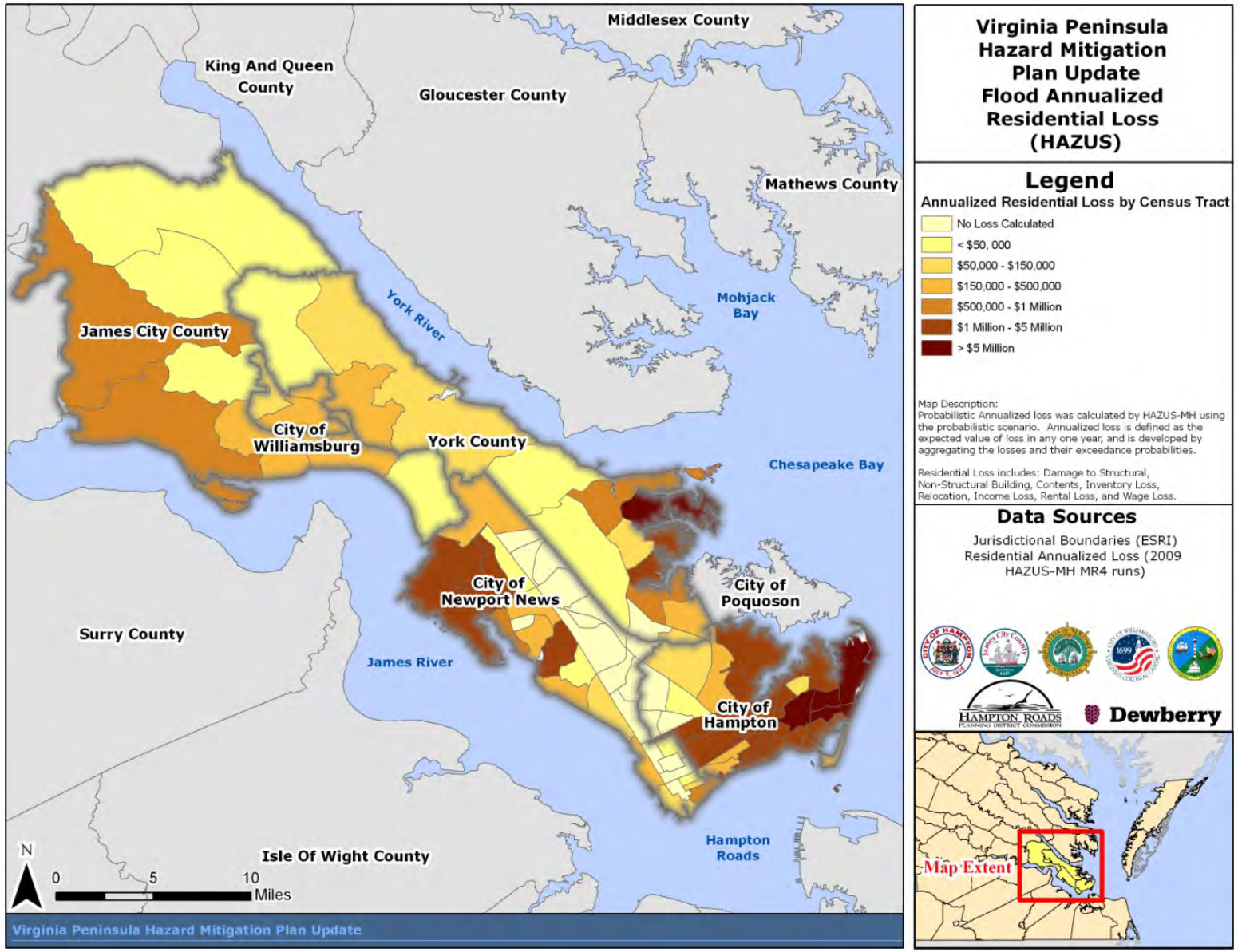

Figure 4-22: Total residential flood annualized loss, by census tract, based on HAZUS-MH MR4 flood module

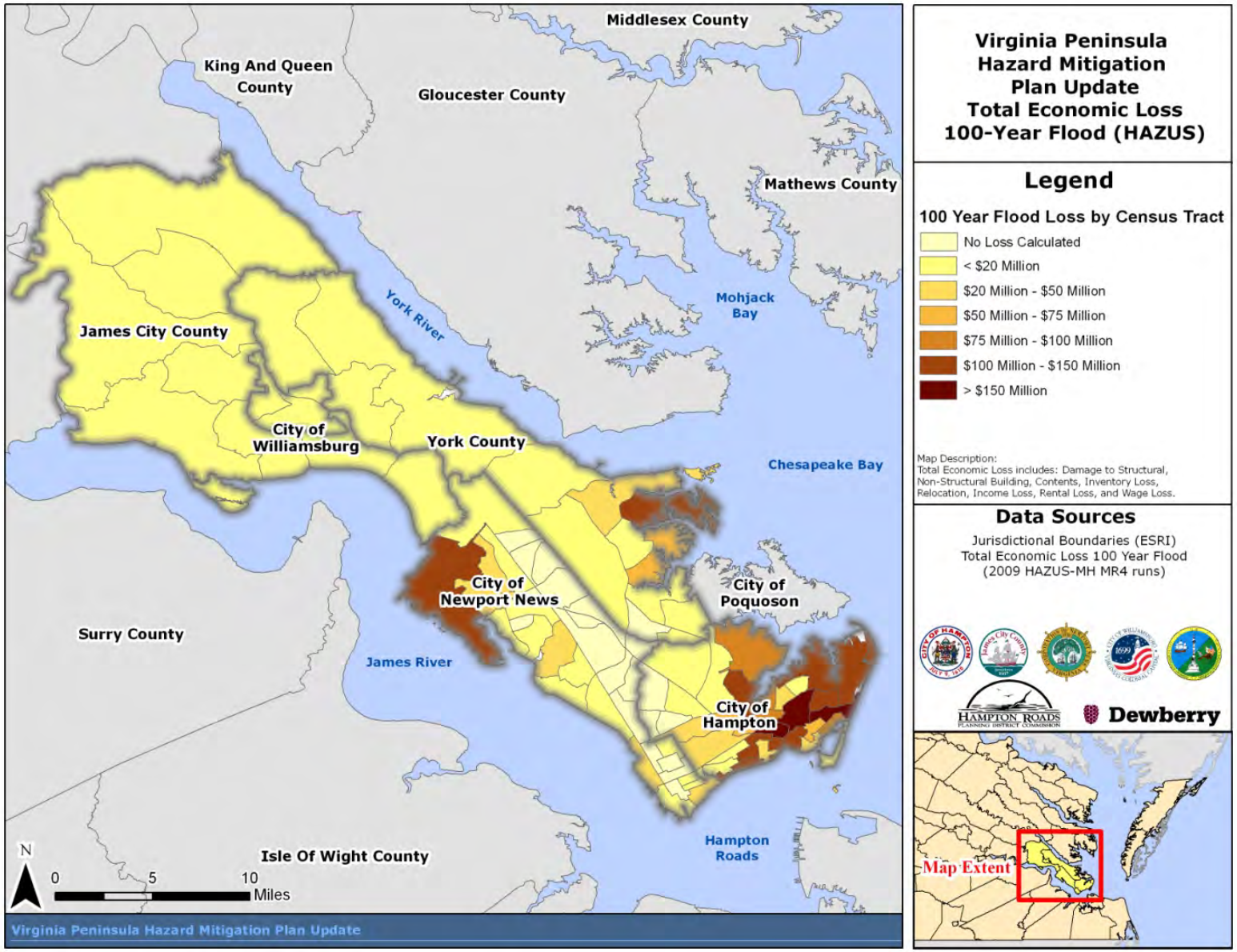

Figure 4-23: Total 100-year economic loss, by census tract, based on HAZUS-MH MR4 flood module

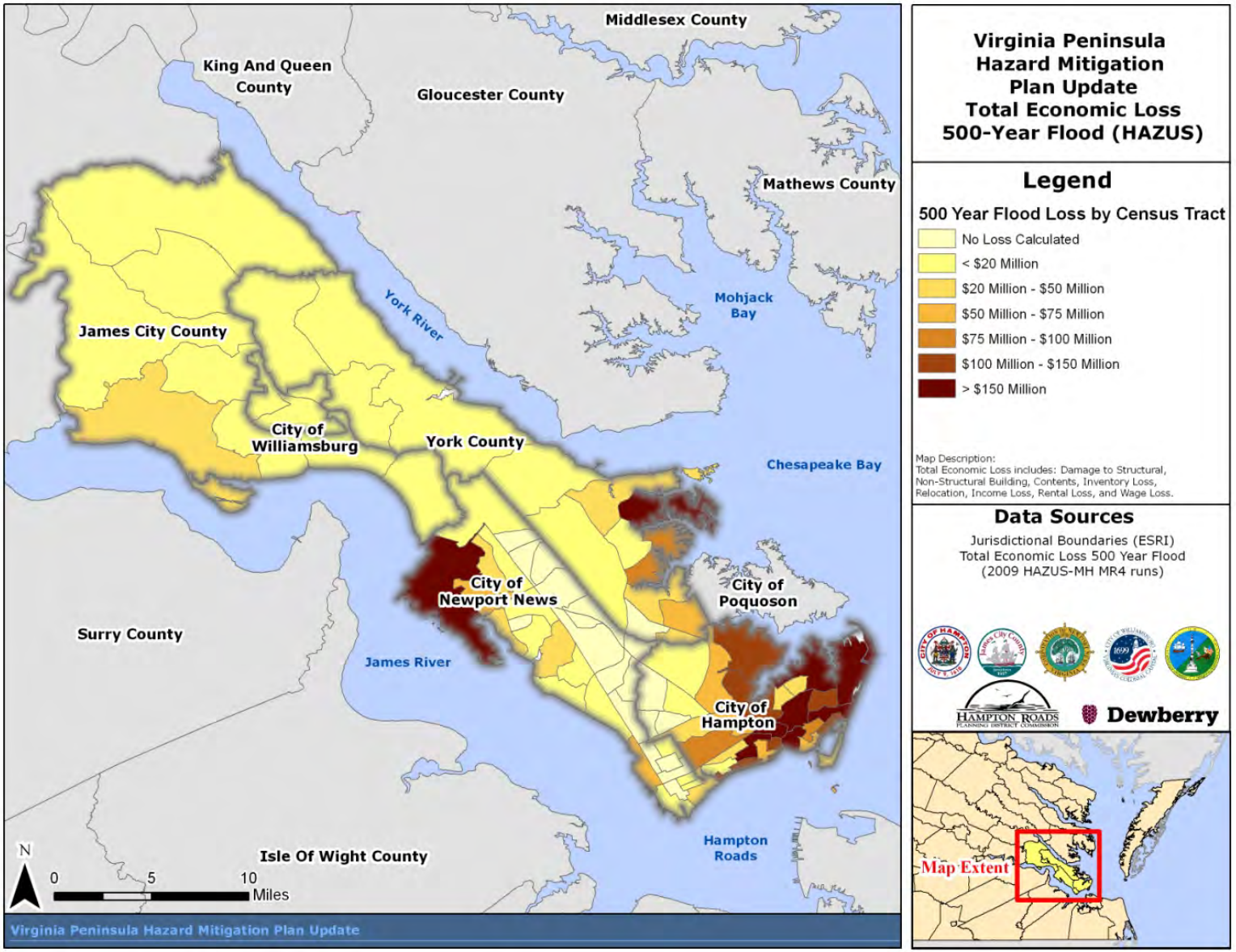

Figure 4-24: Total 500-year economic loss, by census tract, based on HAZUS-MH MR4 flood module

Table 4-49 compares the results of the HAZUS run and NCDC storm events database. As shown, the HAZUS loss estimates are magnitudes higher than the NCDC results. This can be attributed to the various parameters, as mentioned above, taken into account for the HAZUS module. The NCDC loss estimates are solely based on the reported crop and property damages.

Table 4-49: Annualized Flood Impacts

Jurisdiction	NCDC Annualized Property Losses	NCDC Annualized Crop Losses	HAZUS Annualized Total Losses
City of Hampton	$560,234	-	$71,978,000
James City County	$30,395	$27,017	$2,074,000
City of Newport News	$532,558	-	$8,052,000
City of Williamsburg	$795,813	-	$946,000
York County	$800,408	-	$11,457,000
Total	$2,719,408	$27,017	$94,507,000

Zoning and Land Use

Zoning data provided by each of the localities was utilized to determine which zoning classes were located in the mapped flood zones. Approximately 13% of the Peninsula land area is in mapped Zone AE. Table 4-50 provides a summary of the area percentages by each jurisdiction.

The City of Hampton has approximately 27% of its land area in flood Zone AE and 7% in the 500-year floodplain. The majority of the land area in Zone AE is classified as residential (24.5%) and special interest districts (1.3%).

James City County has approximately 14% of its land area in flood Zone AE and 1.8% in the 100-year floodplain. Over half of the land area located in Zone AE is classified as general agriculture, followed by residential (3.6%) and public land (2.9%) classifications.

The City of Newport News has approximately six% of its land area in flood Zone AE and 3% in the 100-year floodplain. Over half of the land area located in Zone AE is classified as residential (3.7%), followed by manufacturing/industrial (1.1%).

The City of Williamsburg has approximately 2% of its land area in flood Zone AE. Almost all of the land area located in Zone AE is classified as residential. The College of William and Mary makes up a small fraction (0.3%) of the mapped Zone AE.

York County has approximately 10% of its land area in flood Zone AE, 3% in Zone VE, 2.3% in the 100-year, and 2.2% in the 500-year flood zones.

Almost half of the land area located in Zone AE is classified as residential (4.5%), followed by water oriented commercial/industrial district (3.3%) and resource conservation (1.3%) classifications.

Table 4-50: Zoning classification percentages located in SFHAs based on land area of each of the jurisdictions.

Jurisdiction	Zone A (100-year)	Zone AE	Zone VE	Shaded X (500-Year)
City of Hampton	0.03%	27.3%	1.3%	7.0%
City of Newport News	2.7%	5.7%	0.7%	0.7%
York County	2.3%	10.1%	3.0%	2.2%
James City County	1.8%	14.4%	-	0.6%
City of Williamsburg	0.1%	2%	-	0.04%
TOTAL (based on total area for the Peninsula)	1.8%	13.0%	1.2%	1.9%

Critical Facility Risk

Risk to local critical facilities was determined by using GIS analysis to intersect the facility location with the mapped FEMA Digital Flood Insurance Rate Maps (DFIRMs). Spatial location of the facilities was provided by each jurisdiction, as discussed in the Risk Assessment Methodology section, although additional information on the facilities (i.e., year of construction, square footage, replacement value, etc.) was not provided. As a result, information on the number of facilities can be determined, but further analysis on loss estimates was not available at this time.

Table 4-51 provides a summary of the number of critical facilities located within the FEMA mapped floodplains. One-third of the City of Hampton's critical facilities are located within one of the mapped SFHAs. Public works facilities make up the majority of facilities located within Zone AE in the City of Hampton. Fort Eustis and the Jamestown/Scotland Ferry are the facilities located within Zone AE in James City County. Public utilities make up the

majority of the facilities located within zone AE in the City of Newport News. Magruder Elementary school in the City of Newport News was located in Zone AE. Sewers and towers make up all of the facilities located within Zone AE and the 500-year floodplains in York County; the Bethel Manor Elementary school is located within the 100-year (zone A). No critical facilities were determined to be within any of the mapped FEMA SFHA. The names and information for the local critical facilities in the flood risk zones are available in Appendix E4.

Figure 4-25 provides a regional view of the locations of critical facilities and the mapped SFHAs on the Peninsula.

Figure 4-26 through Figure 4-30 show jurisdiction-specific mapping for critical facilities and SFHA locations.

Table 4-51: Number of Critical Facilities in SFHA.

Jurisdiction	Total CF	Zone A	Zone AE	Zone AE with FW	Zone VE	500-year	Total CF in SFHA
City of Hampton	68		15			9	**24**
James City County	31		2				**2**
City of Newport News	181		5	1		1	**7**
City of Williamsburg	28						**0**
York County	182	1	11			13	**25**
Total	**490**	**1**	**33**	**1**	**0**	**23**	**58**

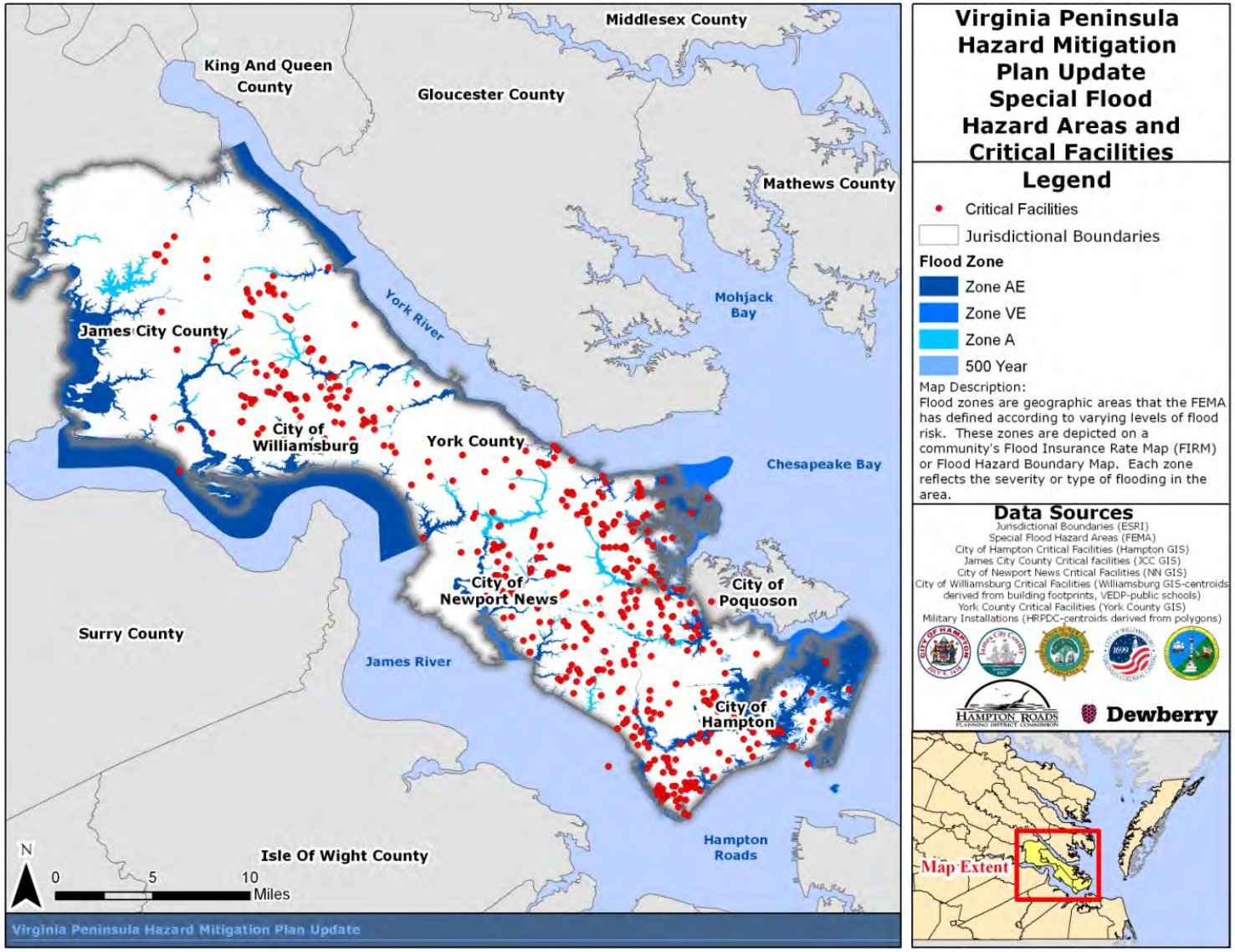

Figure 4-25: Regional view of local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

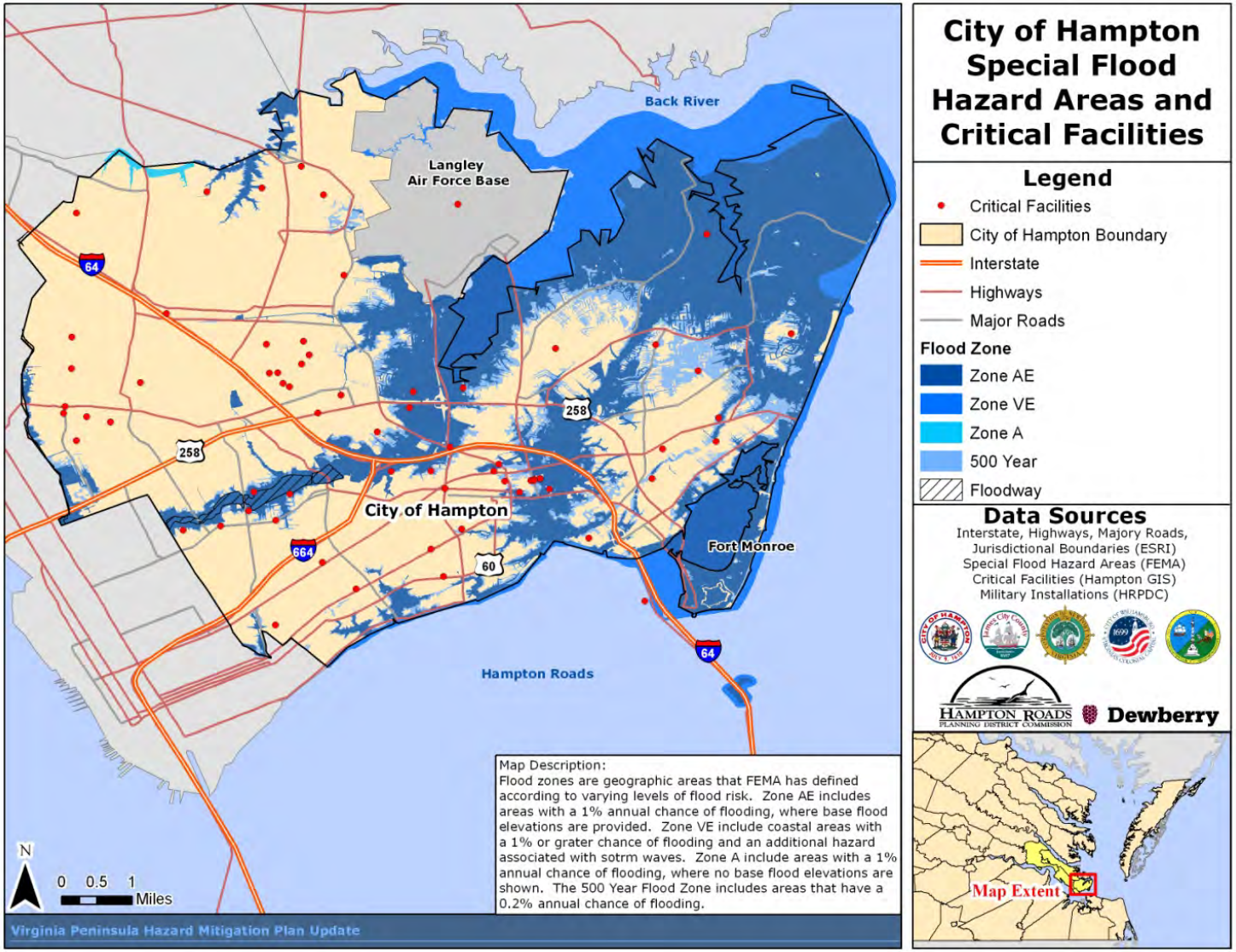

Figure 4-26: City of Hampton local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

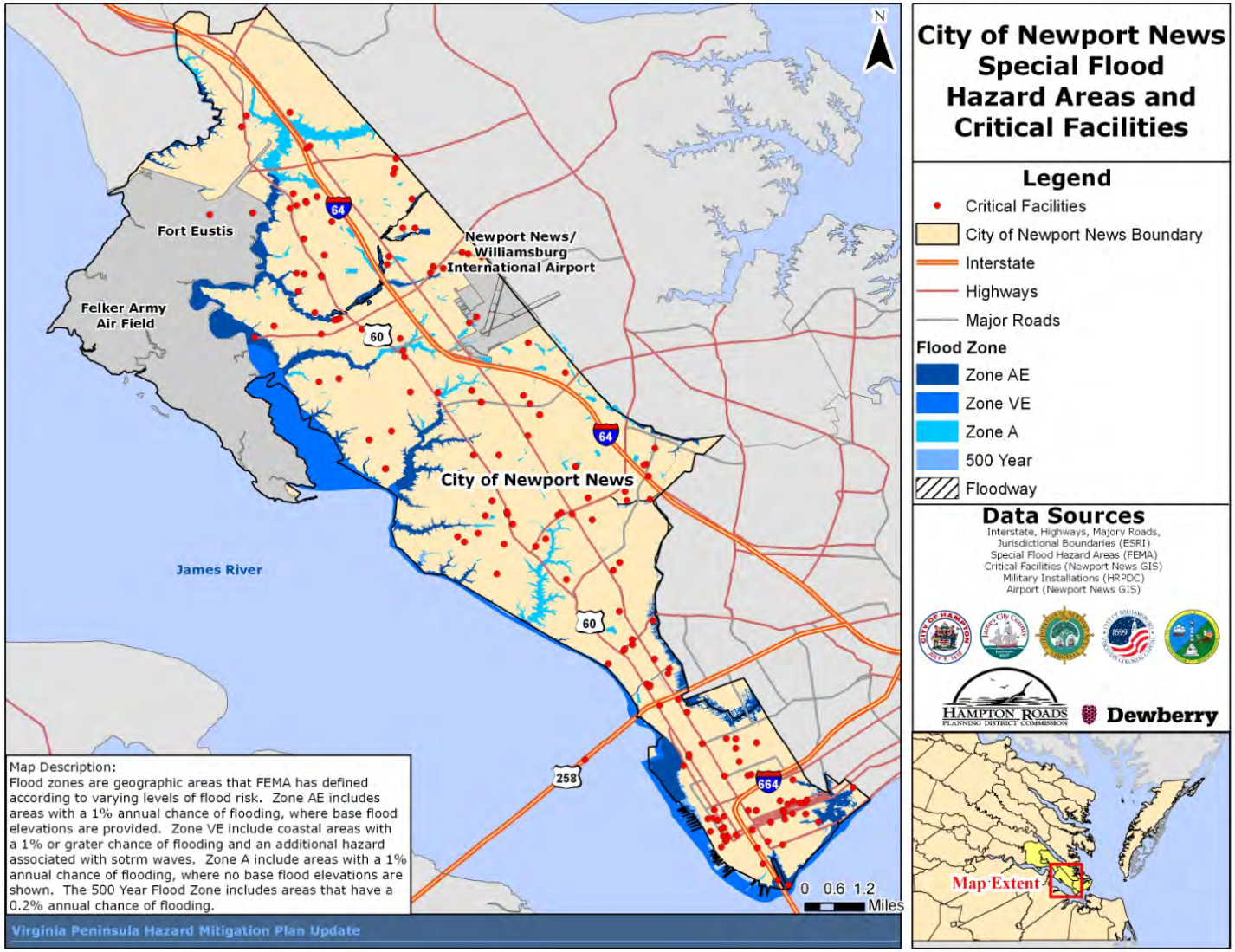

Figure 4-27: City of Newport News local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

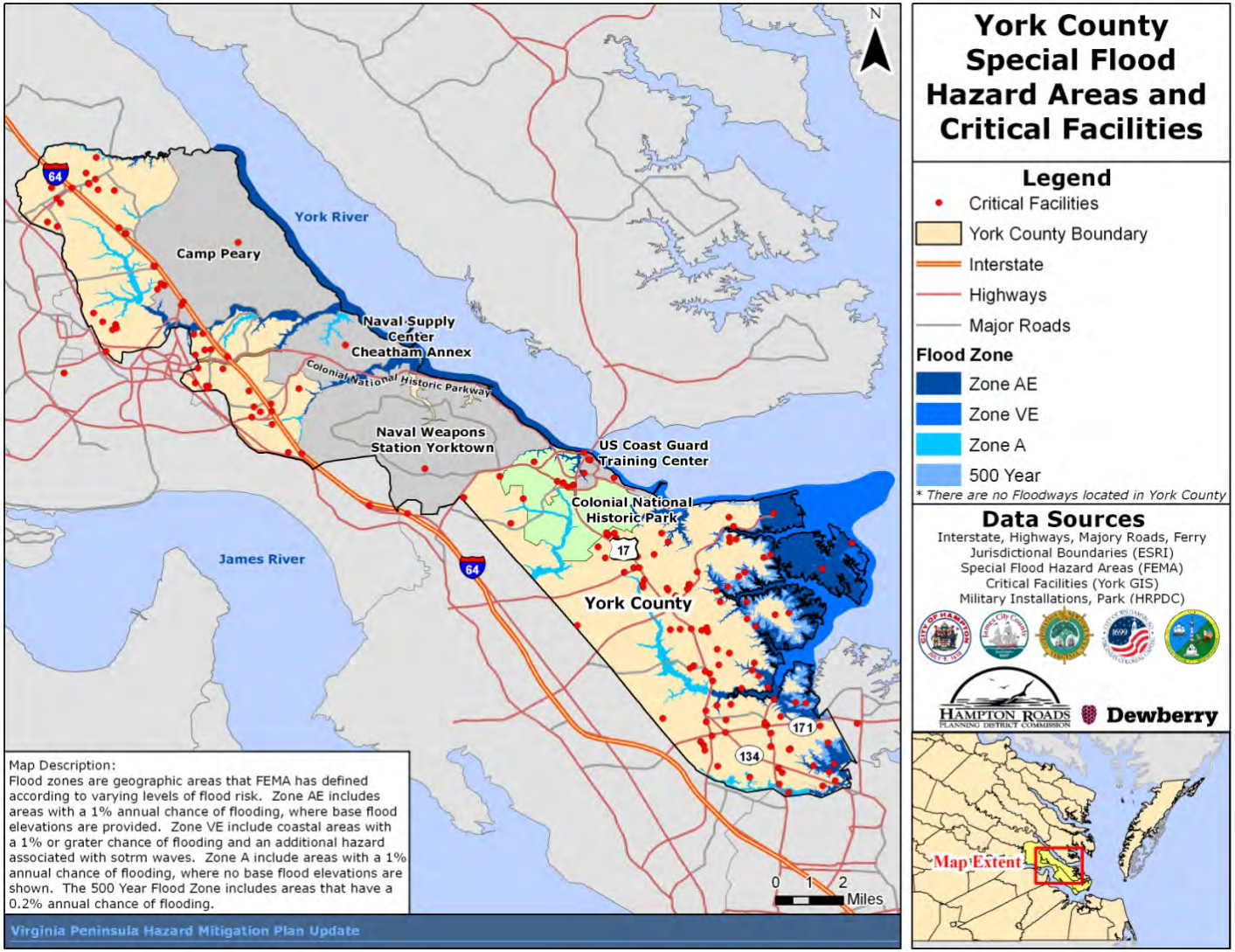

Figure 4-28: York County local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

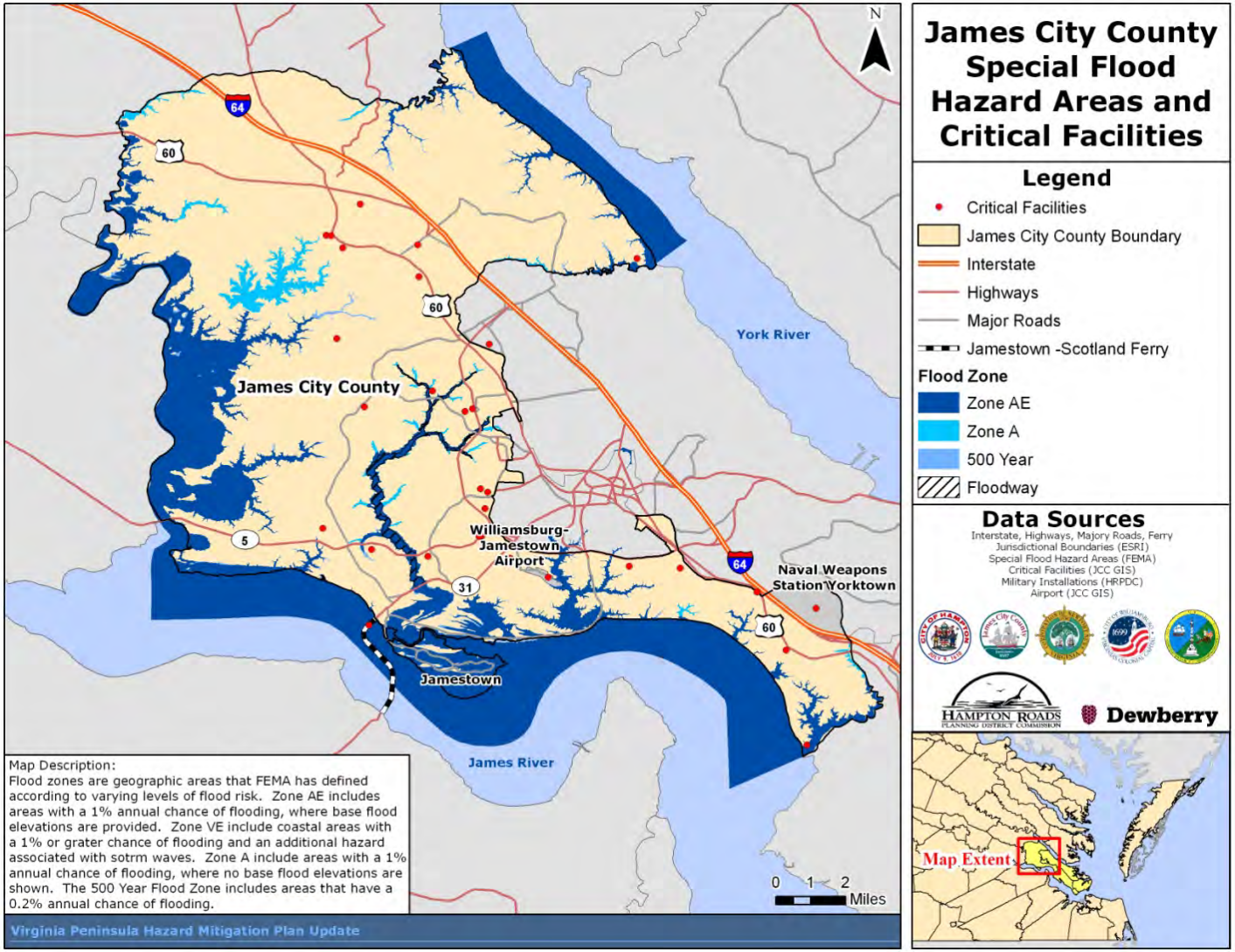

Figure 4-29: James City County local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

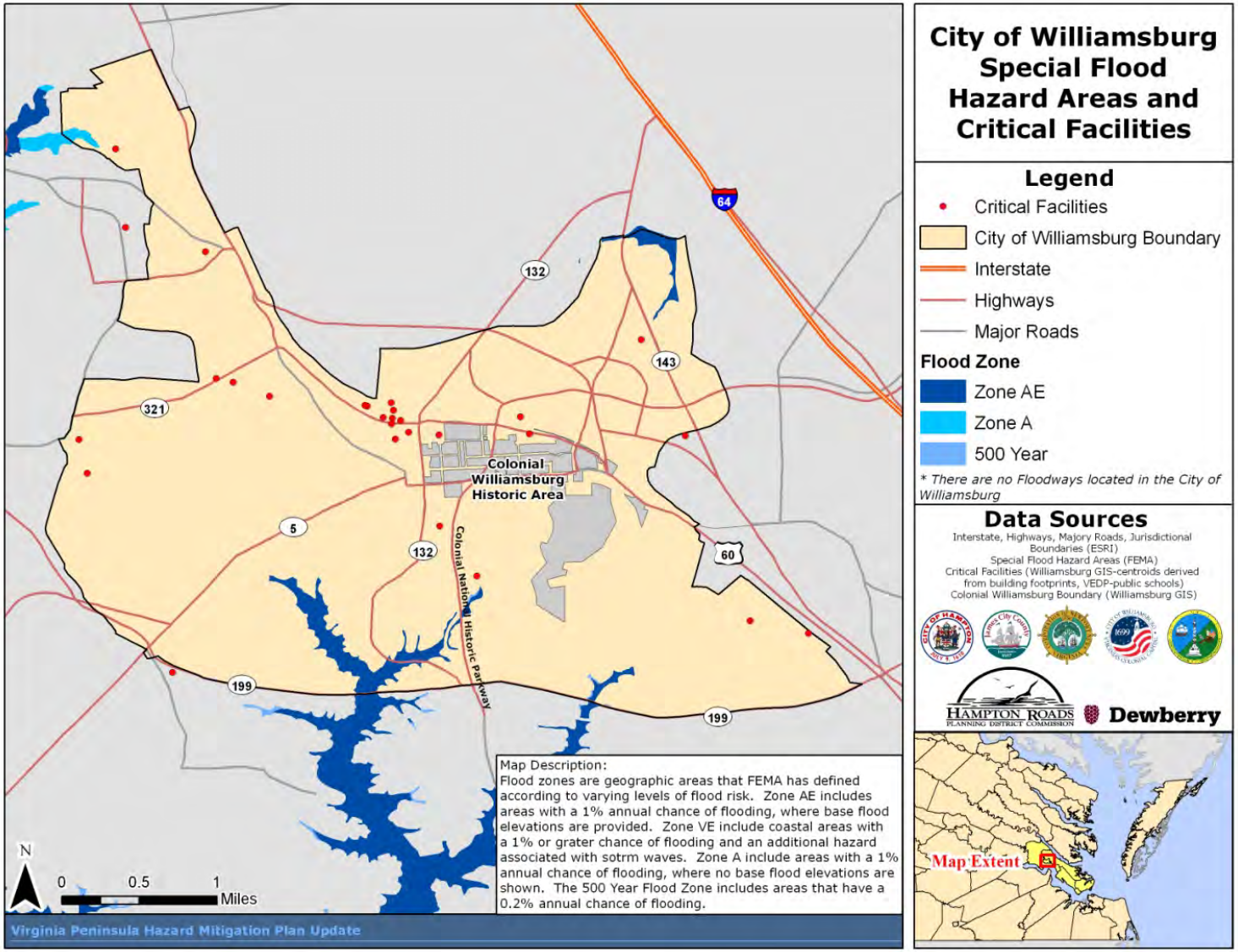

Figure 4-30: City of Williamsburg local critical facilities and Special Flood Hazard Areas (SFHA) as depicted on the FEMA Digital Flood Insurance Rate Maps (DFIRMs)

Existing Buildings and Infrastructure Risk

The most vulnerable properties to flooding on the Peninsula are located in flood hazard areas identified by FEMA through the completion of detailed flood insurance studies. Appendix E3 illustrates the location of these areas for each jurisdiction based upon the most up-to-date digital floodplain data as provided by the FEMA map service store (http://www.msc.fema.gov) and through VDEM and FEMA for preliminary DFIRMs. Digital data was available for all of the localities on the Peninsula.

Building footprint locations were provided by each of the participating jurisdictions. This GIS data was utilized to determine the number of buildings located within the mapped floodplains by intersecting the two layers. The building data provided for the 2011 update did not contain information of building improvement value or total property value. The next section summarizes the tax parcel analysis that was completed for the 2006 plan.

The Peninsula has over 237,303 mapped building footprints. Approximately 9% of the buildings are located within Zone AE and 5% located within the 500-year floodplain. Over 14% of the Peninsula's buildings are located within one of the mapped SFHAs. The majority of the buildings located within detailed studies reside in the City of Hampton. Over 19% of the city's buildings are located within Zone AE. As discussed above, the City of Hampton also has the largest number of repetitive and severe repetitive loss properties for the study area. York County has close to 11% of the county's buildings located within Zone AE. Table 4-52 summarizes the number of buildings mapped for each jurisdiction and the number of buildings located with the mapped SFHAs.

Table 4-52: Building footprints located within SFHAs.					
Jurisdiction	# of Buildings	# of Buildings in Zone AE	# of Buildings in Zone A	# of Buildings in Zone VE	# of Buildings in 500-year
City of Hampton	81,838	15,685	-	98	9,113
James City County	34,816	816	25	-	106
City of Newport News	79,794	1,750	36	78	831
City of Williamsburg	6,433	-	2	-	-
York County	34,422	3,668	61	91	2,164
TOTAL	**237,303**	**21,919**	**124**	**267**	**12,214**

2006 Analysis

Various offices provided both tax parcel data and tax assessor database or completed analysis of the results of intersecting the parcels with FEMA FIRMs. The analysis completed for 2006 included the 100-year flood hazard boundaries delineated on the existing FEMA FIRM for the jurisdictions included detailed, approximate, and V-zones. The shapefiles were merged into a single 100-year flood hazard layer and intersected with the parcel layer provided by the jurisdictions. Any tax parcel that intersected the delineated floodplain was considered as inside the floodplain and its building improvement value (when available) was added to the total property value in the 100-year floodplain. Table 4-53 summarizes the results of this analysis.

Results of the 2006 analysis and the 2011 analysis indicate that the majority of buildings and parcels located within risk zones are in the City of Hampton and York County. The remaining jurisdictions also have significant risk to flooding.

Table 4-53: Tax parcels located within SFHAs. (2006 HMP results)

Jurisdiction	Number of Parcels	Parcels in 100-yr Floodplain*	Improvement Value
City of Hampton	50,252	11,491	$3,211,924,600
James City County	-	2,133	$979,665,400
City of Newport News	53,585	4,596	$2,586,130,866
City of Williamsburg	-	-	-
York County	24,890	4,265	$1,393,066,000
TOTAL	**128,727**	**22,485**	**$8,170,786,866**

**includes detailed, approximate and V-zones.*

Hampton Roads Sanitation District Data

GIS and tabular data were provided by Hampton Roads Sanitation District, further described in the Regional and National datasets section of the HIRA methodology. The data includes the location and quantity of facility and infrastructure assets as well as asset values. The provided pump station and treatment plant data was intersected with the DFIRM data to determine what facilities and length of interceptors were located within mapped floodplains.

Table 4-54 summarizes the number of pump stations and treatment plants located within the mapped floodplains. The City of Hampton has five pump stations located within zone AE and one station in the 500-year floodplain. The City of Newport News has two pump stations and one treatment plant located within Zone AE, one within Zone AE with mapped floodway, one within the 500-year floodplain.

Table 4-55 summarized the interceptor length located within the mapped floodplains. Over 15% of the interceptor length is located within one of the mapped SFHAs. The City of Hampton has the most pipelines located within floodplains, specifically Zone AE.

Figure 4-31 through Figure 4-35 show the locations of the pump stations and interceptors in relation to the mapped SFHA. The station names, facility ID, and flood risk zones are available in Appendix E4.

It should be noted that the City of Hampton included pump stations with their critical facility data. York County provided sewer locations with their critical facility data. Analysis for these facilities is summarized above in the Critical Facility Risk section.

Table 4-54: Hampton Roads pump and treatment plant locations within SFHAs.						
Jurisdiction	Total Pump Stations	Total Treatment Plants	Pump Stations within zone AE	Pump Stations within zone AE with FW	Pump Stations within 500-year	Treatment Plants within zone AE
City of Hampton	10	0	5		1	
James City County	3	1	1			
City of Newport News	13	2	2	1	1	1
City of Williamsburg	1	0				
York County	3	1				
Total	**30**	**4**	**8**	**1**	**2**	**1**

Table 4-55: Hampton Roads interceptor length within SFHAs.					
Jurisdiction	Interceptor Length				
	Total Length	Zone A	Zone AE	Zone VE	500-year
City of Hampton	250,090.58	-	62,947.18	715.64	31,672.43
James City County	157,800.48	-	8,587.52	-	314.79
City of Newport News	329,045.82	7,345.45	14,745.84	3.15	4,825.90
City of Williamsburg	45,958.21	-	210.56	-	4.05
York County	123,227.46	1,122.47	4,614.32	580.73	3,376.27
Total	**906,122.56**	**8,467.92**	**91,105.42**	**1,299.52**	**40,193.44**

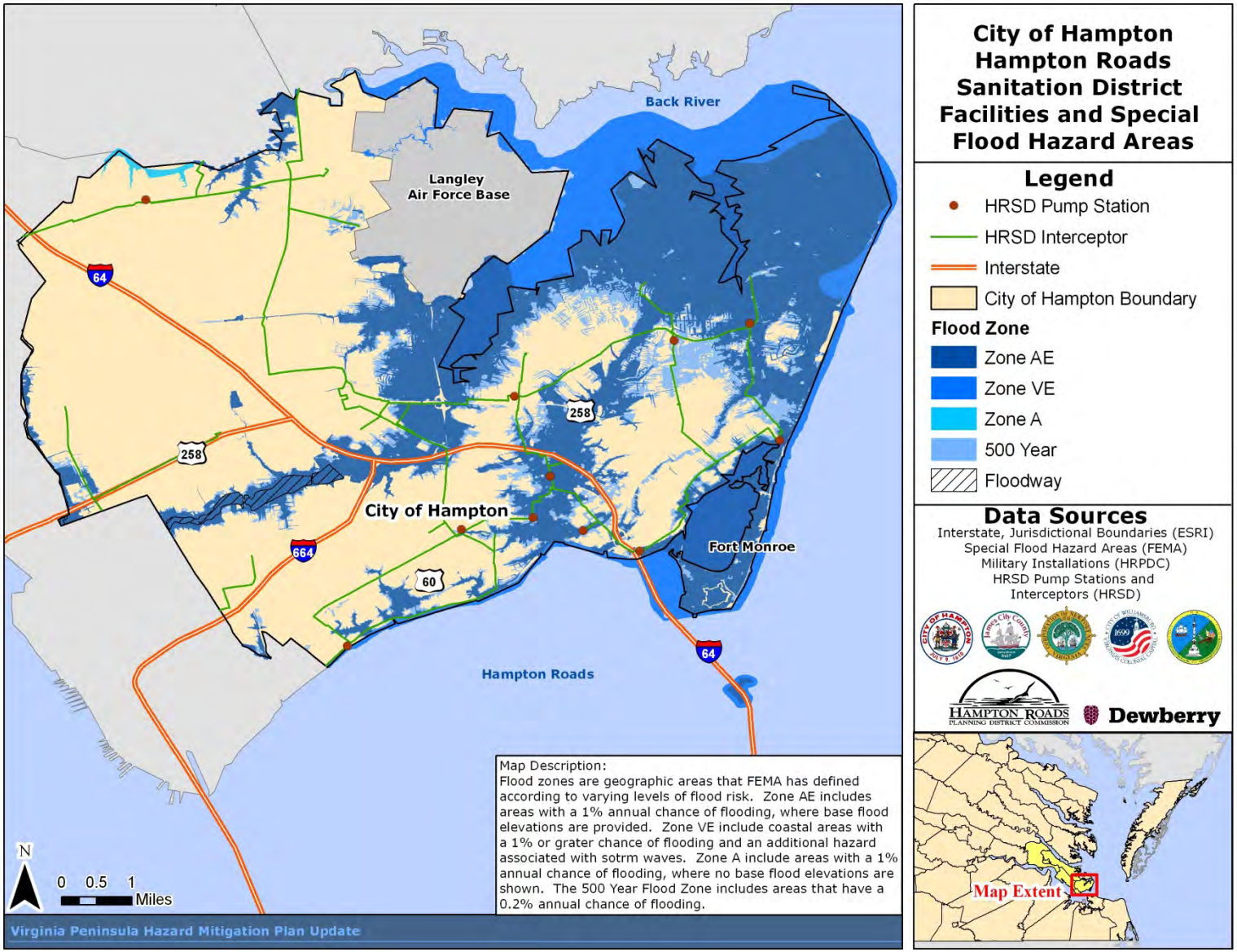

Figure 4-31: City of Hampton pump stations and SFHA as depicted on the FEMA DFIRMs

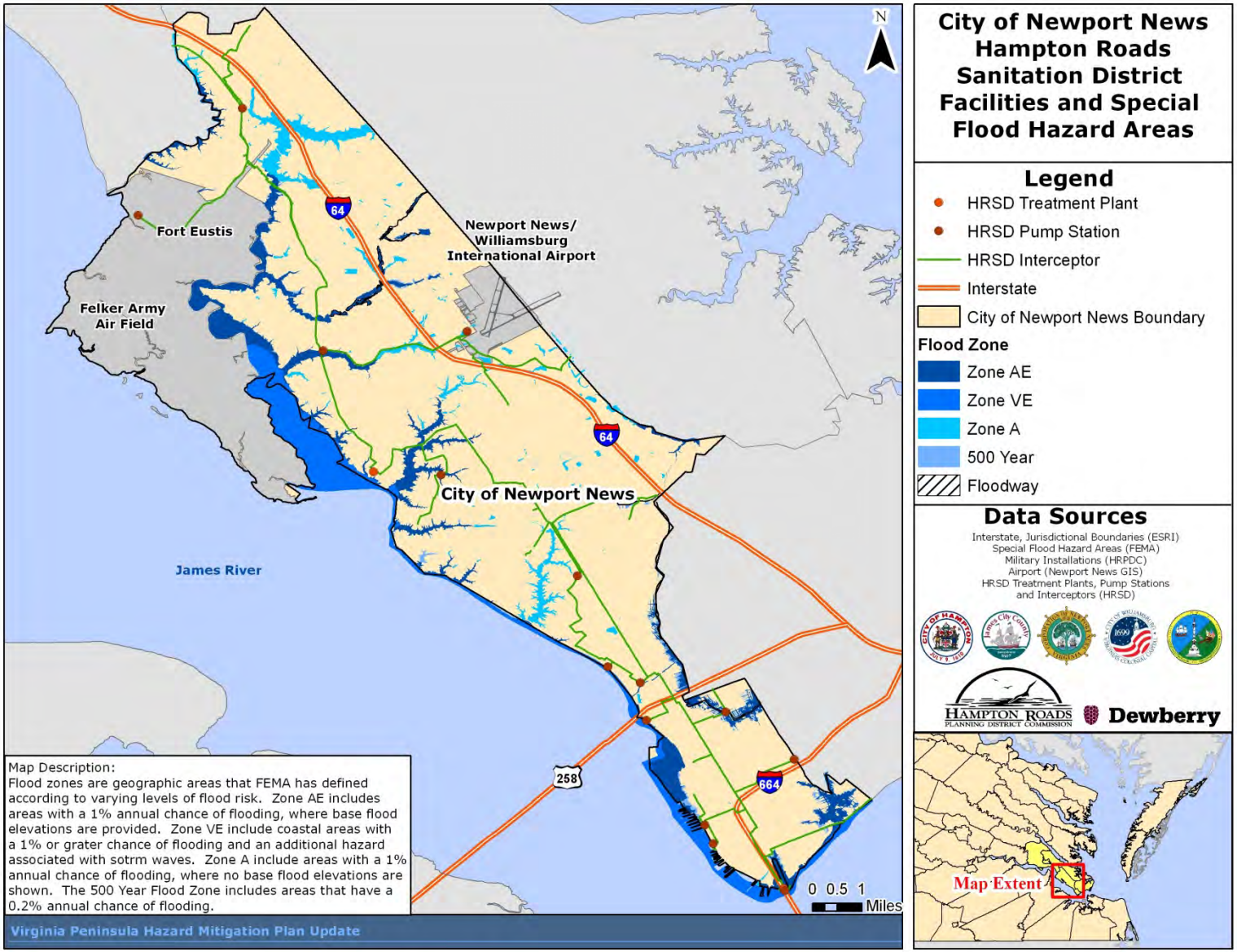

Figure 4-32: City of Newport News pump stations and SFHA as depicted on the FEMA DFIRMs

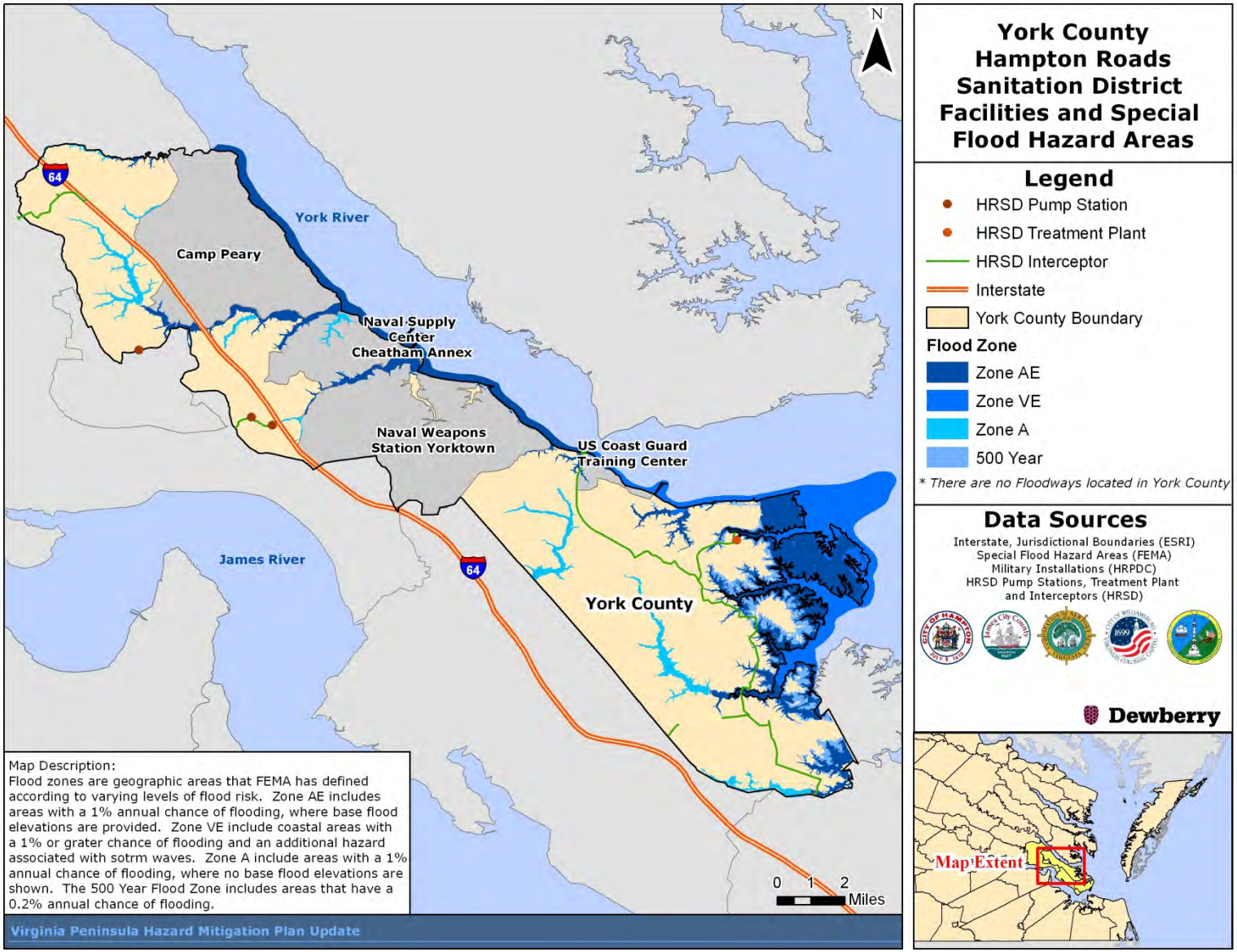

Figure 4-33: York County pump stations and SFHA as depicted on the FEMA DFIRMs

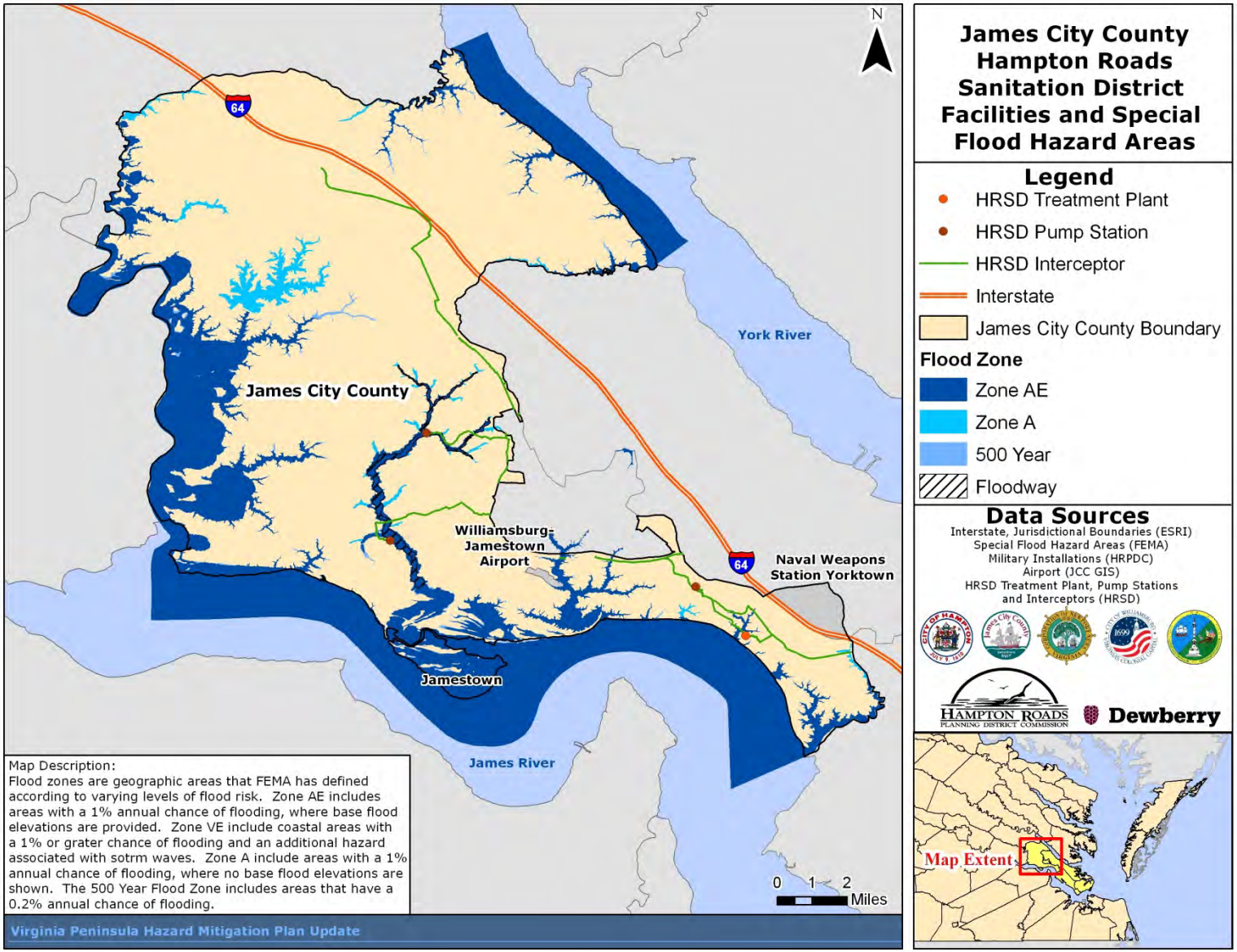

Figure 4-34: James City County pump stations and SFHA as depicted on the FEMA DFIRMs

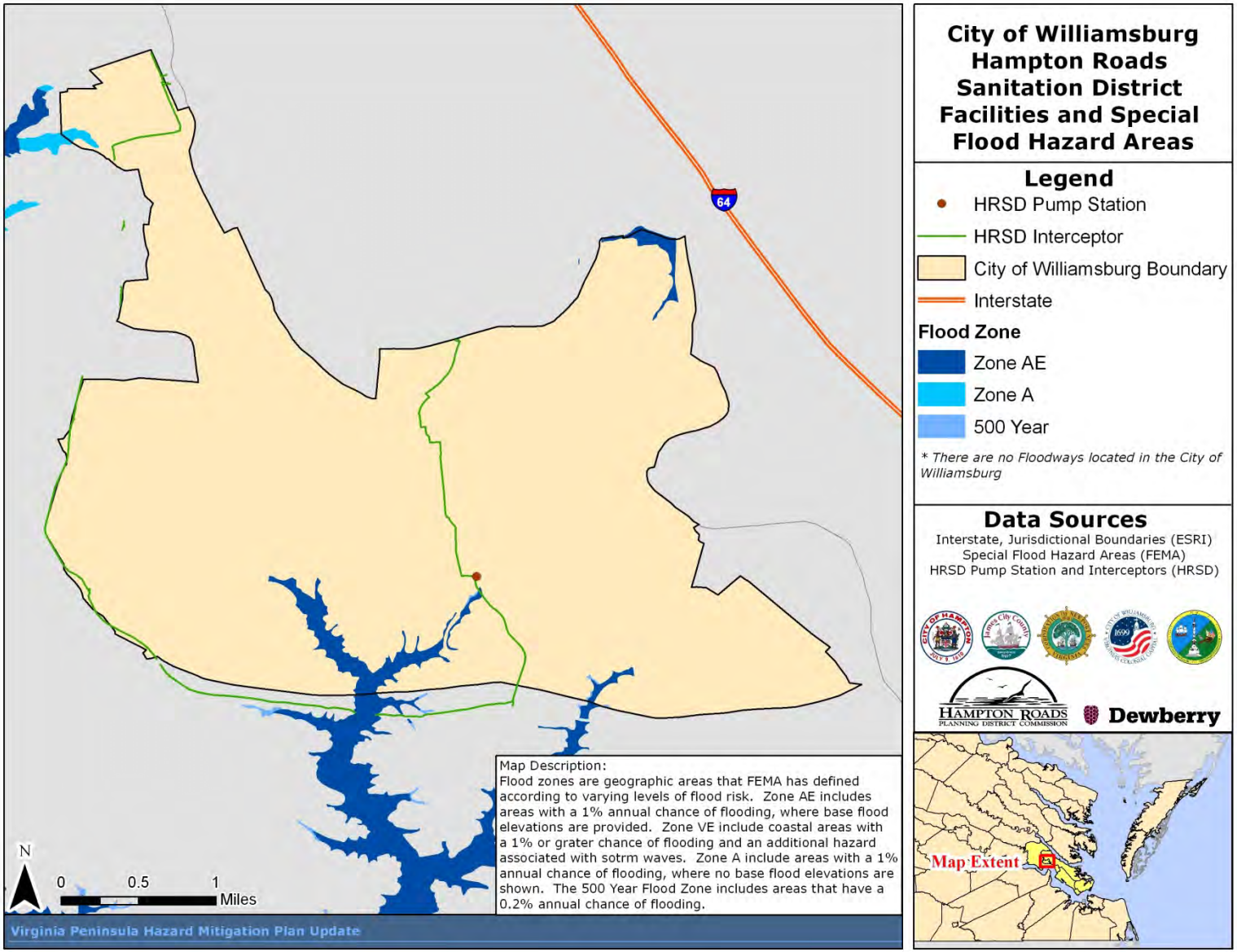

Figure 4-35: City of Williamsburg pump stations and SFHA as depicted on the FEMA DFIRMs

Hazard Summary

The loss estimates and ranking results for the flood hazard for the Peninsula is principally based on the results of the detailed GIS and HAZUS-MH MR4 analysis, and the NCDC storm events database. No loss estimates were provided in the 2006 analysis completed for this plan.

Since 1994, when the NCDC database started recording flood events, the Peninsula has been impacted by numerous instances of a flooding. Based on the NCDC data for flood events, there has been over $43,510,524 in property and $432,279, in total crop damages. To be able to determine annualized loss for the region, the total damages from NCDC were divided by the length of available record. HAZUS analysis is described above in the Risk Assessment section. Table 4-56 summarizes the annualized damages based on NCDC and HAZUS for each of the jurisdictions on the Peninsula. Prior to this period of record, very little historical damage data exists for past flood events.

Table 4-56: Flood Summary

Jurisdiction	Hazard Ranking	HAZUS Potential Annualized Losses	NCDC Potential Annualized Losses
James City County	Medium-High	$2,074,000	$57,412
York County	Medium-High	$11,457,000	$800,408
City of Hampton	Medium-High	$71,978,000	$560,234
City of Newport News	Medium-High	$8,052,000	$532,558
City of Williamsburg	Medium	$946,000	$795,813
OVERALL RESULTS	Medium-High	$94,507,000	$2,746,425

The Commonwealth of Virginia's 2010 hazard mitigation plan ranking was based on the NCDC database. The update to the Peninsula plan used this same framework to establish a common system for evaluating and ranking hazards. The geographic extent score for each jurisdiction is based on the percent of the jurisdiction that falls within the SFHA, as defined by FEMA. Figure 4-36 shows the seven parameters that were used to calculate the overall risk to flooding for the Peninsula.

As shown, the entire Peninsula, except for the City of Williamsburg, is ranked Medium-High. The City of Williamsburg received a Medium ranking for flooding which can be attributed to several of the ranking parameter scores (i.e., population vulnerability, damages, and geographic extent).

Refer to the Risk Assessment Methodology section of the HIRA for a full description of the methodology and the limitations of the data used for ranking the hazards. NCDC data, although limited, provides a comprehensive historical record of natural hazard events and damages.

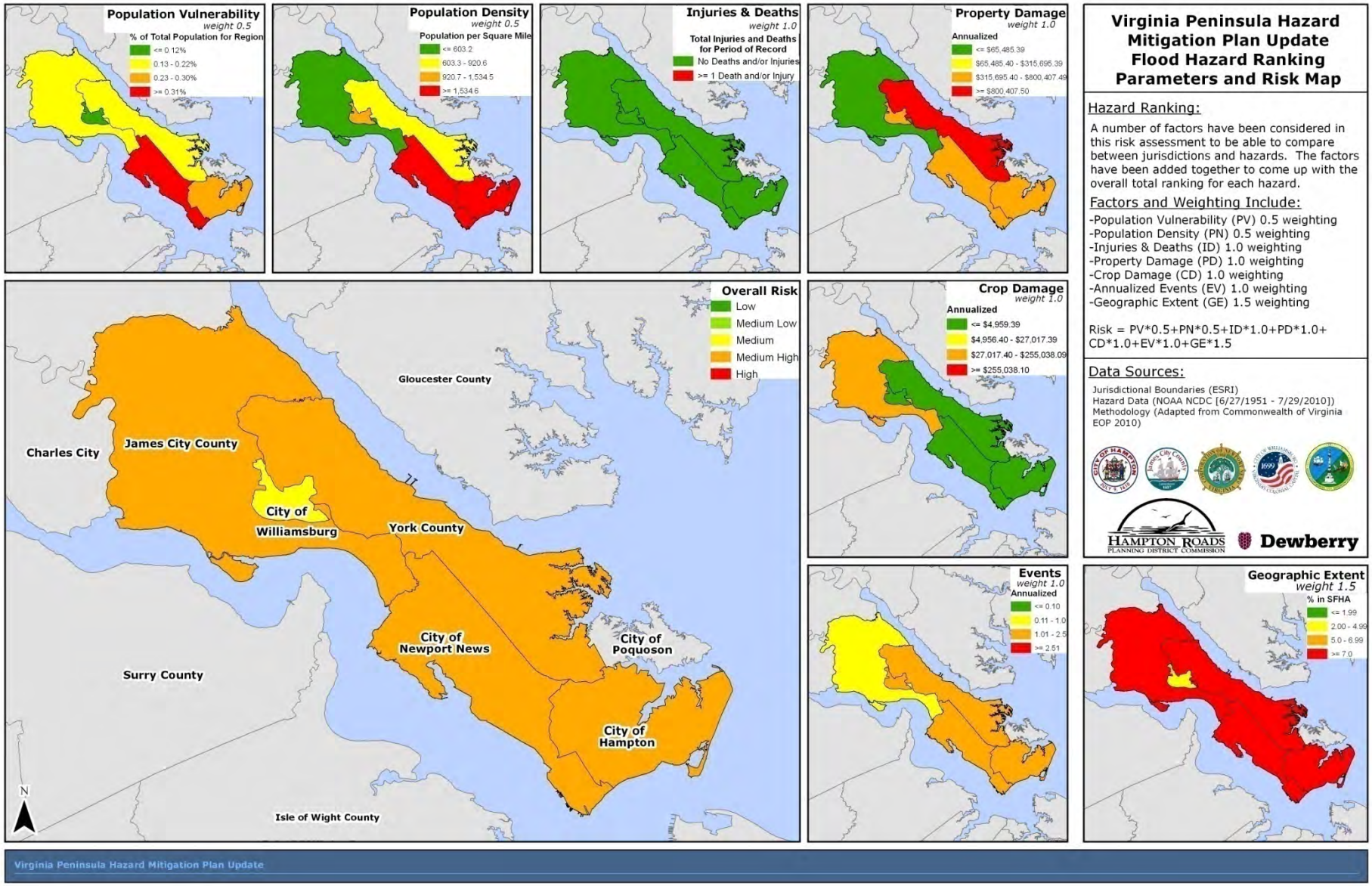

Figure 4-36: Flood Hazard Ranking Parameters and Risk Map

Additional Hazard Identification Areas of Interest

It was noted in the 2006 Hazard Mitigation plan that York County had been working with residents to identify and abate these drainage problems. As a result of Hurricane Floyd, Newport News Waterworks made changes to their reservoir management practices to be more proactive in adjusting reservoir elevations ahead of storm systems that are predicted to produce excessive rainfall amounts. Residents indicated that Little Brick Kiln Creek, which is on the Newport News/York County boundary, is a major outfall for several York County tributaries with very low slopes. Maintenance of the creek by all stakeholders (including the U.S. Army, which also has land holdings in the area) is critical to maintaining sufficient drainage using existing infrastructure.

Tornadoes

Hazard Profile

NOTE: As part of the 2011 plan update, the Tornado hazard was reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the hazard by jurisdiction using the methodology described in detail in HIRA Introduction section. Each section of the plan was also reformatted for improved clarity and new maps and imagery, when available and appropriate, were inserted.

Description

Tornadoes are one of nature's most violent storms. A tornado is characterized by a twisting, funnel-shaped cloud, most often circulating in a counterclockwise direction. Tornadoes are usually spawned by a thunderstorm (sometimes as part of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. They tend to occur in the afternoons and evenings; over 80% of all tornadoes strike between noon and midnight.

Geographic Location / Extent

In the U.S., the highest concentration of tornadoes has historically been in the Plains (See Figure 4-37) in an area that has been nicknamed "Tornado Alley." Tornado Alley is generally considered to run in a strip from Texas north to Nebraska. Another favored spot is the Southeast, near the Gulf Coast. Figure 4-38 presents the results of a tornado frequency analysis performed as part of the 2010 Commonwealth of Virginia Hazard Mitigation Plan update. The analysis suggests that relative to the entire Commonwealth of Virginia, southeastern Virginia including the Peninsula and portions of the DC metro area observe the highest tornado frequency of the Commonwealth. Even so, annualized tornado frequency is calculated as being between 0.0001 and 0.0003 for any particular point in these areas. On the Peninsula, no one particular jurisdiction experiences more tornadoes on average than any other. History shows that tornadoes can occur in any jurisdiction.

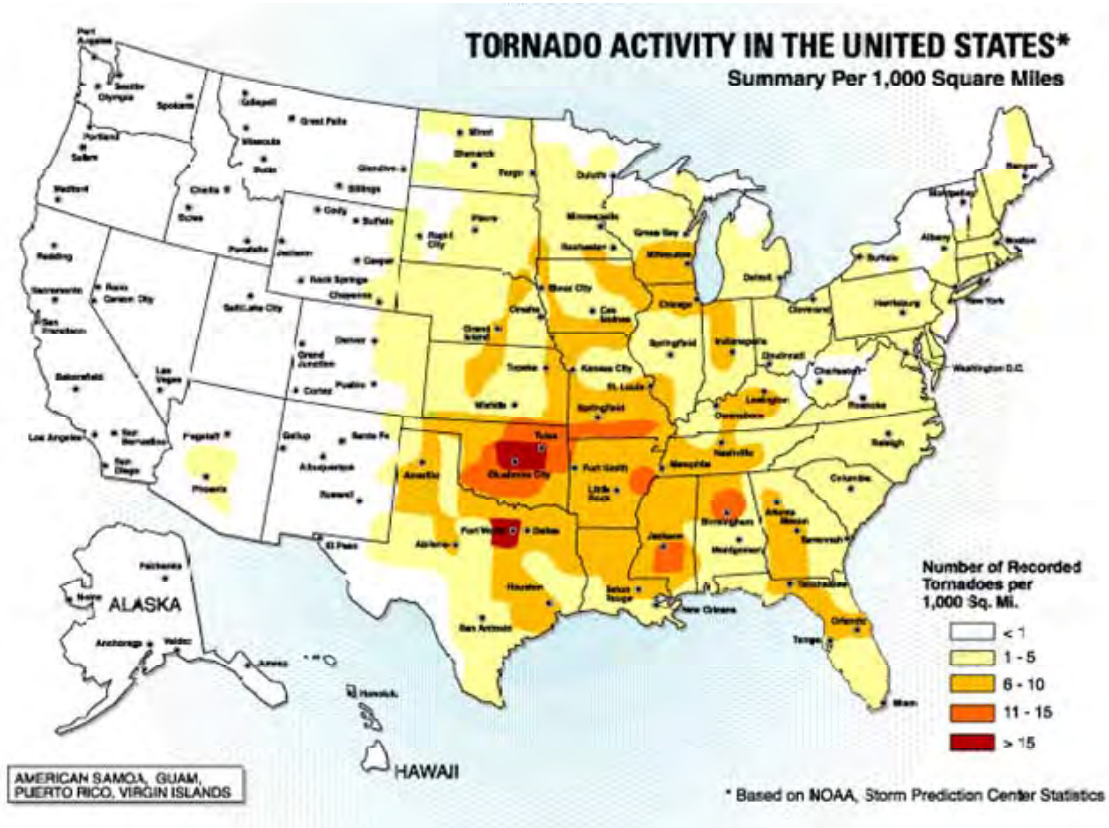

Figure 4-37: Tornado Activity in the United States. Source: American Society of Civil Engineers

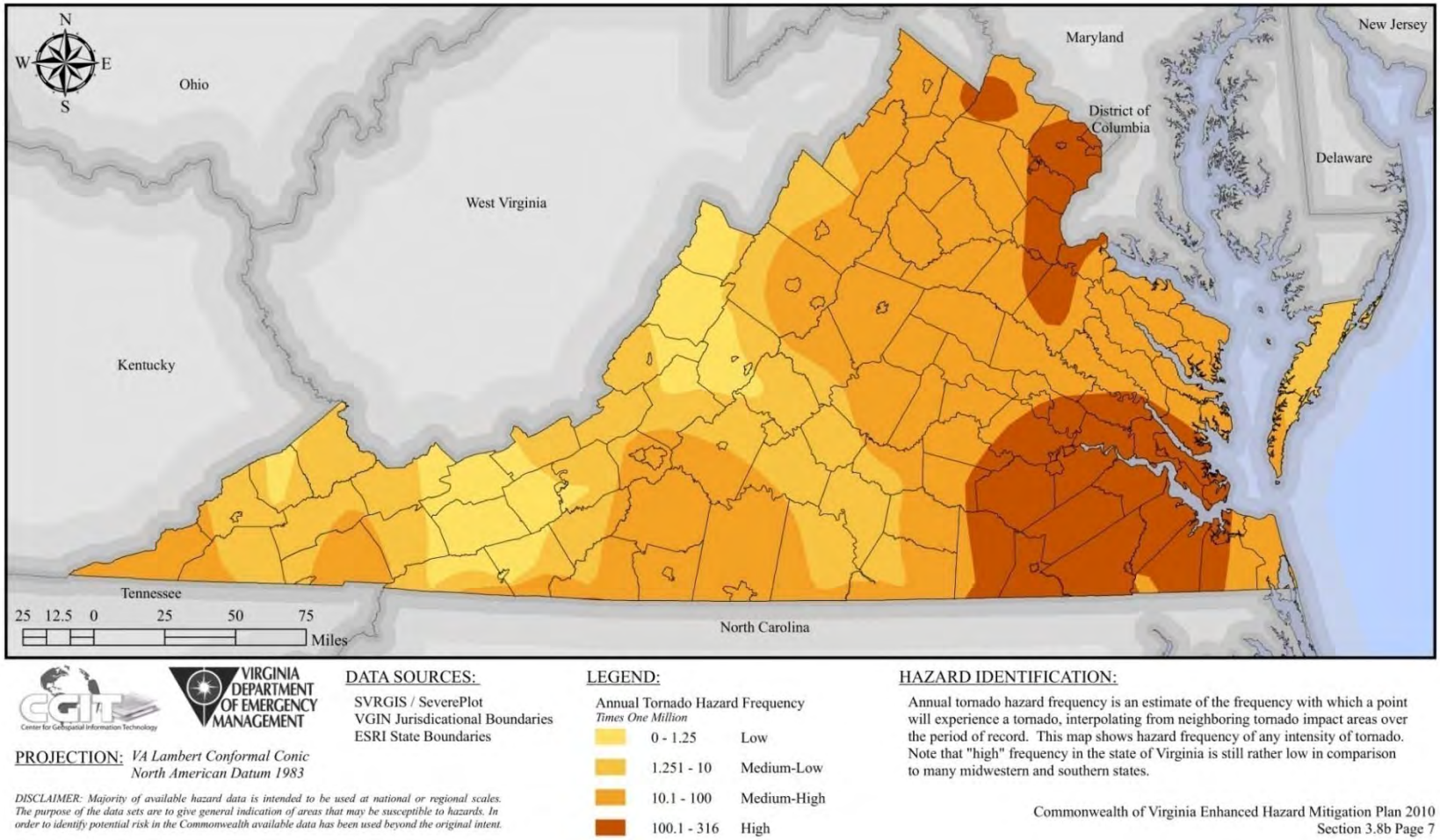

Figure 4-38: Tornado Hazard Frequency. Source: Commonwealth of Virginia Hazard Mitigation Plan

Magnitude or Severity

In an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. A tornado's destructive power is measured using the Fujita Damage Scale (see Table 4-57). The Fujita-Pearson Scale for Tornadoes was developed in 1971 to rate tornado intensity based on associated damages. A tornado's intense power often destroys homes, downs power lines, and can cause significant tree damage.

An Enhanced Fujita Scale (EF Scale) was developed and implemented operationally in 2007. The EF Scale was developed to better align tornado wind speeds with associated damages. Table 4-58 provides a side-by-side comparison of the F Scale and the EF Scale.

Table 4-57: Fujita Damage Scale

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	Light Damage Some damage to chimneys; branches off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate Damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable Damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe Damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating Damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Source: Fujita, 1971.

Table 4-58: Fujita Scale Vs. Enhanced Fujita Damage Scale				
Fujita Scale			Enhanced Fujita Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	**0**	**65-85**
1	73-112	79-117	**1**	**86-110**
2	113-157	118-161	**2**	**111-135**
3	158-207	162-209	**3**	**136-165**
4	208-260	210-261	**4**	**166-200**
5	261-318	262-317	**5**	**Over 200**

Source: National Weather Service

Most tornadoes on the Peninsula have occurred from June through October, and the magnitudes ranged from F0 to F3. The most significant tornado to strike the Peninsula in recent history was an F3 tornado with winds of between 136 to 165 mph occurring on Saturday, April 16, 2011. The twister initially touched down near the Surry Nuclear Power plant in Surry, VA and then tracked northeast across the James River into James City County, across the Peninsula into York County before crossing the York River and cutting a path of destruction through Gloucester County and portions of Matthew Counties.

Previously, the most significant event occurred when an F3 tornado touched down in the City of Newport News on September 5, 1979. The tornado cut a path 50 yards-wide and 3 miles-long, and caused an estimated $2.5 million in property damage. In addition to tornadoes over land, Peninsula residents are also subject to waterspouts.

Waterspouts are similar to tornadoes, but occur over water, are generally weaker, and are not necessarily associated with thunderstorms.

Previous Occurrences

According to NCDC records, the Peninsula has experienced 30 tornado events from 1950 through July 2010. Figure 4-39 graphically depicts the touchdown points and tracks as well as the Fujita scale rating for each of those events. As can be seen in the figure, most of these events have been recorded as either F0 or F1 events although there have also been some stronger F2 and F3 events. It should be noted that in several instances,

multiple tornado events occurring on different dates have been assigned the same latitudes and longitudes in the NCDC database. This is the result of a precise latitude and longitude of a tornado touchdown or track within a particular jurisdiction(s) for some events being unknown. In these instances, tornadoes are plotted in a centralized jurisdictional location for date and intensity purposes only.

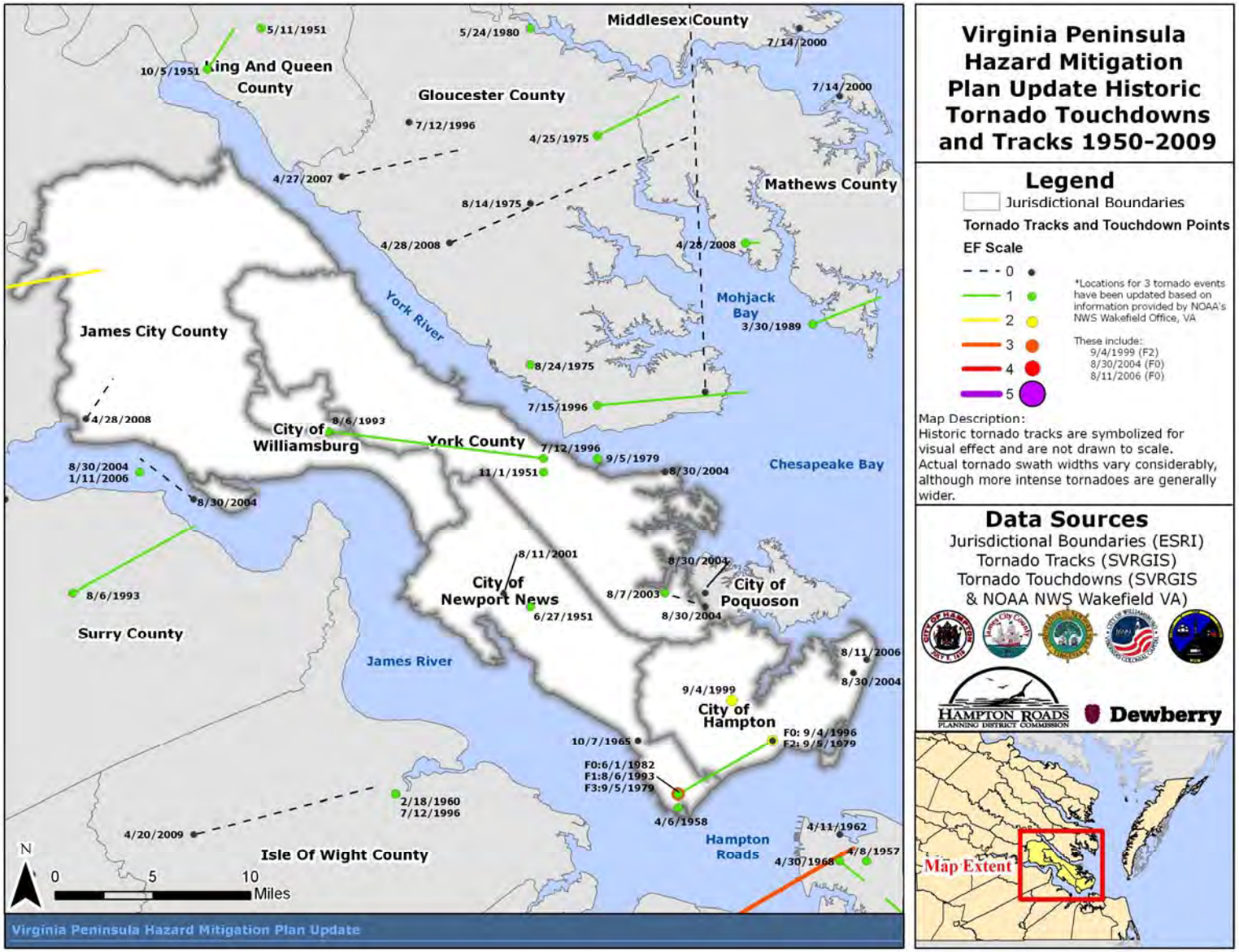

Figure 4-39: Historical Tornado Touchdowns and Tracks

The tornado history compiled for Table 4-59 provides information on Peninsula tornadoes that caused significant damage, and was compiled from the NCDC database and Watson (2004b). The list begins with a storm in 1951. Quite obviously, tornadoes occurred on the Peninsula before 1951, but records of these storms were not readily available for the purposes of this plan. As with lighting strikes, if there is no sighting or confirmation of a tornado, inclusion in the body of tornado statistics is not likely, so this table should not be considered an all-inclusive list of tornadoes impacting the Peninsula.

Table 4-59: Previous Significant Tornado Events

Date	Community	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Associated Tropical Cyclone?
June 27, 1951	Newport News	F1	0	0	$3K	0	No
November 1, 1951	York County	F1	0	0	$3K	0	No
April 6, 1958	Newport News	F1	0	0	$250K	0	No
October 7, 1965	Newport News	F0	0	0	$3K	0	No
September 5, 1979	Newport News	F3	0	2	$2.5M	0	Yes, David
September 5, 1979	Hampton	F2	0	9	$250K	0	Yes, David
June 1, 1982	Newport News	F0	0	0	$0K	0	No
August 6, 1993	Hampton & Newport News	F1	0	10	$5.0M	0	No
July 12, 1996	York County	F1	0	0	$15K	0	Yes, Bertha
September 4, 1996	Hampton	F0	0	0	$1K	0	Yes, Fran
September 4, 1999	Hampton	F2	0	6	$7.7M	0	Yes, Dennis
August 11, 2001	Newport News	F0	0	0	$50K	0	No
August 7, 2003	York County	F1	0	0	$20K	0	No
August 30, 2004	Hampton	Not reported	0	0	Not reported	0	Yes, Gaston

Table 4-59: Previous Significant Tornado Events							
Date	Community	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Associated Tropical Cyclone?
August 11, 2006	Hampton	Not reported	0	0	1.1.1 ot reported	0	No
January 11, 2006	James City County	F1	0	2	$20K	0	No
April 28, 2008	James City County	F0	0	0	$200K	0	No
April 16, 2010*	James City County, York County	EF3	3 in Gloucester County	24	N/A	N/A	No

Sources: NCDC and Watson 2004b.

*NOTE: Information is preliminary based on an NWS survey of damage

As described above in the Magnitude or Severity section, significant tornado events of the past include an EF-3 tornado that impacted James City and York Counties, including Grove the evening of Saturday, April 16, 2011. Damage was reported to approximately 36 buildings and numerous trees were downed, blocking roadways. The tornado injured 24 people and killed three others in Gloucester County. The tornado was just one in a major outbreak of over 200 tornadoes that impacted the Plains, the Southeast and part of the Mid-Atlantic over a three day period in which at least 44 people lost their lives.

An F1 tornado on January 11, 2006, touched down briefly, injuring two people in a campground in James City County. An F2 twister occurred on September 4, 1999, preceding what had formerly been Hurricane Dennis but was Tropical Storm Dennis at the time of landfall in North Carolina. This tornado caused extensive structural damage to a three block area in the City of Hampton. As a result, fifteen to thirty (depending on the source) people were injured (six seriously) and three apartment complexes and an assisted living facility were condemned. Ten cars and an 18 wheel tractor trailer were flipped over.

A tornado struck Newport News a little past 3 p.m. on August 6, 1993. A man on the James River Bridge saw three funnel clouds over the river. Two dissipated and the third touched down moving through the woods on the Newport News side of the river. The tornado tracked 12 miles through the Cities of Newport News and Hampton and Langley Air Force Base. The tornado injured at least eight people in the City of Newport News. In the

City of Hampton, two people were injured, 85 homes were damaged, eight condemned with damage costs near three-quarters of a million dollars. On Langley, the tornado damaged several F-15s parked at the end of a runway for an air show scheduled for the next day.

In James City County, a tornado occurred on October 14, 1986, which generated wind of 110 mph and caused $1.8 million in damages. Two significant tornadoes impacted the Peninsula in association with Hurricane David on September 5, 1979. Two people were injured and approximately $2 million in damage resulted when an F3 tornado touched down in the City of Newport News. The City of Hampton was struck by an F2 tornado that injured nine people and caused over a half million dollars in damage.

Risk Assessment

Probability of Future Occurrences

Based on historical frequency of occurrence using NCDC (or other) data, a reasonable determination of probability of future tornado events can be made. Although relatively infrequent, tornadoes have had significant impacts on the Peninsula in the past and are likely to impact the Peninsula in the future. An examination of NCDC data suggests that on an annual basis, approximately 0.12 to 0.14 tornadoes occur in any particular Peninsula jurisdiction (see Table 4-60). In other words, on average, an individual Peninsula jurisdiction is impacted by a tornado every seven to nine years.

The NCDC database shows that there have been no reports of tornadoes in the city limits of Williamsburg dating back to 1951. It is important to point out that some tornadoes go unobserved and others unreported. In both instances, tornadoes that may have impacted Williamsburg would not show up in the NCDC statistics. It should not be inferred that Williamsburg has a lower probability of seeing tornadoes as compared to other Peninsula jurisdictions based solely on this data. It is instead recommended that the NCDC tornado data for Williamsburg be considered an anomaly and that the probability of future tornado occurrences be interpolated based on the past occurrences observed in neighboring jurisdictions.

Climate change is projected to increase the frequency and intensity of extreme weather events,[37] including severe thunderstorms. At this time, it remains uncertain if this might also translate into an increased frequency of tornadoes. Future plan updates should consider a review of the latest climate science to determine what impact, if any, climate change might have

on the future frequency or intensity of tornadoes and how this might apply to the Peninsula.

Table 4-60: Annualized Tornado Events from NCDC Storm Events Data (Years of record: 1951 – July 2010)	
Jurisdiction	**NCDC Annualized Events (Events Per Year)**
James City County	0.14
York County	0.12
City of Hampton	0.12
City of Newport News	0.14
City of Williamsburg	0

Impact & Vulnerability

Tornadoes are considered to be low frequency, high-impact events. Despite the City of Williamsburg not having any reported direct tornado hits within the city limits dating back to 1950 (See Table 4-61), the Peninsula region faces nearly uniform susceptibility to tornadoes.

Electrical utilities and communications infrastructure are vulnerable to tornadoes. Damage to power lines or communication towers has the potential to cause power and communication outages for residents, businesses and critical facilities. In addition to lost revenues, downed power lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires.

A structure's tornado vulnerability is based in large part on building construction and standards. Other factors, such as location, condition and maintenance of trees also plays a significant role in determining vulnerability.

Human vulnerability is based on the availability, reception and understanding of early warnings of tornadoes (i.e., Tornado Warning issued by the NWS) and access to substantial indoor shelter. In some cases, despite having access to technology (computer, radio, television, outdoor sirens, etc.) that allows for the reception of a warning, language differences are sometimes a barrier to individuals understanding them. Once warned of an impending tornado hazard, seeking shelter indoors on the lowest floor of a substantial building away from windows is recommended as the best protection against bodily harm.

Table 4-61: Tornado Impacts (Years of record: 1951 – July 2010)			
Jurisdiction	NCDC Total Events	NCDC Deaths	NCDC Injuries
James City County	8	0	12
York County	7	0	0
City of Hampton	7	0	15
City of Newport News	8	0	2
City of Williamsburg	0	0	0

Risk

As is evident in property loss figures (see Table 4-62) obtained from the NCDC, tornadoes have the potential to be very destructive. Total property losses (adjusted for inflation) for the participating Peninsula jurisdictions is about $35.7 million which equates to approximately $605,884 on an annual basis. Losses have been highest for James City County ($11.5 million) followed closely by the City of Hampton ($10.9 million) and then the City of Newport News ($9.5 million). Although twisters can wipe out entire fields of crops, NCDC records do not contain any tornado-related crop losses for the jurisdictions of interest.

Table 4-62: Annualized Tornado Impacts				
Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Total Annualized Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
James City County	$11,543,578.96	$195,653.88	$195,653.88	$0
York County	$3,863,642.26	$65,485.46	$65,485.46	$0
City of Hampton	$10,853,093.45	$183,950.74	$183,950.74	$0
City of Newport News	$9,486,847.87	$160,794.03	$160,794.03	$0
City of Williamsburg	$0	$0	$0	$0
TOTAL	**$35,747,162.54**	**$605,884.11**	**$605,884.11**	**$0**

Based on the available data, the Tornado hazard is ranked High for the City of Newport News; Medium-High for James City County and City of Hampton;

and Medium for York County and the City of Williamsburg (see Table 4-64 in the Hazard Summary section and Figure 4-40). The criteria used for ranking the tornado hazard are detailed in the Hazard Ranking Methodology section.

Critical Facility Risk

In-depth, quantitative assessments of critical facilities for tornado risk were not feasible for this plan update. Even so, the type and age of construction plays a role in the vulnerability of facilities to tornadoes. In general, concrete, brick and steel-framed structures tend to fare better in tornadoes than older, wood-framed structures or manufactured homes. Finally, not all critical facilities have redundant power sources and may not even be wired to accept a generator. Future plan updates should consider closer examination of critical facilities risk by looking at construction type of critical facilities in jurisdictions considered to be at higher risk of tornadoes.

A cursory examination of those critical facilities located in 'High' tornado hazard areas shows there are approximately 181 critical facilities (based on GIS data provided by each jurisdiction; facility dollar values not provided) located within Newport News, which for the 2011 plan update is ranked as being 'High' for the tornado hazard. Table 4-63 shows a generalized breakdown of the types of critical facilities in Newport News.

Table 4-63: Critical Facilities in 'High' Tornado Hazard Area

Jurisdiction	Law Enforcement (Including Police)	Fire / EMS	Hospital / Medical	Schools / Education	Emergency Management	Other
City of Newport News	13	13	4	38	1	112

In addition to police, fire, hospital and other facilities, utility companies and the services they provide also have significant potentially vulnerable assets in the 'High' tornado hazard area. For instance, Hampton Roads Sanitation District has nearly $687 million in infrastructure (pipes, stations, treatment plants, etc.) assets located within Newport News. Newport News Waterworks has nearly $300 million in infrastructure exposure in Newport News.

Existing Buildings and Infrastructure Risk

Risk to existing buildings and infrastructure is largely determined by building construction type including construction method, materials and roof span. As

mentioned above, concrete, brick and steel-framed structures tend to fare better in tornadoes than older, wood-framed structures.

Hazard Summary

Tornadoes are low-frequency, high-impact hazards. Calculations based on historical data suggest that the participating Peninsula jurisdictions experience approximately $605,884 in losses on an annualized basis.

Table 4-64: Tornado Summary

Jurisdiction	Hazard Ranking	Potential Annualized Losses (based on NCDC)
James City County	Medium-High	$195,653.88
York County	Medium	$65,485.46
City of Hampton	Medium-High	$183,950.74
City of Newport News	High	$160,794.03
City of Williamsburg	Medium-High	$0
	TOTAL	**$605,884.11**

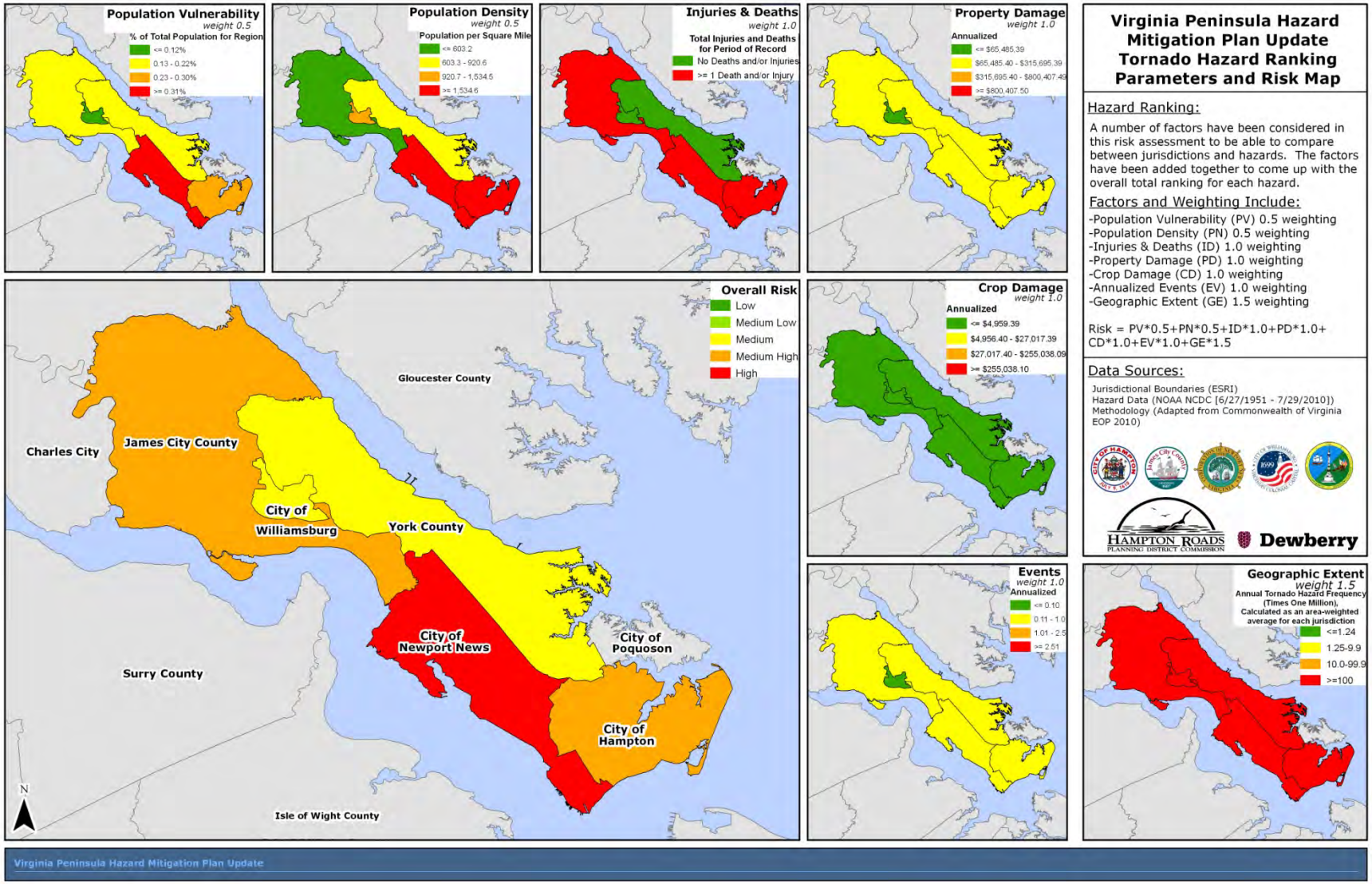

Figure 4-40: Tornado Hazard Ranking

Thunderstorms

Hazard Profile

NOTE: As part of the 2011 plan update, the Thunderstorm hazard was reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the hazard by jurisdiction using the methodology described in detail in HIRA Introduction section. Each section of the plan was also reformatted for improved clarity and new maps and imagery, when available and appropriate, were inserted.

Description

Virginia averages 40 to 50 thunderstorm days per year.[38] Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months, and in conjunction with frontal boundaries. Thunderstorms are generally beneficial because they provide needed rain for crops, plants, and reservoirs. About 5% of thunderstorms become severe and can produce tornadoes, large hail, damaging winds, and heavy rains causing flash flooding. Thunderstorms can develop in less than 30 minutes, allowing little time for warning. The NWS does not issue warnings for ordinary thunderstorms nor for lightning. The NWS highlights the potential for thunderstorms in daily forecasts and statements. Thunderstorms often create hazardous boating conditions for Peninsula mariners, who must be diligent in monitoring weather broadcasts for advance notice of late afternoon squalls or squall lines.

All thunderstorms produce lightning, which can be deadly. A bolt of lightning can strike 10 to 15 miles from the rain portion of a thunderstorm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to eight miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm but it is still a part of that storm. Lightning bolts may come from the front, side or back of the storm, even striking after the rain and storm seem to have passed, or striking areas missed by rain. It is these types of strikes that reportedly come from “out of the blue” and “without warning.”

Geographic Location/Extent

Although most frequent in the Southeast and parts of the Midwest, thunderstorms are a relatively common occurrence across the Peninsula and have been known to occur in all calendar months. No one portion of the Peninsula is deemed to be more likely to experience thunderstorms than another portion of the region.

Magnitude or Severity

Thunderstorms bring the possibility of multiple hazards including hail, damaging winds, lightning, and torrential rainfall which can produce flooding. Straight-line winds, which in extreme cases have the potential to cause wind gusts that exceed 100 miles per hour, are responsible for most thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to that of a tornado and can be extremely dangerous to aviation.

Hail greater than ¾" diameter can cause damage to building roofs, siding, and windows, as well as vehicles and crops. Thunderstorms have been known to produce very large hail that occasionally exceeds 2" in diameter.

Between 1959 and 2000, lightning killed 58 people in Virginia and injured at least 238.[39] On the Peninsula, there have been at least 13 noteworthy cloud-to-ground lightning strikes since 1993, as shown in Table 4-65. These significant lightning events represent only a tiny fraction of the total number of lightning occurrences, both in-cloud (never reaching the ground) and cloud-to-ground strikes. The majority of the damage caused by lightning in the area was related to home strikes, and power line failures. Lightning strikes since 1993 have injured one person and killed at least one other on the Peninsula. A typical 100-million volt lightning flash can heat the air to more than 40,000 degrees in an instant. This amazing amount of power can damage homes, down trees and power lines, and take lives. The best defense against this natural hazard is to recognize the danger and take shelter when appropriate.

Heavy downpours associated with thunderstorms have the potential to push rivers, creeks and streams out of their banks and to overwhelm storm water management infrastructure, resulting in flash flooding. Flooding is discussed in greater detail in the Flood hazard section.

Previous Occurrences

Table 4-65: Previous Significant Thunderstorm Events					
Date	Event	Jurisdiction(s) Impacted	Death	Injury	Damage / Comments
5/8/1984	Thunderstorm Winds	Newport News	1		Thunderstorm wind gusts are blamed for 1 fatality; no details given.
4/1/1993	Lightning	Williamsburg	0	0	$50K
9/4/1993	Lightning	Norfolk	0	1	$500K
5/26/1994	Thunderstorm Winds	Hampton		3	$500K; A condominium under construction was flattened injuring 3 workers; 199-foot radio tower downed
7/17/1995	Lightning	Williamsburg	0	0	$25K
11/11/1995	Thunderstorm Winds	James City County	0	1	One person injured when tree fell onto a mobile home
1/2/1996	Lightning	Williamsburg	0	0	$20K
5/1/1997	Hail	Hampton, Newport News			$1M; Widespread damage to homes, businesses and vehicles
6/13/1998	Hail	Hampton			$5K
6/19/2000	Lightning	Newport News	0	0	$100K
7/15/2000	Lightning	Grafton	0	1	$20K
8/24/2000	Lightning	James City County	0	0	$100K
5/29/2003	Hail	Hampton			$5K; numerous windshields broken
7/16/2003	Lightning	Hampton	0	0	$5K
8/30/2003	Lightning	Jamestown	1	0	$0
9/20/2005	Lightning	James City County	0	0	Roof damaged by fire, holes in roofs/walls
6/6/2007	Lightning	Newport News	0	0	$80K; lightning sparked a roof/attic fire
6/29/2007	Large Hail	James City County	0	0	$250K; hail damaged grapes and vines at a local vineyard
6/29/2007	Thunderstorm Winds	James City County	0	0	$1M; Three planes overturned/severely damaged at Williamsburg-Jamestown Airport
5/20/2008	Large Hail	Hampton	0	0	Hail 1.75” in diameter was reported

Table 4-65: Previous Significant Thunderstorm Events					
Date	Event	Jurisdiction(s) Impacted	Death	Injury	Damage / Comments
8/15/2008	Lightning	Hampton	0	0	$1K; lightning struck a tree which knocked over a power pole
1/7/2009	Thunderstorm Winds	Newport News	0	0	$10K; thunderstorm winds damaged roofs and toppled trees
4/6/2009	Large Hail	York County	0	0	Hail 0.75" or larger broke windows in several vehicles
4/6/2009	Thunderstorm Winds	Newport News			$25K; Straight-line thunderstorm winds of up to 70 mph produce significant structural damage to building on Jefferson Avenue and toppled trees in Newport News.
4/6/2010	Lightning	York County	0	0	$5K; lightning struck a home and blew a hole in the roof, sparking a small fire

NCDC significant thunderstorm-related wind, hail, and lightning events occurring between 1957 and July 2010 have been plotted in Figure 4-41. It should be noted that in several instances, multiple events occurring on different dates have been assigned the same latitudes and longitudes in the NCDC database. This is likely the result of a precise latitude and longitude within a particular jurisdiction for some events being unknown.

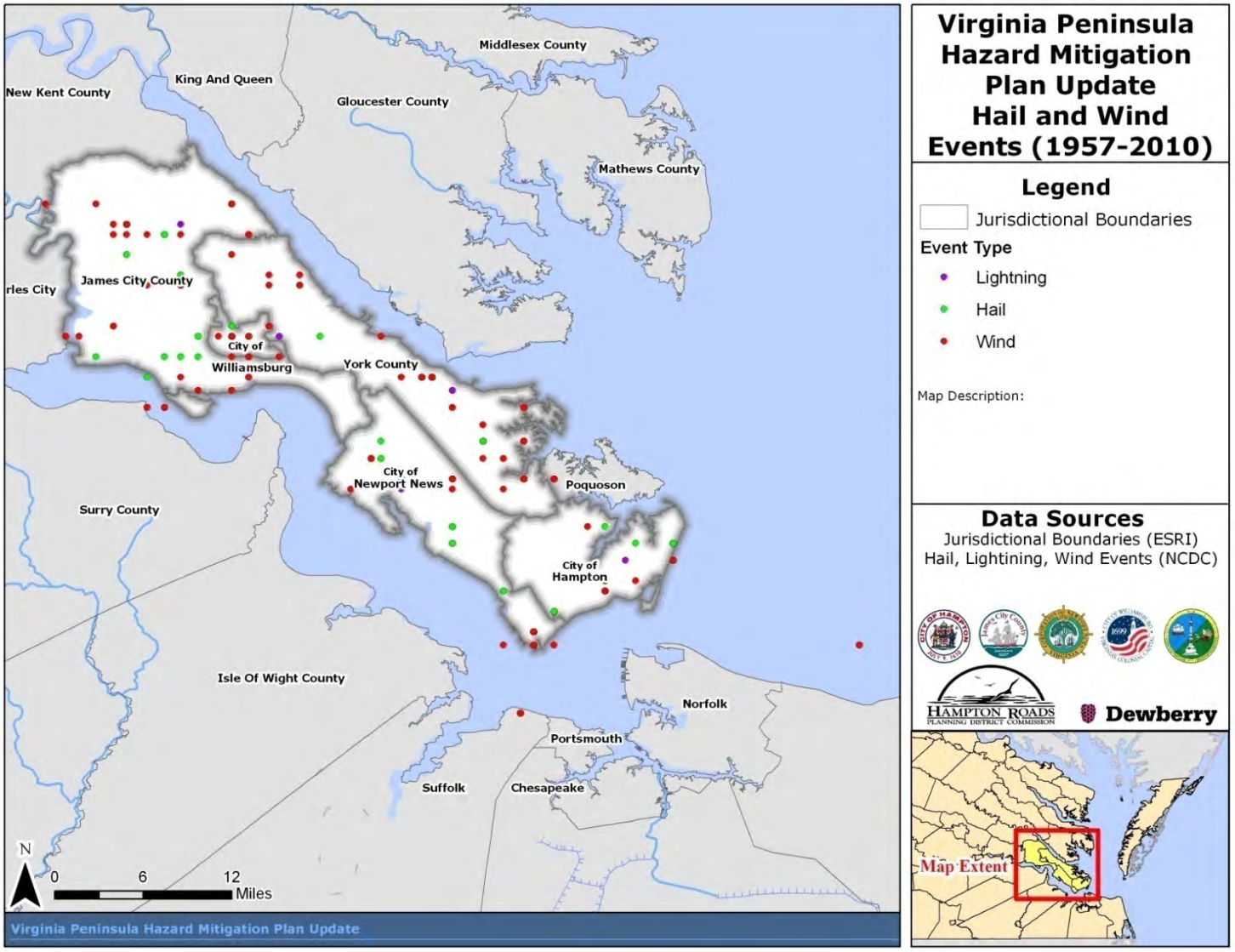

Figure 4-41: NCDC Significant Thunderstorm Wind, Hail and Lightning Events 1957 – July 2010

Risk Assessment

Probability of Future Occurrences

Because significant thunderstorms are difficult to predict, it is extremely difficult to determine the probability of future occurrence with any degree of accuracy. It can, however, with considerable confidence, be projected that the Peninsula will continue to experience thunderstorms in the future. Based on analysis of previous events in the NCDC database, it appears that thunderstorm events causing injury, death or damage have occurred on a seemingly random basis. The number of significant thunderstorm events in the database since the mid-1990s averages to just under two events per year in York County, and just over one event per year in James City County, the City of Hampton, and the City of Newport News (see Table 4-66). The database contained fewer records of significant thunderstorm events in the City of Williamsburg where resulting calculations estimate that there are approximately 0.58 significant thunderstorm events annually.

Table 4-66: Annualized Significant Thunderstorm Events from NCDC Storm Events Data

Jurisdiction	NCDC Annualized Events (Events Per Year)
James City County	1.26
York County	1.74
City of Hampton	1.15
City of Newport News	1.23
City of Williamsburg	0.58

Climate change is projected to increase the frequency and intensity of extreme weather events, including severe thunderstorms. Using global climate models and a high-resolution regional climate model, one study that investigated the link between severe thunderstorms and global warming found a net increase in the number of days with environmental conditions that foster the development of severe thunderstorms. This was true for much of the U.S., including eastern Virginia.[40]

Impact & Vulnerability

The Peninsula region faces nearly uniform susceptibility to the effects of significant thunderstorm events, including high winds, lightning and hail. The impact of thunderstorms can be measured in financial terms (property and crop damage – see details in *Risk* below) as well as fatalities and

injuries. An examination of NCDC data shows that thunderstorms contributed to the deaths of at least two individuals and injuries sustained by nine others (see Table 4-67).

Electrical utilities and communications infrastructure are vulnerable to thunderstorm winds and lightning. Damage to power lines or communication towers due to high winds, downed trees or direct lightning strikes have the potential to cause power and communication outages for residents, businesses and critical facilities. In addition to lost revenues, downed power lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires.

A structure's thunderstorm vulnerability is based in large part on building construction and standards. Other factors, such as location, condition and maintenance of trees also plays a significant role in determining vulnerability.

Human vulnerability is based on the availability and reception of early warnings of significant thunderstorm events (i.e., Severe Thunderstorm Warning issued by the NWS) and access to substantial indoor shelter. Seeking shelter indoors on the lowest floor of a substantial building away from windows is recommended as the best protection against thunderstorm related hazards.

Table 4-67: Significant Thunderstorm Impacts

Jurisdiction	NCDC Annualized Events (Events Per Year)	NCDC Deaths	NCDC Injuries
James City County	1.26	1	2
York County	1.74	0	6
City of Hampton	1.15	0	1
City of Newport News	1.23	1	0
City of Williamsburg	0.58	0	0

Risk

Risk, defined as probability multiplied by impact, cannot be fully estimated for significant thunderstorm wind, hail, and lightning events due to the lack of intensity-damage models for these hazards. Instead, financial impacts of these types of thunderstorm events can be developed based on NCDC Storm Events data (see Table 4-68 below). Using this data, property and crop damage adjusted for inflation related to thunderstorm wind, hail and lightning events totaled nearly $21.6 million or approximately $407,000 on

an annualized basis for the Peninsula. Property damages were highest for York County, where total losses were estimated at $16,731,861 or approximately $315,695 annually.

Table 4-68: Significant Thunderstorm Impacts				
Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Total Annualized Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
James City County	$1,673,373.22	$31,573.08	$26,616.63	$4,956.45
York County	$16,731,860.65	$315,695.48	$315,695.48	$0
City of Hampton	$1,427,038.49	$26,925.25	$26,925.25	$0
City of Newport News	$1,649,794.16	$31,128.19	$31,128.19	$0
City of Williamsburg	$81,892.41	$1,545.14	$1,545.14	$0
TOTAL	**$21,563,958.93**	**$406,867.15**	**$401,910.70**	**$4,956.45**

Based on the available data, the Significant Thunderstorm hazard is ranked High for York County; Medium-High for James City County, the City of Hampton, and the City of Newport News; and Medium-Low for the City of Williamsburg (see Table 4-70 and Figure 4-42 in the Hazard Summary section below). The ranking criteria for the Significant Thunderstorm hazard is detailed in the Hazard Ranking Methodology section and considers those thunderstorms capable of producing large hail, damaging winds and damage or injury producing cloud-to-ground lightning.

Critical Facility Risk

In-depth, quantitative assessment of critical facilities for significant thunderstorms was not feasible for this update. Even so, the type and age of construction plays a role in vulnerability of facilities to thunderstorms. In general, concrete, brick and steel-framed structures tend to fare better in thunderstorms than older, wood-framed structures or unanchored mobile homes. Finally, not all critical facilities have redundant power sources and may not even be wired to accept a generator. Future plan updates should consider closer examination of critical facilities risk by looking at construction

type of critical facilities in jurisdictions considered to be at higher risk of significant thunderstorms.

An examination of those critical facilities located in "High" significant thunderstorm hazard areas shows there are approximately 182 critical facilities (as identified through GIS data provided by each jurisdiction; facility dollar values not provided) located within York County, which for the 2011 plan update is ranked as being 'High' for the significant Thunderstorm hazard. Table 4-69 shows a generalized breakdown of the types of critical facilities in York County.

Table 4-69: Critical Facilities in 'High' Significant Thunderstorm Hazard Area

Jurisdiction	Law Enforcement (Including Police)	Fire / EMS	Hospital / Medical	Schools / Education	Emergency Management	Other
York County	2	7	1	17	2	153

In addition to police, fire, hospital and other facilities, utility companies and the services they provide also have considerable potentially vulnerable assets in the 'High' significant thunderstorm hazard area. For instance, Hampton Roads Sanitation District has nearly $216 million in infrastructure (pipes, stations, treatment plants, etc.) assets located within York County. Newport News Waterworks has nearly $147 million in infrastructure exposure in York County.

Existing Buildings and Infrastructure Risk

Risk to existing buildings and infrastructure is largely determined by building construction type including construction method, materials and roof span. As mentioned above, concrete, brick and steel-framed structures tend to fare better in thunderstorms than older, wood-framed structures, particularly in damaging thunderstorm wind events.

Hazard Summary

Significant thunderstorm events pose a considerable threat to the Peninsula. Based on NCDC historical data, total annualized losses for the participating Peninsula jurisdictions total nearly $407,000. Table 4-70 shows a breakdown of hazard ranking and potential annualized loss by jurisdiction due to significant thunderstorms.

The Significant Thunderstorm hazard is ranked as Medium-Low for the City of Williamsburg; Medium-High for James City County, the City of Hampton, and the City of Newport News; and ranked High for York County.

Table 4-70: Significant Thunderstorm Summary		
Jurisdiction	**Hazard Ranking**	**Potential Annualized Losses (based on NCDC)**
James City County	Medium-High	$31,573.08
York County	High	$315,695.48
City of Hampton	Medium-High	$26,925.25
City of Newport News	Medium-High	$31,128.19
City of Williamsburg	Medium-Low	$1,545.14
	TOTAL	**$406,867.14**

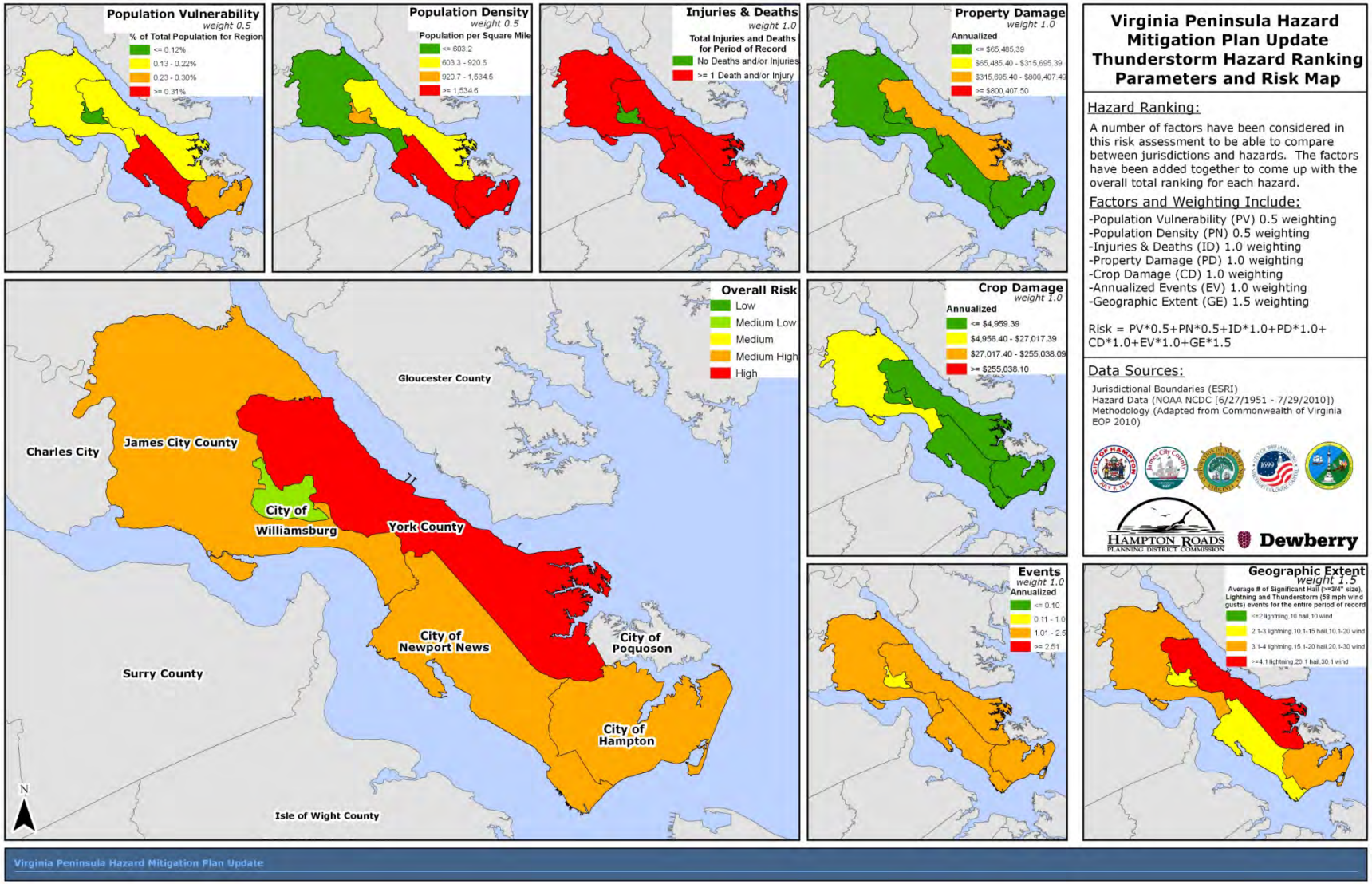

Figure 4-42: Significant Thunderstorm Hazard Ranking

Winter Storms and Nor'easters

Hazard Profile

NOTE: As part of the 2011 plan update, the Winter Storms and Nor'easters hazards were consolidated, reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the hazard by jurisdiction using the methodology described in detail in HIRA Introduction section. Each section of the plan was also reformatted for improved clarity and new maps and imagery, when available and appropriate, were inserted.

Description

Winter storms can refer to various types of precipitation including snow, freezing rain and sleet. Sometimes winter storms are accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chill.

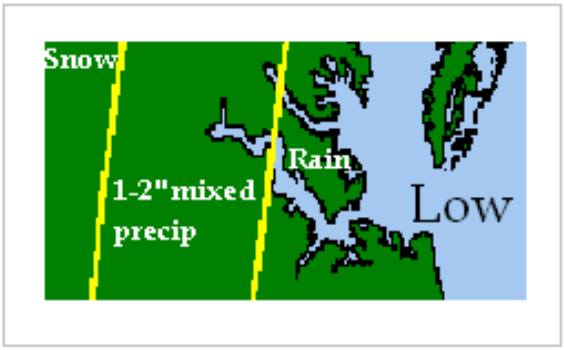

Figure 4-43: One Potential Precipitation Pattern Scenario Relative to a Winter-time Low Pressure Center

Although not all of Virginia's biggest winter storms are nor'easters, many of them are. At times, nor'easters have become so strong and produced such large amounts of blowing snow, that they have been termed "White Hurricanes."

Nor'easters are coastal storms that develop off the mid-Atlantic Coast during late fall, winter and early spring. The storms are named after the direction of the prevailing winds. The storms may rapidly and unexpectedly intensify, gaining strength from the relatively warm air over the Atlantic Ocean. Simultaneously, colder air is forced southward along the East Coast. This mixture of warm and cold air can produce rain, snow, sleet, or freezing rain. The coastal plain of Virginia typically receives rain if the storm tracks over the coast or inland east of the Appalachian Mountains. When a storm center tracks east over the Atlantic Ocean, the Peninsula can receive record snowfalls.

Nor'easters generate strong northeast winds, heavy precipitation and storm surge on the Peninsula. The impacts of a nor'easter can be similar to that of a strong tropical storm or minimal hurricane. Although the winds and storm surge associated with nor'easters are generally less intense than that of hurricanes, nor'easters can linger for several days over a given area. Storms with a long duration allow large accumulations of precipitation and damage to structures that are exposed to high wind and flooding. High-pressure systems to the north can hinder movement of the lows and serve to increase the severity of the low, thereby increasing or prolonging the impacts of the storm.

Figure 4-44: November 12, 2009, Nor'easter produces storm surge flooding as water flows under elevated homes and onto First Street in Hampton.

Wind blowing counter clockwise around the storm center carries warm, moist air from the Gulf Stream up and over the cold inland air. The warm air rises and cools and precipitation begins. Heavy snow often falls in a narrow 50 mile wide swath about 150 miles northwest of the low pressure center. Figure 4-43 presents one scenario where the center of a Nor'easter tracks just offshore of the Peninsula. The Low pressure center or storm center is represented by "Low". In this scenario, the heaviest snowfall associated with the storm is well west and northwest of the Peninsula. In other scenarios, the center of the storm may track further east off the coast, in which case the Peninsula could be squarely in the heaviest snow bands. Regardless, the Peninsula area is often affected in some way by these types of storms.

Erosion

The exposed coastline of the Peninsula is subject to severe erosion during nor'easters and winter storms as well as tropical storms and hurricanes. Mechanical, chemical, and biological agents contribute to the wearing away or removal of coastal lands, resulting in a landward retreat of the shore. High waves and strong currents initiate coastal erosion, while breaking waves contribute to the process by suspending sediment particles and

dislodging rocks. When the forces causing erosion occur at high tide, and especially during spring high tide, the resultant flooding and overwash can significantly increase the land loss and property damage.[41] The erosion of unconsolidated sediments and tidal wetlands throughout the Peninsula is a recurring hazard; however, private property losses and shoreline erosion are rarely quantified and for this reason, the erosion hazard has not been ranked for purposes of this plan. The Virginia Institute of Marine Science continues to research the hazard, and maintains considerable data for the Gloucester Point area north of the Peninsula.

Tropical systems, nor'easters, and winter storms generate breaking waves and strong currents that have the effect of contributing new sediment to the littoral system and redistribute pre-existing sediments over large areas of the shoreface. A variety of factors, including beach composition and storm characteristics, determine how beaches are affected by storms. For example, retreat of bluffs and muddy shores occurs in an episodic, stepwise pattern without any seaward advancement between retreat events, as has historically occurred along the York River near Yorktown. Sandy beaches, like Buckroe Beach and Grandview in Hampton, tend to partially recover after storms.

Geographic Location/Extent

The Peninsula is in a part of the country that occasionally experiences hazardous winter weather conditions, including severe winter storms that bring heavy accumulations of snow, sleet and freezing rain. While not as likely to experience significant winter storms as frequently as parts of the northern and northeastern sections of the U.S., the region has been impacted with some regularity. Although western most sections of the Peninsula might be slightly more inclined to see accumulating snow or mixed precipitation with any given winter storm, winter storm event impacts are generally spread equally throughout the Peninsula.

Magnitude or Severity

Winter weather can have devastating effects on a community. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the potentially extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Heavy snow can immobilize a region and paralyze a community, stranding commuters, stopping the flow of supplies, and disrupting emergency and

medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can also have a significant economic impact on communities.

The Dolan-Davis Scale (1993), shown in Table 4-71, was developed to identify and classify the damages that may occur during nor'easters. Although rarely referenced by the NWS or other media in describing nor'easters, the scale provides a useful descriptive tool for the types and levels of damage associated with a nor'easter. Heavy precipitation in the form of rain or snow, beach and dune erosion from wave action, sand/water overwash associated with storm surge, and resultant coastal property damage are all commonly associated with strong nor'easters.

Table 4-71: 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: Davis and Dolan, 1993

Another scale developed by Paul Kocin and Louis Uccellini[42] called the Northeast Snowfall Impact Scale (NESIS) attempts to rank Northeast snowstorms based on the impacts such systems have on society (Table 4-72). The scale is broken into 5 categories ranging from Category 1 which is considered a "Notable" event to a Category 5 which is considered "Extreme." The NESIS values used when assigning a category are based on a calculation factoring both the amount of snowfall for a particular storm and the population impacted. This scale too is infrequently referenced by the media or the National Weather Service in describing significant snowfall events and is mentioned here only as background information for the reader.

Table 4-72: Northeast Snowfall Impact Scale (NESIS)		
Category	NESIS Value	Description
1	1—2.499	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Previous Occurrences

It is not uncommon for the Peninsula area to experience winter storms and nor'easters. One such event occurred in December 1998. A major ice storm hit central and eastern Virginia, with ice accumulations of 0.5 – 1.0 inches that left dozens of power lines downed along with hundreds of tree limbs. Over 400,000 people in the area were left without power. The combination of automobile accidents, power line repair and clean-up cost the area over $20 million (NCDC 2004). Table 4-73 details several previous significant winter weather events, while Table 4-74 focused on Nor'easters that have directly impacted the Peninsula.

Table 4-73: Previous Significant Winter Storm Events	
Date	**Description**
November 17, 1873	Severe storm and gale brought high tides to tidewater area flooding wharves and the lower portion of Norfolk.
December 26-28, 1892	Norfolk set three local records for snow (Official Weather Records began in 1871). The greatest single storm amount with 18.6 inches; the most in 24 hours with 17.7 inches; and the maximum depth of snow on the ground with 18.6 inches. Normal snowfall at Norfolk is only 7.8 inches per year.
Winter of 1960-1961	Stormy pattern of previous winters continued with three more significant storms. The first was December 10-12, 1960 with heavy snow and high winds from Virginia to New York. In Virginia, snow fall ranged from 4 - 13 inches in the north and west. Seven fatalities in Virginia. The next snowstorm struck on January 19-20 from North Carolina to New York. Virginia saw up to 12 inches. Two deaths were blamed on the storm in Virginia, due to overexertion and accidents. The third storm struck February 3-5 and hit like a blizzard with severe cold and gale force winds. Two to 13 inches of snow across Virginia, and four fatalities.
Winter of 1980	On January 4 and 5, a heavy wet snow fell over eastern Virginia with as much as 18 inches reported at Williamsburg. A second storm hit on February 6 that dumped 6 inches in Williamsburg and as much as 20 inches at Virginia Beach. Over a foot of snow fell in Norfolk. Once again, arctic air had settled over Virginia and temperatures were in the teens. More than 1 foot of snow at Norfolk. The heavy snow combined with strong winds to create blizzard conditions. Norfolk's total for the season came to a record 41.9 inches making this the snowiest winter ever for eastern Virginia.
February 1989	This was a month of big swings in the weather for Southeast Virginia. Twice, Hampton Roads saw record high temperatures in the mid 70°s followed by a significant snowfall. The two storms that struck dumped a record 24.4 inches of snow at Norfolk. Over 14 inches occurred during one 24 hour period. It was the most snow to occur in one month in southeast Virginia in the last 100 years.
January 6-8, 1996	Much of the eastern seaboard received 1 to 3 feet of snow. Wind gusts of over 50 mph were common and resulted in blizzard conditions for much of the east coast, including Virginia. Many areas of Virginia received over 20 inches of snow. Numerous accidents and flood related damages were reported in the area, along with 13 deaths in Virginia. Virginia, along with Ohio, Pennsylvania, Maryland, West Virginia and New York were declared Presidential Disaster Areas. All totaled the blizzard and resulting flooding killed and estimated 187 people and caused approximately $3 billion in damages along the eastern seaboard.
December 23, 1998	A prolonged period of freezing rain and some sleet resulted in ice accumulations of up to an inch. The heavy ice accumulations on trees and power lines caused widespread power outages. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads and parts of I-64 on the Peninsula

Table 4-73: Previous Significant Winter Storm Events	
Date	**Description**
	were impassable due to fallen trees and tree limbs. Approximately 400,000 people were left without power in central and eastern Virginia and damages totaled more than $20 million. York County estimated at last $300,000 in damage costs incurred by the County; approximately 75% direct damage, 20% debris-related, and 5% emergency response costs.
February, 2004	On February 15 and 16, a winter storm hit the Tidewater area of Virginia dumping wind driven rain, freezing rain, and snow on a significant portion of Hampton Roads. Snow accumulation totals in some areas reached three to six inches and winds were reported at up to 30 mph. Sleet fell across much of the region causing roads to become icy and treacherous.
January 29 -30, 2010	A potent winter storm brought a heavy swath of snow to much of southern and eastern Virginia. The snow began late Friday, January 29 and continues into Saturday, January 30. The Peninsula was hit hard as accumulations generally ranged from 6 to 10 inches. National Weather Service tallies for the storm included: Hampton 8"; Newport News/Williamsburg International Airport 7"; Williamsburg 7.5"; York 9".

Table 4-74: Notable Nor'easters	
Date	**Description**
January 18-19, 1857	More than a foot of snow fell with temperatures in the single digits and teens across the state. Strong winds caused structural damage on land and wrecked ships at sea. One account states that Norfolk was buried under 20 foot drifts of snow. Temperatures fell to between -10° to -17° in the city. According to eyewitness accounts, the cold was so extreme that all Virginia rivers were frozen over. The Chesapeake Bay was solid ice a mile and a half out from its coast. At Cape Henry, one could walk out 100 yards from the lighthouse on the frozen ocean.
March 1-2, 1872	Known as the "Great Storm of 1872." During the evening of March 1, winds increased from the northeast to gale force (over 40 mph) on the coast and snow began blowing and drifting. It was very cold and the snow accumulated several inches. The wind drove water up into the Tidewater area and up the rivers. Water rose rapidly flooding wharves and the lower part of Norfolk.

April 11, 1956	Tidewater experienced gale winds (40 mph +) and unusually high tides. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were high. Two ships were driven aground. Waterfront fires were fanned by the high winds and, the flooded streets made access for firefighters very difficult, adding to the damages.
March 6,1962 Ash Wednesday Storm	The storm hit Virginia during spring tide, when sun and moon phase to produce a higher than normal tide. Storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and higher waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and seven feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and seawall. Houses on the Bay side also saw extensive tidal flooding and wave damage. An estimated $4 million in wind and flood damages occurred in Hampton. Winds up to 70 mph built 40-foot waves at sea. Flooding had a devastating effect on the Peninsula, including Grandview (Hampton) and Poquoson. Legendary storm caused over $200M (1962 dollars) damage from North Carolina to Long Island, New York.
March 13-14, 1993	The "Superstorm of March '93" was also known as "The Storm of the Century" for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. As the storm's center crossed Virginia, weather stations recorded their lowest pressure ever. Unlike most big winter storms that move up the coast, this storm took a more inland track across Richmond and the Chesapeake Bay. It brought rain and some high winds to Southeast Virginia and heavy snow and blizzard conditions over portions of the north and west. Eleven people died in Virginia from over-exertion and heart attacks shoveling snow or from exposure and hypothermia. Snow removal and clean-up costs were estimated at 16 million dollars statewide.
February 4,1998	Storm battered eastern Virginia for 3 to 4 days. Storm's slow movement resulted in an extended period of gale and storm force onshore winds, driving tides to 7.0 feet above MLLW at Sewell's Point in Norfolk. High tides resulted in severe coastal flooding throughout Hampton Roads and Eastern Shore. Damage was estimated at $75 million for Hampton Roads. $314,000 in costs incurred by York County government; approximately $75% direct damage, %20 debris-related, and 5% emergency response costs.
January 24-25, 2000	Storm spread heavy snow into Virginia. Several inches of snow was on the ground at daybreak on the 25th, with winds gusting at 25 to 45 mph, creating blizzard conditions in some areas. The region was at a standstill; airports and transit systems were shut down, schools were closed, Federal, state and county government offices were closed. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties of Virginia.

November 11-12, 2009	Developing from the remnant circulation of what was once Hurricane Ida, this nor'easter brought torrential rains and flooding and damaging winds to the Peninsula. A maximum rainfall report of 18" was reported just northwest of Hampton; Langley Air Force Base recorded 10.73" and Newport News/Williamsburg International Airport measured 10.07" during the event. Winds gusted to between 50 and 76 mph resulting in downed trees, power outages and minor structural damage. Storm surge during the event was comparable to a Category 1 hurricane.
December 25-26, 2010	A potent storm system impacted the Peninsula, bringing significant snowfall to the region. Low pressure tracked along the Gulf coast and then re-emerged and strengthened off the Carolina coastline on December 25. The system continued to gain strength as it tracked northeastward on December 26, developing into a powerful Nor'easter by the time it reached New England. Snowfall for the Peninsula ranged from 8 to 14 inches. Roadways throughout the area were treacherous and in many cases impassable through December 27.

Risk Assessment

Probability of Future Occurrences

The recurrence of severe winter weather, including that associated with nor'easters, is a near certainty on the Peninsula. Based on NCDC historical data, between one and two winter storm events impact the Peninsula every year (see Table 4-75). On average, James City County has recorded approximately two events annually, edging it slightly higher in winter storm event frequency than the other four participating jurisdictions. Even so, based on past occurrences, winter storm events are generally considered equally likely for all jurisdictions on the Peninsula.

Table 4-75: Annualized Winter Storm Events from NCDC Storm Events Data	
Jurisdiction	**NCDC Annualized Events (Events Per Year)**
James City County	2.06
York County	1.71
City of Hampton	1.94
City of Newport News	1.94
City of Williamsburg	1.65

The Virginia Tech Center for Geospatial Information and Technology's (CGIT) performed analyses of weather station daily snowfall data for the Commonwealth of Virginia's Hazard Mitigation Plan in 2008. Station-specific statistics were used as the basis for a seamless statewide estimate based on multiple linear regressions between the weather statistics (dependent variable) and elevation and latitude (independent variables). Figure 4-45 shows that the average number of days with at least 3 inches of snowfall is calculated to be 1.5 days or less for the entire Peninsula. Although significant snowfall events have occurred since the analysis, the data is still considered to be representative of the longer term averages for the region.

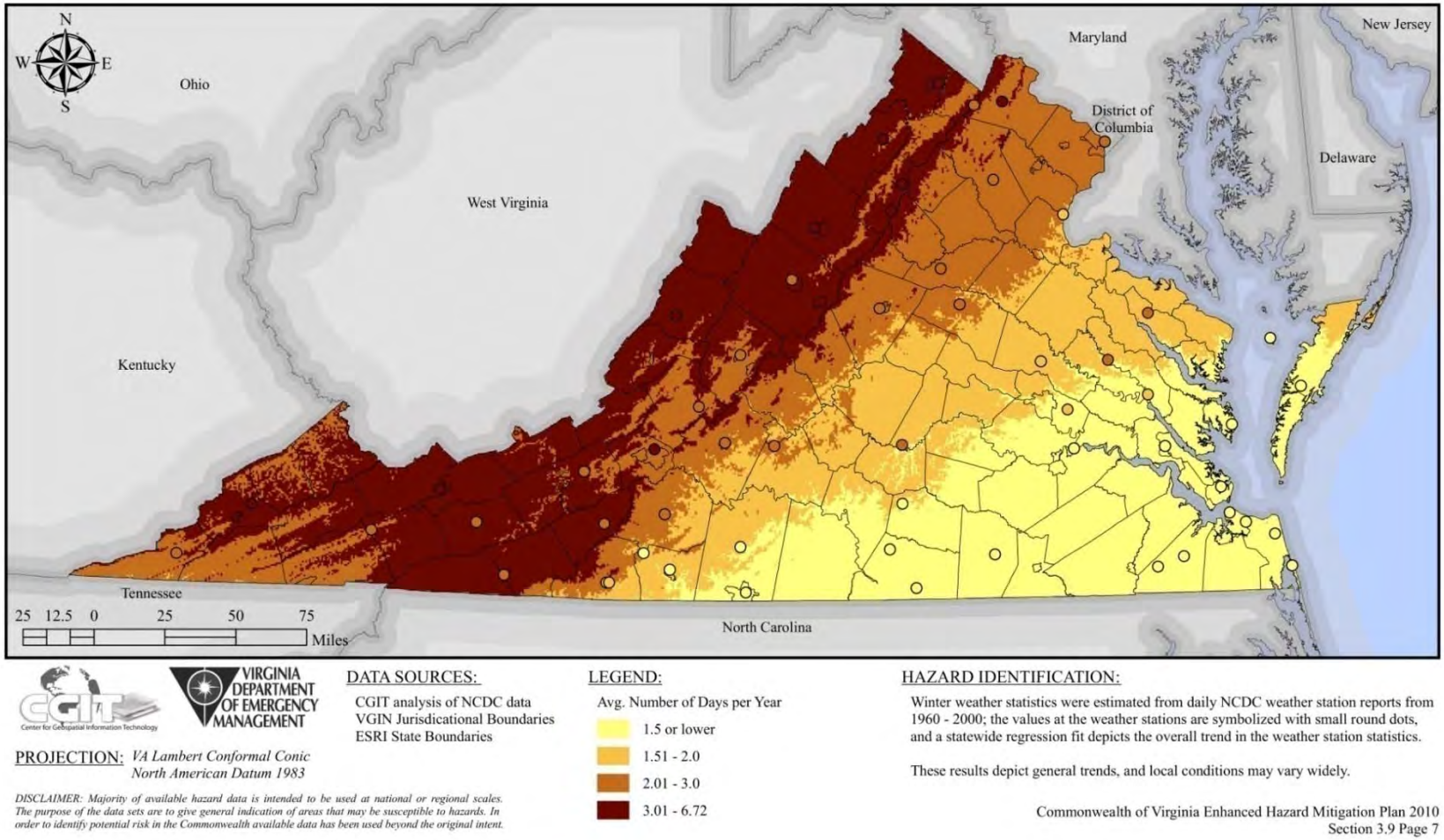

Figure 4-45: Average Number of Days with at Least 3 Inches of Snow

Source: Commonwealth of Virginia 2010 Hazard Mitigation Plan

Long range climate modeling suggests that as the planet warms, a trend of more winter precipitation taking the form of liquid precipitation, rather than snowfall would result.[43] Future hazard mitigation plan updates might consider factoring the latest climate science as part of a quantitative method for determining the probability of future occurrence of wintry weather.

Impact & Vulnerability

Winter storm vulnerability can be thought of in terms of individual, property, and societal elements. For example, the exposure of individuals to extreme cold, falling on ice-covered walkways, and automobile accidents is heightened during winter weather events. NCDC records dating back to the mid 1990s indicate that there has been at least one fatality directly related to winter storm events (see Table 4-76). This fatality occurred on January 25, 2000, in James City County. Property damage due to winter storms includes damage done by and to trees, water pipe breakage, structural failure due to snow loads, and injury to livestock and other animals. The disruption of utilities and transportation systems, as well as lost business and decreased productivity are vulnerabilities of society as a whole. The vulnerability to these damages varies in large part due to specific factors; for example, proactive measures such as regular tree maintenance and utility system winterization can minimize property vulnerability. Localities accustomed to winter weather events are typically more prepared to deal with them and therefore less vulnerable than localities that rarely experience winter weather.

The impacts of winter storms are primarily quantified in terms of the financial cost associated with preparing for, response during and recovering from them. The primary source of data providing some measurement of winter storm impacts is the NCDC Storm Events database. The database includes winter event data back to 1993, but is not necessarily complete or consistent from event to event. Although a more comprehensive, labor-intensive analysis consisting of using weather station data, NCDC damages, and other data sources could possibly produce an intensity-damage relationship between winter weather occurrences and resultant damages, this type of analysis was not performed for the update of this plan. The branches of government most often affected by winter storms include the Virginia Department of Transportation (VDOT), the National Park Service (NPS) and local public works and transportation departments. Roadway treatment operations often begin in advance of a winter storm, and continue for as long as necessary.

Table 4-76: Winter Storm Impacts			
Jurisdiction	NCDC Annualized Events (Events Per Year)	NCDC Deaths	NCDC Injuries
James City County	2.06	1	0
York County	1.71	0	0
City of Hampton	1.94	0	0
City of Newport News	1.94	0	0
City of Williamsburg	1.65	0	0

Risk

Risk, defined as probability multiplied by impact, cannot be fully estimated for winter storm events due to the lack of intensity-damage models for this hazard. Instead, financial impacts of these types of events can be developed based on NCDC Storm Events data (see Table 4-77 below). Using this data, property and crop damage adjusted for inflation related to winter storm events totaled to approximately $3.2 million or $189,486 on an annualized basis for the Peninsula. Property damages were highest for James City County, where total losses were estimated at $650,079 or approximately $38,240 annually. Losses for York County, City of Hampton, City of Newport News and the City of Williamsburg were only slightly less at approximately $642,796 each in total or about $37,812 each on an annual basis. It is important to note that these figures do not include costs associated with preparing for and recovering from winter storm events, including those associated with treatment of roadways and snow removal.

Table 4-77: Winter Storm Impacts				
Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Total Annualized Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
James City County	$650,079	$38,240	$38,240	$0
York County	$642,796	$37,812	$37,812	$0
City of Hampton	$642,796	$37,812	$37,812	$0
City of Newport News	$642,796	$37,812	$37,812	$0

Table 4-77: Winter Storm Impacts				
Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Total Annualized Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
City of Williamsburg	$642,796	$37,812	$37,812	$0
TOTAL	**$3,221,263**	**$189,488**	**$189,488**	**$0**

Based on the ranking methodology used for this plan update, the Winter Storm hazard is considered to rank Medium-Low for York County, City of Hampton, and City of Williamsburg and Medium for James City County and City of Newport News (see Figure 4-46).

Critical Facility Risk

Quantitative assessment of critical facilities for winter storm risk was not feasible for this plan update. Even so, it is apparent that transportation structures are at great risk from winter storms. In addition, building construction type – particularly roof span and construction method, are factors that determine the ability of a building to perform under severe stress weights from snow. Finally, not all critical facilities have redundant power sources and may not even be wired to accept a generator for auxiliary heat. Future plan updates should consider including a more comprehensive examination of critical facility vulnerability to winter storms.

Existing Buildings and Infrastructure Risk

As described in the Impact and Vulnerability sub-section above, the risks posed by winter storms to existing buildings and infrastructure include damage done by and to trees, water pipe breakage, and structural failure due to snow and ice loads. Construction type and load design are primary factors in determining the vulnerability of buildings and infrastructure to winter storms.

Hazard Summary

NCDC data suggest that Winter Storms produce roughly $189,486 in crop and property losses annually in the five participating Peninsula jurisdictions, with losses spread nearly evenly across the jurisdictions. These annualized

losses do not factor other costs incurred preparing for or recovering from winter storm events. These costs are often times significant, but difficult to quantify due to the lack of readily available data. Table 4-78 (and Figure 4-46) shows that the Winter Storm hazard is ranked as Medium-Low for York County, City of Hampton, and City of Williamsburg, and Medium for James City County and City of Newport News.

Table 4-78: Winter Storm Summary

Jurisdiction	Hazard Ranking	Potential Annualized Losses (based on NCDC)
James City County	Medium	$38,240
York County	Medium-Low	$37,812
City of Hampton	Medium-Low	$37,812
City of Newport News	Medium	$37,812
City of Williamsburg	Medium-Low	$37,812
	TOTAL	**$189,488**

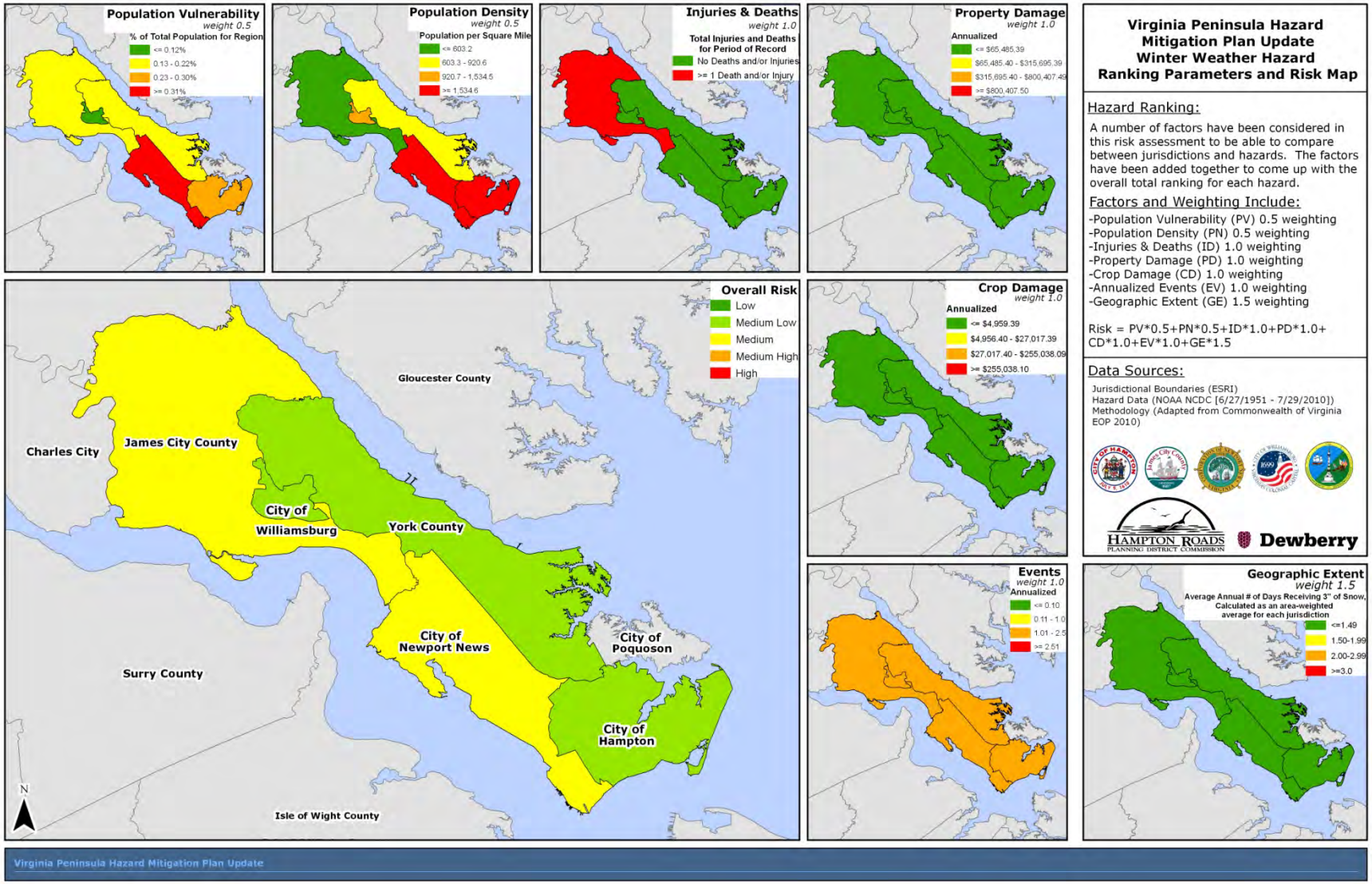

Figure 4-46: Winter Weather Hazard Ranking

Drought and Extreme Heat

Hazard Profile

NOTE: As part of the 2011 plan update, the Drought and Extreme Heat hazards were consolidated, reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the hazard by jurisdiction using the methodology described in detail in HIRA Introduction section. Each section of the plan was also reformatted for improved clarity and new maps and imagery, when available and appropriate, were inserted.

Description

Drought is loosely defined as a persistent period of unusual dryness that may impact crops and water supply. In particular, a meteorological drought is defined as less than average precipitation over a prolonged period of time. Agricultural drought is a condition in which there is a shortfall in moisture available for crops. Hydrological drought occurs when water levels in reservoirs, lakes and aquifers fall below statistical averages. All of the Peninsula communities are susceptible to droughts, which are characterized by a combination of intensity and duration.

High summer temperatures can exacerbate the severity of a drought. Daily high temperatures in southeastern Virginia during the summer can easily reach the 90 degree mark and higher. When soils are wet, a great deal of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy goes toward heating the ground surface and temperatures can even reach into the low 100's – further drying the soil. This can have a devastating effect on crops, stream levels and water reserves. A short-term precipitation deficit of six summer weeks can often ruin crops. Droughts lasting a year or more, which occur in the Mid-Atlantic when the region receives 60% of the typical 40 inches of rain, begin to draw down water wells and livestock ponds and decrease stream flows and water reserves.

Extreme Heat

While the Peninsula generally has a temperate climate, periods of extreme heat, can and have occurred. Extreme heat hazards result from high daily temperatures combined with high relative humidity. High relative humidity

slows evaporation, robbing the body of its ability to cool itself. On average, about 175 Americans succumb to the taxing demands of heat every year.[44]

There have not been any Presidential Disaster or Federal Emergency declarations, nor is there a history of any State Disasters or other major incidents, for extreme heat on the Peninsula.

When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. Table 4-79 shows the HI that corresponds to the actual air temperature and relative humidity. This chart is based upon shady, light wind conditions. Exposure to direct sunlight can increase the HI by up to 15°F.

Table 4-79: Heat Index

Temperature (°F)	Relative Humidity					
	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

The NWS issues heat-related products to inform citizens of forecasted extreme heat conditions. These products are based on projected or observed heat index values and include:

- Excessive Heat Outlook: When there is a potential for an excessive heat event within three to seven days;
- Excessive Heat Watch: When conditions are favorable for an excessive heat event within 12 to 48 hours but some uncertainty exists in regards to occurrence and timing;
- Excessive Heat Warning / Advisory: When an excessive heat event is expected within 36 hours. These products are usually issued when confidence is high that the event will occur. A warning implies that conditions could pose a threat to life or property, while an advisory is issued for less serious conditions that may cause discomfort or inconvenience, but could still lead to threat to life and property if caution is not taken.

On the Peninsula, extreme heat constitutes a low risk to the general populace. Even so, the elderly, small children, the chronically ill and pets

are considered to be more vulnerable to excessive heat than the general population.

Geographic Location/Extent

The Peninsula is susceptible to drought conditions, although to a lesser extent than portions of the West and Plains as evident in Figure 4-47, Historical Mapping of the Palmer Drought Severity Index (PDSI). The PDSI has been used for U.S. drought monitoring for over 30 years. It is based on a water budget model that incorporates the balance between water supply (i.e., precipitation), soil moisture, runoff, and water demand (computed from estimates for evaporation and transpiration).

No one particular jurisdiction or region within the Peninsula is generally considered to be more at risk of drought than any other.

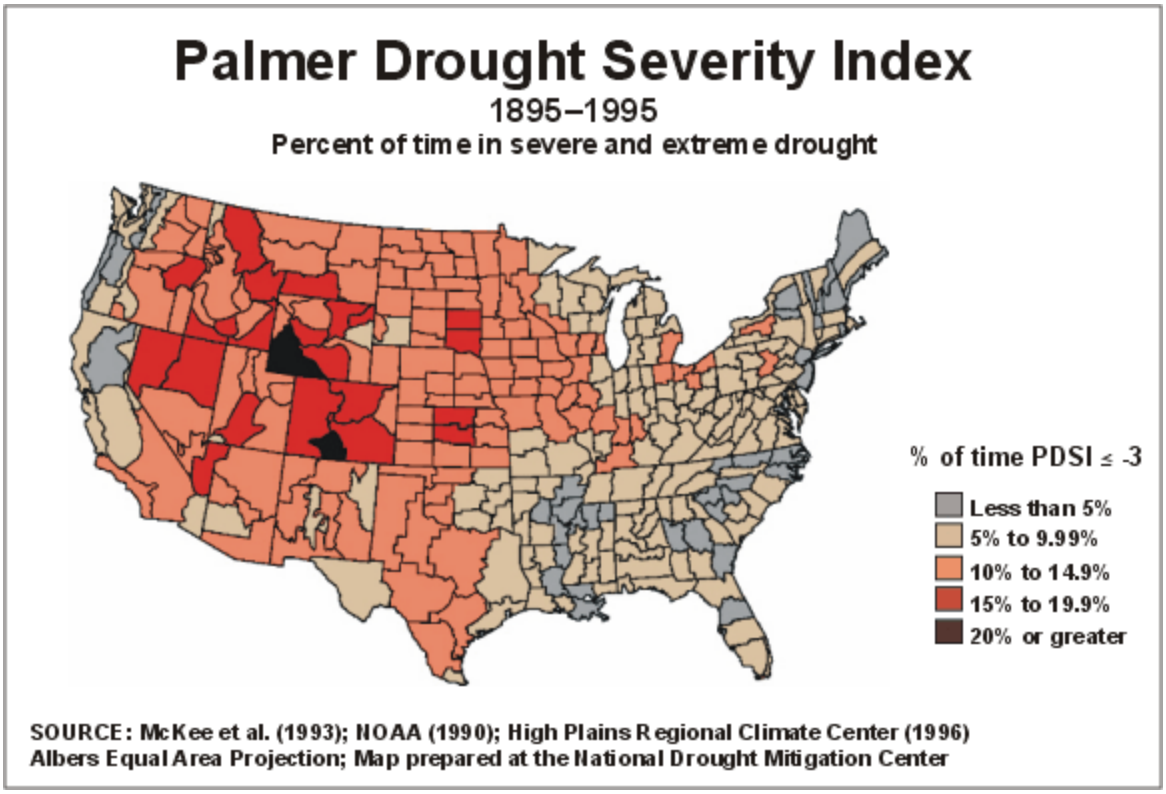

Figure 4-47: Historical Mapping of the Palmer Drought Severity Index (PDSI) 1885 – 1995

Magnitude or Severity

VDEM rates Virginia's drought risk as "Significant," with Virginia communities experiencing approximately 20 years of severe drought in the last century. These droughts have caused millions of dollars of damage and have impacted agriculture as well as water supply.

There are two primary drought monitoring tools currently in use in the United States. The PDSI as described above in Geographic Location / Extent section and the U.S. Drought Monitor. The U.S. Drought Monitor is a blend of science and subjectivity, resulting in a drought severity classification table based on ranges for primary indicators for each dryness level. Because the ranges of the various indicators often do not coincide, the final drought category tends to be based on what the majority of the indicators show. The analysts producing the map also weight the indices according to how well they perform in various parts of the country and at different times of the year. The PDSI is one of many indicators used to develop the U.S. Drought Monitor. Other indicators include: soil moisture, weekly streamflow, standardized precipitation, and a satellite vegetation health index. Table 4-80 provides a description of possible impacts for the drought severity categories indicated by the U.S. Drought Monitor.

Table 4-80: U.S. Drought Monitor, Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies

Previous Occurrences

Several significant droughts have affected the communities on the Peninsula since the early 1900s (see Table 4-81). The drought of 1930-32 was one of the most severe droughts recorded in the region. The droughts of 1938-42 and 1962-71 were less severe; however, the 1962-71 drought had an extreme duration. The droughts of 1980-82 and 1998-99 were the least severe for the state; however, the drought of 1998-99 hit the communities

of the Peninsula region particularly hard. The drought of 2000-2002 was felt statewide, and is considered the most significant since the 1930-32 event.[45]

Table 4-81: Sampling of Previous Significant Drought Events

Date	Jurisdiction(s) Impacted	Comments
1930 - 1932	All Peninsula jurisdictions	Crops totally destroyed Rivers/streams dried up Losses in Virginia estimate at $1 billion (adjusted for inflation) Related wildfire consumed 300,000 acres of land in the Commonwealth
1997	All Peninsula jurisdictions	A stretch of unusually dry weather lasted from May to September Losses in eastern and southeastern Virginia were estimated at $86,605,022 (adjusted for inflation)
1998- 1999	All Peninsula jurisdictions	Losses nearly $190 million Many stream gages reported streamflow at or below 10% of normal Governor declared state of emergency
2000-2002	All Peninsula jurisdictions	U.S. Drought Monitor categorized Peninsula as in 'Extreme Drought' Record minimum flows on the James and York Rivers Williamsburg forced to purchase water from Newport News Waterworks in July
2007	All Peninsula jurisdictions	Peninsula experienced 10th driest year on record

The drought of 1930-32 had a tremendous effect on Virginia. Numerous rivers completely dried up, crops were totally destroyed, drinking water was difficult to find, forest fires burned approximately 300,000 acres of land (over 30 times the current annual average) and average summer temperatures were in the low 100s. After adjusting for inflation, the estimated losses for this drought were $1 billion. If the same drought were to occur in Virginia today, the devastation would be much greater due to an increased population and demand for water resources.

The drought of 1998-99 had a particularly hard impact on the Peninsula. The region received some of the lowest rainfall totals in over 120 years. This led to decimated crops and depletion of water and feed reserves, as well as a number of brush fires. Many stream-gauging stations reported streamflow at or below 10% of the normal flow. On December 1, 1998, the Governor declared a state of emergency and requested federal aid. Losses in the region grew to nearly $190 million. During August of 1999, NOAA ranked the Peninsula area in a moderate to severe drought.

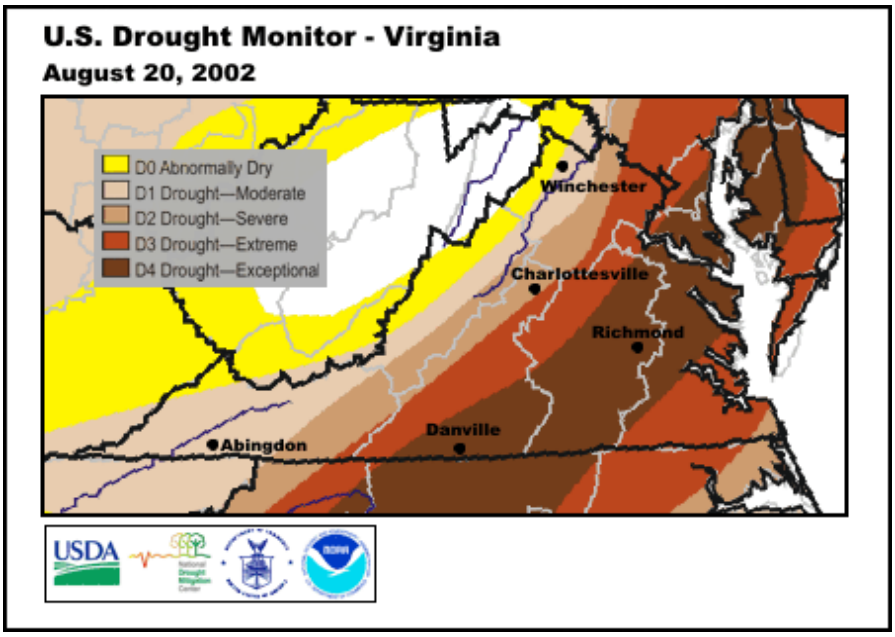

Figure 4-48: U.S. Drought Monitor, August 20, 2002

Following on the heels of the 1998-99 drought, the designated drought of 2000-2002 reached its height in late summer, early fall of 2002. The Virginia Drought Monitoring Task Force, a consortium of interested state and Federal agencies, provided Drought Status Reports on a monthly basis between June and November 2002. Conditions deteriorated quickly in the first two weeks of August 2002, and the U.S. Drought Monitor indicated an "Extreme Drought" for the Peninsula (see Figure 4-48) by August 20. Drought indicators were numerous and severe: record minimum flows on the James and York Rivers, continually declining groundwater levels, declining reservoir levels, short or very short topsoil moisture conditions across 82% of the Commonwealth, numerous ozone advisories, and higher than normal wildfire activity.

For the Tidewater area, normal one-year precipitation for the period September 2001 to August 2002 was 41.17 inches. By August 20, 2002, the one-year precipitation was only 29.35 inches, a 71% departure from normal. Newport News Waterworks customers were under voluntary conservation measures beginning July 25, with the reservoir at 71% capacity. James City Service Authority Central System instituted voluntary measures, as well. The Waller Mill Reservoir serving Williamsburg dropped 27 inches below the spillway, and voluntary conservation measures went into effect on March 20,

2002. Williamsburg was purchasing water from Newport News Waterworks in July. By November 2002, much of the Peninsula area had returned to normal conditions due to rainfall after September 1.

Drought conditions impacted much of the Southeast and a considerable portion of the West in 2007. Although the most significant drought conditions (an extended period of Extreme and Exceptional intensity as determined by the U.S. Drought Monitor) impacted southwestern Virginia and south through North and South Carolina, Tennessee, Alabama and Georgia, the Peninsula did not escape this unusual dry period that extended from 2007 to 2008. As a whole, Virginia experienced its tenth driest year on record in 2007.

Risk Assessment

Probability of Future Occurrences

Based on historical frequency of occurrence using NCDC and other NWS data, a reasonable determination of probability of future drought events can be made. The data show recurrence of drought conditions, of varying magnitude, on a relatively regular basis. The historical record also notes extraordinarily severe drought events, particularly the period from 1930 to 1931, the late 1960s and 2001 to 2002. With records dating back to 1993, the NCDC database indicates that drought events of some significance occur roughly every 5.5 to 6 years (statistically 0.18 to 0.24 events annually; see Table 4-82) on the Peninsula. Based on historical data, it is reasonable to assume that drought has the potential to impact the Peninsula again in the future.

Furthermore, long-term climate forecast models suggest that a warming planet will lead to changes in precipitation distribution and the possibility of more frequent and severe drought. The IPCC Fourth Assessment Report indicates that it is very likely that hot extremes and heat waves will become more frequent as the Earth warms.

Table 4-82: Annualized Drought Events from NCDC Storm Events Data

Jurisdiction	NCDC Annualized Events (Events Per Year)
James City County	0.24
York County	0.18
City of Hampton	0.18
City of Newport News	0.18
City of Williamsburg	0.18

Impact & Vulnerability

As described in historical accounts above, agriculture and water supply are two sectors with considerable vulnerability to drought. The impacts to agriculture can include crop and livestock losses. In terms of water supply, drought impacts can include not only diminishing water quantity, but also negative impacts to water quality. In the past, drought conditions that produced lowered streamflows also resulted in salt water intrusion from the ocean into rivers supplying fresh water. This was the case in 2002 when salinity levels were elevated in the Chickahominy River. The Chickahominy watershed is the largest in the Newport News Waterworks' system.[46]

Droughts generally impact large swaths of the region at once and no one particular Peninsula jurisdiction is more likely to experience drought than any other jurisdiction.

Risk

Based on NCDC historical data dating back to 1993, crop losses due to drought have been estimated to be approximately $255,000 on an annual basis in James City County and around $439 annually for the remaining participating Peninsula jurisdictions (see Table 4-83). It should be noted that a drought event in summer and early fall of 1997 skewed crop damage losses considerably higher for James City County as compared to other jurisdictions. The NCDC database did not report crop losses for the other jurisdictions during the 1997 event, although it is likely that crops in those areas suffered losses too. Drought has a very limited impact on structures, so property damage is generally not an issue and no damages are reported in the NCDC database.

In terms of water supply, losses from drought can be the result of increased pumping costs and potentially the need to divert water from one area to another in order to keep up with demand. Increased pumping costs are generally offset by a tiered customer pricing system, with higher rates in effect during times of drought. As of the writing of this plan update, Newport News Waterworks has never had to resort to emergency inter-connections to bring water into its service area from an outside source.

Table 4-83: Annualized Drought Impacts			
Jurisdiction	NCDC Raw Total Losses (Property plus crop loss)	NCDC Annualized Property Losses	NCDC Annualized Crop Losses
James City County	$4,335,647.19	$0	$255,038.07
York County	$7,464.06	$0	$439.06
City of Hampton	$7,464.06	$0	$439.06
City of Newport News	$7,464.06	$0	$439.06
City of Williamsburg	$7,464.06	$0	$439.06
TOTALS	$4,365,503.43	$0	$256,794.31

Critical Facility Risk

Risk associated with drought has not been quantified in terms of geographic extent for this revision; as a result, critical facility risk has not been calculated. Droughts have a very limited impact on buildings or infrastructure.

Existing Buildings and Infrastructure Risk

Typically, droughts do not impact (or damage) buildings or infrastructure.

Hazard Summary

Based on NCDC historical data, total annualized losses for the participating Peninsula jurisdictions are approximately $256,794 and the Drought hazard is ranked as being Medium-Low.

The Commonwealth of Virginia's 2010 HIRA ranking was based largely on the NCDC database. The update to the Peninsula plan used this same framework to establish a common system for evaluating and ranking hazards. No geographic extent data was available for drought probability each locality was considered low probability throughout the planning region.

Based on this analysis and the available data, the drought hazard is considered to be Medium-Low for all of the participating Peninsula jurisdictions (see Table 4-84). Figure 4-49 shows the ranking criteria and overall risk for the planning region.

Extreme heat was not ranked and no loss estimates were calculated.
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Table 4-84: Drought Summary		
Jurisdiction	**Hazard Ranking**	**Potential Annualized Losses (based on NCDC)**
James City County	Medium-Low	$255,038.07
York County	Medium-Low	$439.06
City of Hampton	Medium-Low	$439.06
City of Newport News	Medium-Low	$439.06
City of Williamsburg	Medium-Low	$439.06
	TOTAL	**$256,794.31**

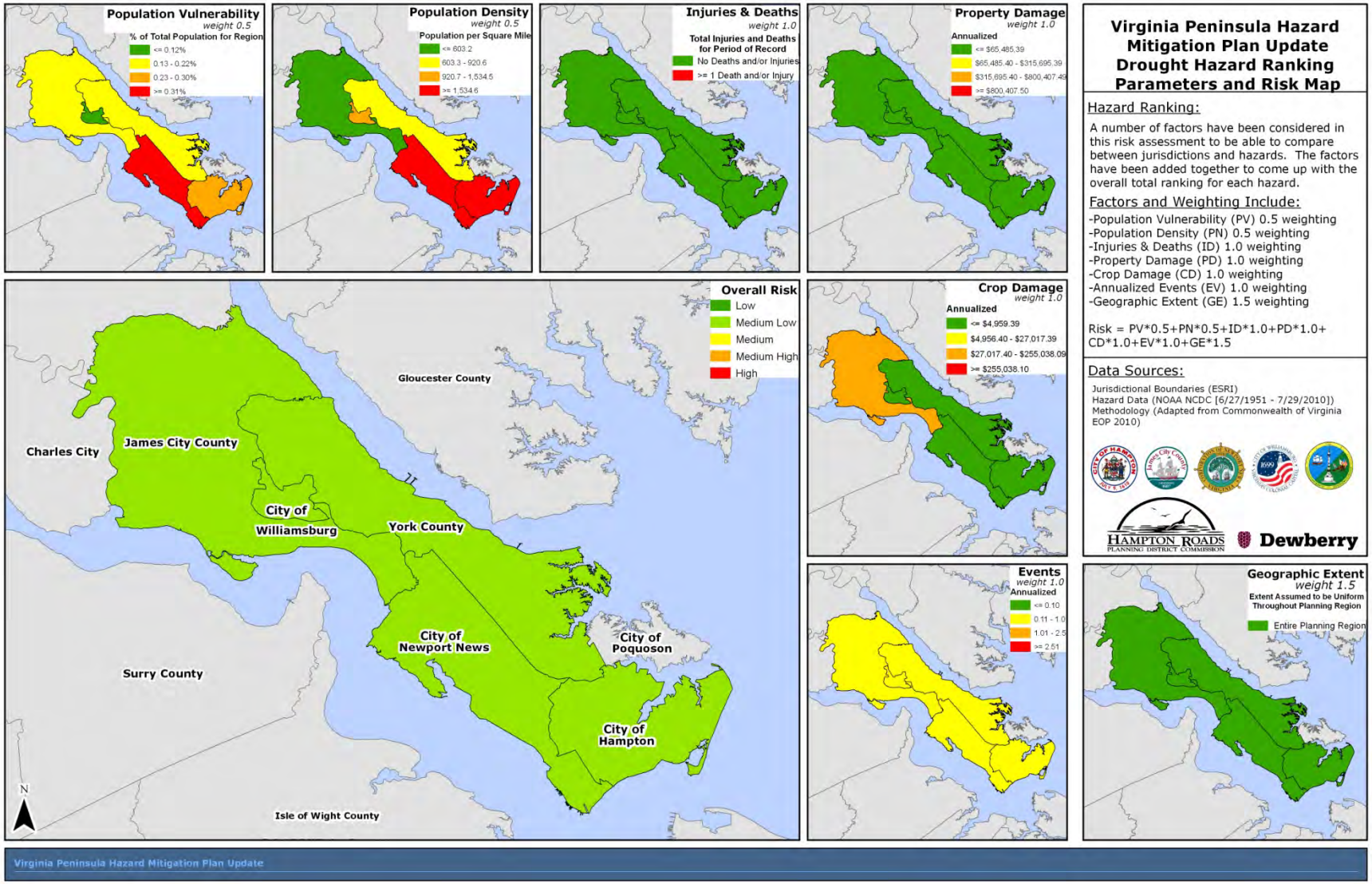


Figure 4-49: Drought Hazard Ranking

Wildfire

Hazard Profile

NOTE: During the 2011 plan update, the Wildfire hazard was reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data. Each section of the plan was also reformatted for improved clarity and new maps and imagery, when available and appropriate, were inserted.

Description

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. Wildfires often start unnoticed and spread quickly, causing dense smoke that fills the area for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires.[47] Generally, there are three major factors to consider when assessing the threat of wildfires to a community: topography, vegetation, and weather.

A wildfire is any fire occurring in a wildland area (i.e., grassland, forest, brush land), except for fire under prescription. Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters. Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. More than 80% of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

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

State and local governments can impose fire safety regulations in residential areas 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.

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 (ice storms, hurricanes, etc.) increase the probability of wildfires by producing woody 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 within minutes.

Geographic Location/Extent

The type of land cover in an area affects a number of factors including ease of ignition, the intensity with which a fire burns, and the facilitation of wildfire advancement. Topographic variations, such as steep slopes, can lead to a greater chance of wildfire ignition. Generally, steep slopes are predisposed to convective pre-heating, which warms and dries the vegetative cover. Also, slopes that face south receive more direct sunlight than those facing north. Direct sunlight dries vegetative fuels, creating conditions that are more conducive to wildfire ignition. Population density has a causal relationship to wildfires because humans ignite an overwhelming majority of the wildfires in Virginia, intentionally or unintentionally. Travel corridors increase the probability of human presence, which increases the potential for wildfire ignition. Hence, areas close to roads have a higher ignition probability. Storms such as hurricanes and winter ice storms can topple trees, creating an enormous amount of debris, which can serve as wildfire fuel. During 2003, Hurricane Isabel brought down thousands of trees on the Peninsula. The resultant increase in potential fuel initiated a public awareness campaign by Virginia Department of Forestry (VDOF) to educate the public regarding the increased hazard. Phragmites, a type of large perennial grass that can grow in dense stands several feet high, are also found on the Peninsula. The stands can contain a

significant amount of dead material and are capable of readily carrying wildfires. The risk of fire in association with phragmites is highest after a killing frost in the fall and before new growth in the spring.

York and James City Counties have the most forest land area (by percentage) within the high wildfire risk classification as compared to the other jurisdictions in the planning region (Table 4-88).

Magnitude or Severity

While the Peninsula is not considered as at-risk to wildfire as other areas of the Commonwealth, wildfires have occurred in the past– particularly in James City and York Counties. According to VDOF records, there were 110 wildfire events on the Peninsula between 1995 and 2008. Twenty-seven (27) wildfires were recorded in 2002, and 21 in 2006 for the region. These fires burned a total of 170.9 acres and caused an estimated $12,400 in property damages, but fortunately caused no deaths or injuries. Table 4-85 lists the number of these fire events, acres burned, and estimated damages by jurisdiction for the Peninsula.

York County wildfires make up the majority of fires, acres burned, and damages in the region during the period of record (1995-2008). Figure 4-50 shows the locations of past wildfire incidents. It should be noted that this data comes from VDOF records and has not been checked for accuracy; several events may occur on a given date and were not determined if they were different fires on the same day or duplicated results.

Table 4-85: Wildfire events in the Peninsula Region, 1995-2008

Jurisdiction	Number of Fires	Total Acres	Total Damages
City of Hampton	2	13.2	$0
James City County	58	42.5	$650
City of Newport News	1	6.5	$0
City of Williamsburg	2	0	$0
York County	47	108.7	$11,750
TOTAL	**110**	**170.9**	**$12,400**

Source: VDOF

Previous Occurrences

While the Commonwealth of Virginia rarely experiences the large, extensive wildfires typically seen in the western regions of the United States, wildfire

risk remains a genuine concern. According to the VDOF, about 1,600 wildfires consume a total of 8,000 to 10,000 acres of forest and grassland in the state each year. During the fall drought of 2001, Virginia lost more than 13,000 acres to wildfires.

Virginia's wildfire season normally occurs in the spring (March and April) and then again in the fall (October and November). During these times, the relative humidity is usually lower, winds tend to be higher, and the fuels are cured to the point where they readily ignite. Also during these times hardwood leaves are on the ground providing more fuel and allowing sunlight to directly reach the forest floor, warming and drying the surface fuels.

Fire activity fluctuates during each month and also varies from year to year based on precipitation amounts. During years of adequate rain and snow, wildfire occurrence is typically low. Lack of moisture during other years means extended periods of warm, dry, and windy days and therefore increased fire activity. The damage caused by Hurricane Isabel in 2003 increased the threat of wildfires in Virginia, and wildfires will be a major threat to lives and homes in the eastern half of Virginia for several years to come. The dead and downed timber caused by the storm has had time to cure and could produce wildfires that will be larger and much harder and dangerous to suppress.

Records indicate that most of Virginia's wildfires are caused by people. Virginia is growing more rapidly than many other states, and its population has doubled in the last 45 years. Further, people are moving into residential developments located within forested areas, and there is an increased use of the forests for recreational uses. All of these trends increase the risk of wildfires, which requires continued fire prevention and protection activities.

The majority of the wildfire occurrences on the Peninsula are caused by debris burning and other human activities. Table 4-86 shows the leading causes of wildfires in the region based on VDOF records for the 110 historical wildfires occurring between 1995 and 2008. Together, incendiary and children represent almost 50% of the wildfire causes on the Peninsula.

Table 4-86: Leading Causes of Wildfires on the Peninsula, 1995-2008. Source: VDOF

Cause	# of Fires	% of Wildfires
Incendiary	**32**	29%
Children	**22**	20%
Debris Burning	**19**	17%

Table 4-86: Leading Causes of Wildfires on the Peninsula, 1995-2008. Source: VDOF		
Cause	**# of Fires**	**% of Wildfires**
Miscellaneous	**11**	10%
Campfire	**8**	7%
Smoking	**6**	5%
Lightning	**4**	4%
Equipment Use	**4**	4%
Unknown	**2**	2%
Railroad	**2**	2%

Based on the number of historical occurrences, wildfires are somewhat prevalent events on the Peninsula. These events however are usually contained to very small areas and have caused minimal damages to property due to strong fire response and suppression capabilities. Figure 4-50 shows the locations of past wildfire incidents for 1995 - 2008. Electronic data for events before 1995 was not available. Two wildfire events occurred prior to 1995 causing significant damage in the region.

In April 1978, a significant wildfire burned off of Route 60 in a northward direction near the former “Fred’s Inn” restaurant. The fire consumed more than 500 acres, and required suppression resources from James City and New Kent Counties, Williamsburg, and other jurisdictions along with the VDOF.

On April 4, 1982, wildfires burned throughout the Commonwealth on a warm, windy Sunday afternoon. The Peninsula did not escape the fires, as a wildfire that exceeded 1,100 acres burned across York County and the Newport News Waterworks property. This ground fire quickly became a crown fire and crossed four lanes of Oyster Point Road due to windy conditions. Units from Newport News, Hampton, York, and James City Counties fought the fire, along with the VDOF and the Newport News Waterworks. The National Guard responded to the fire as well. Several smaller fires burned in James City County that same day.

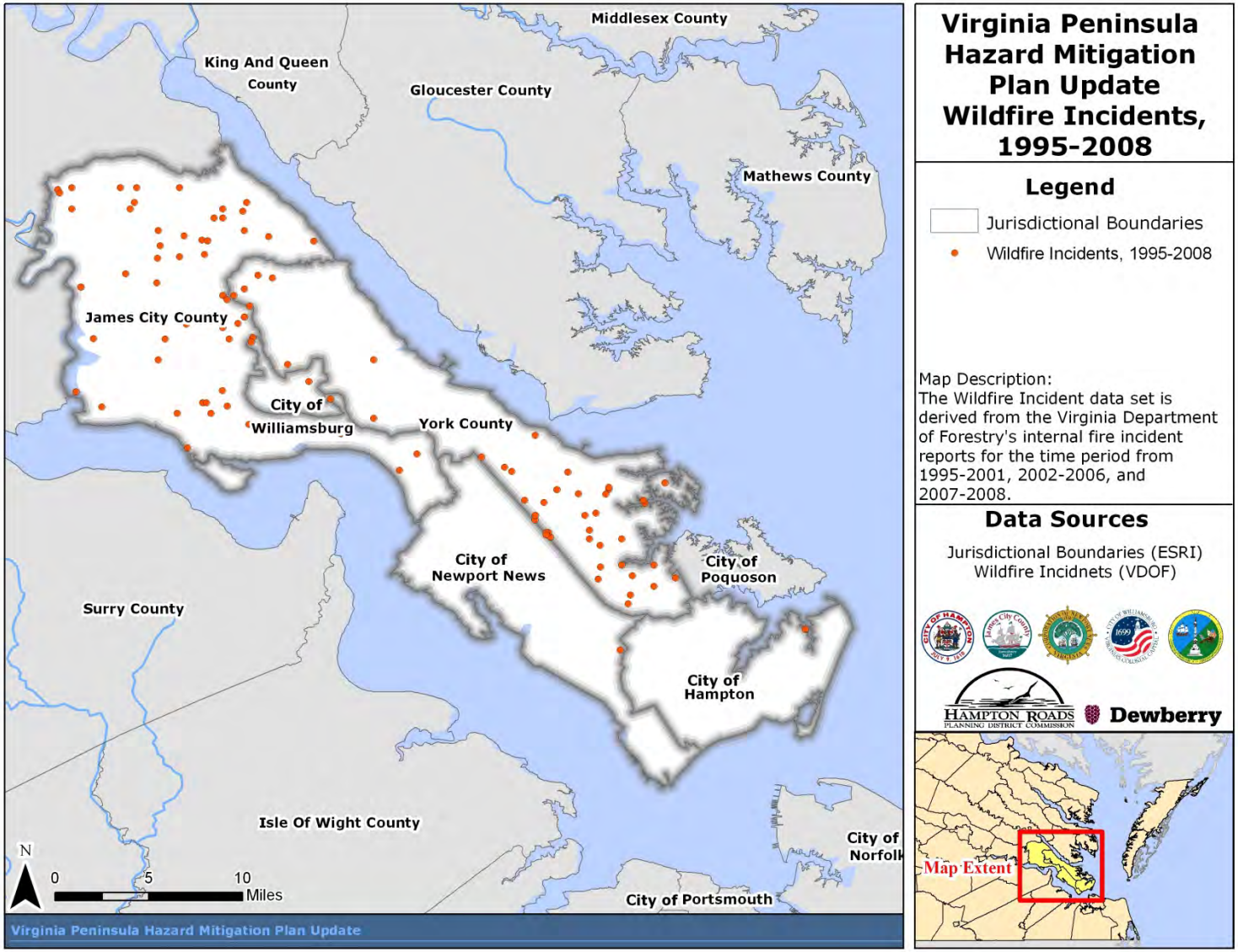


Figure 4-50: Wildfire Incidents (1995 – 2008) from VDOF

In addition to data recorded by the VDOF, York County provided detailed non-forest, open land fire reports from 2006 to 2010, which log those fires to which the County's fire department responds. It is clear from Table 4-87 that the number of open land fires varies significantly from year to year with more fires occurring coincident with very dry or drought conditions. This was the case in 2007 and 2010, both years in which extended periods of dry weather occurred.

Table 4-87: York County Non-Forest/Open Land Fires

Year	2006	2007	2008	2009	2010
Number of Fires	52	101	49	37	112

Risk Assessment

Probability of Future Occurrences

Future wildfire incidents are difficult to predict, as the factors influencing wildfire generation vary greatly with changing weather conditions and with human activities. There is currently no quantitative estimate of future wildfire probability for specific regions of the state. Probability for wildfire cannot be deduced into specific return periods or recurrence intervals as it can be for some of the other hazards.

While the VDOF Wildfire Risk Assessment indicates the relative propensity for wildfires across the state, this assessment does not assign probabilities of occurrence or return intervals as is common with some of the other hazards. Based on available data from VDOF, during the years 1995 – 2008, the Peninsula experiences an average of 8 wildfires per year, affecting an average of 12 acres annually, and totaling $885 in annualized loss. This may be a dramatic underrepresentation of wildfire risk on the Peninsula. Additional data will help to strengthen these estimates in the future.

There currently are no recoded NCDC events for wildfire on the Peninsula.

Impact & Vulnerability

Vulnerability to wildfire is influenced by a variety of factors, such as land cover, weather, and the effectiveness of land management techniques. Highly urbanized areas are less vulnerable to wildfire, but suburban neighborhoods located at the urban/wildland interface are very vulnerable to wildfire. The primary impacts of most wildfires are timber loss and

environmental damage, although the threat to nearby buildings is always present. Secondary impacts may also include landslides and mudslides caused by the loss of groundcover which stabilizes the soil.

Risk

In 2002 and 2003, VDOF used GIS to develop a statewide spatial *Wildfire Risk Assessment* model that aims to: (1) identify areas where conditions are more conducive and favorable to wildfire occurrence and wildfire advancement; (2) identify areas that require closer scrutiny at larger scales; and (3) examine the spatial relationships between areas of relatively high risk and other geographic features of concern such as woodland home communities, fire stations, and fire hydrants. This model incorporates data from several other state and federal agencies including land cover, demographics, transportation corridors, and topography to illustrate the level of wildfire risk for all areas across the State of Virginia. The results of this model were merged, and the wildfire risks were classified and scored as: 1 (low), 2 (moderate), and 3 (high).

Figure 4-51 shows the results of using the VDOF model to map wildfire hazard areas for the Peninsula. As can be shown on the map, most wildfire hazard areas are located in James City and York Counties.

According to VDOF, approximately 30% of the Peninsula land area is a high fire risk zone, 38% is a moderate fire risk zone, and 32% is a low fire risk zone. York County has the highest percentage of the jurisdictions in the High risk zone. Table 4-88 summarizes the percentage of land area exposed to wildfire hazard for each Peninsula community.

Table 4-88: Wildfire Risk by Jurisdiction

Community	Area (sq. mi.)	Fire Risk in Square Miles and % of Jurisdiction		
		High	Medium	Low
Hampton	51.8	3.5 (6.7%)	6.0 (11.6%)	42.3 (81.7%)
Newport News	176.9	16.1 (9.1%)	36.8 (20.8%)	124.0 (70.1%)
Williamsburg	8.5	0.8 (9.0%)	3.1 (36.1%)	4.7 (54.9%)
James City County	143.0	47.6 (33.3%)	18.0 (12.6%)	77.4 (54.1%)
York County	106.0	53.0 (50.0%)	42.3 (39.9%)	10.7 (10.1%)
Total	486.2	147.8 (30.4%)	183.8 (37.8%)	154.1 (31.7%)

More information on VDOF's GIS-based Wildfire Risk Assessment is available at www.dof.virginia.gov.

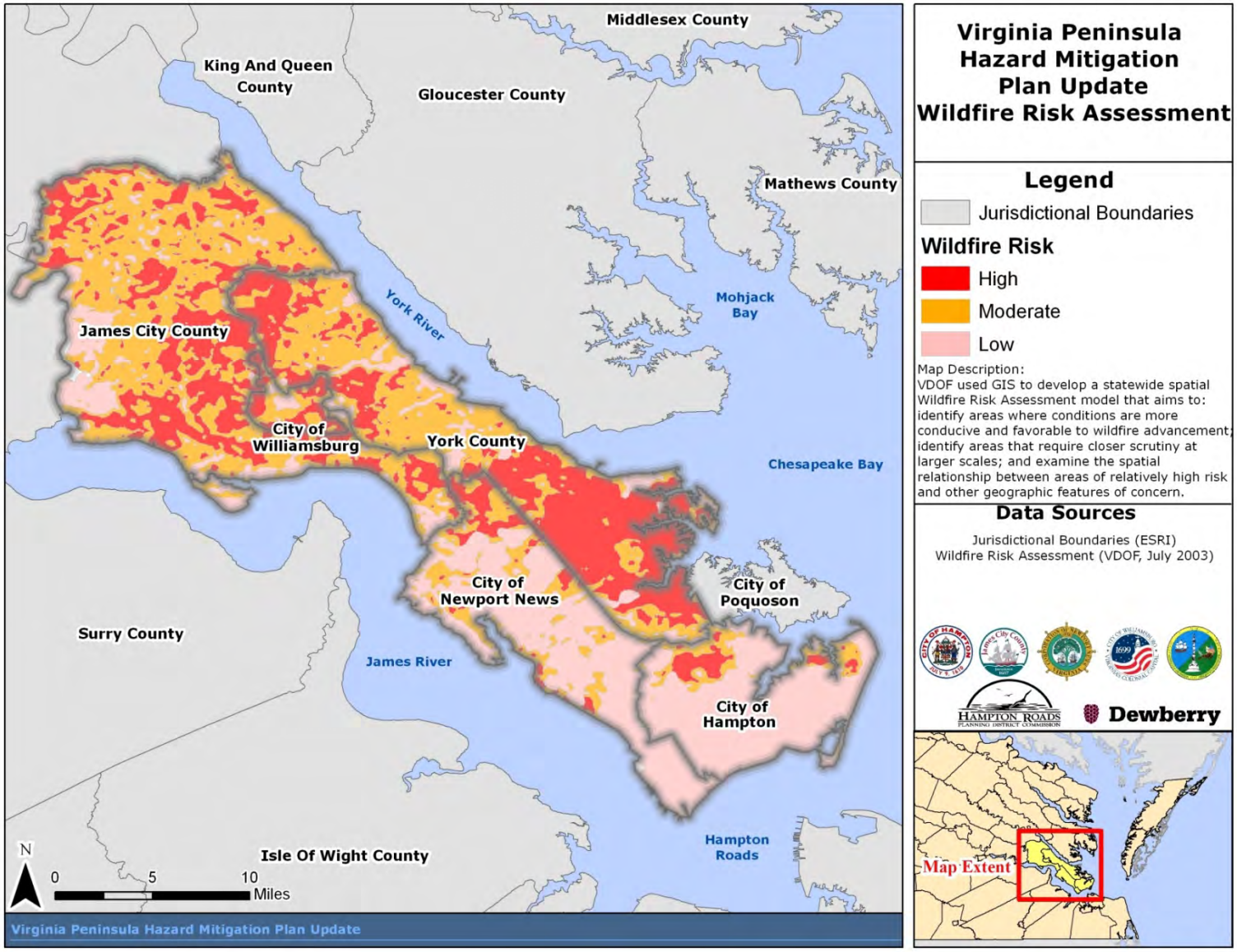


Figure 4-51: Wildfire Risk Assessment from VDOF

Critical Facility Risk

Critical facilities data was intersected with the VDOF Wildfire Risk Assessment to determine which facilities were at an increased risk for wildfire, or being in the urban/wildland interface. Figure 4-52 shows the location of critical facilities in relation to the wildfire risk zones. Table 4-89 shows the number of critical facilities, by locality, for the moderate and high VDOF risk zones. The results of this analysis indicate 133 critical facilities are located in high wildfire risk zones, 101 in moderate risk zones, and 253 in low risk zones. York County has the highest number of critical facilities in moderate (59) and high (105) risk zones. Sewer and Towers represent the majority of critical facilities in the high wildfire risk zone for York County. Government offices represent the majority of critical facilities in the high wildfire risk zone for James City County.

The names and information for the critical facilities in the wildfire risk zones are available in Appendix E4. The lack of wildfire probabilities and detailed infrastructure data led to the inability to calculate potential losses due to wildfire.

Table 4-89: Number of Critical Facilities Potentially At-Risk to Wildfire

Jurisdiction	Wildfire Risk		
	High	Moderate	Low
City of Hampton	1	4	63
City of Newport News	5	15	159
City of Williamsburg	10	8	10
James City County	12	15	3
York County	105	59	18
Total	**133**	**101**	**253**

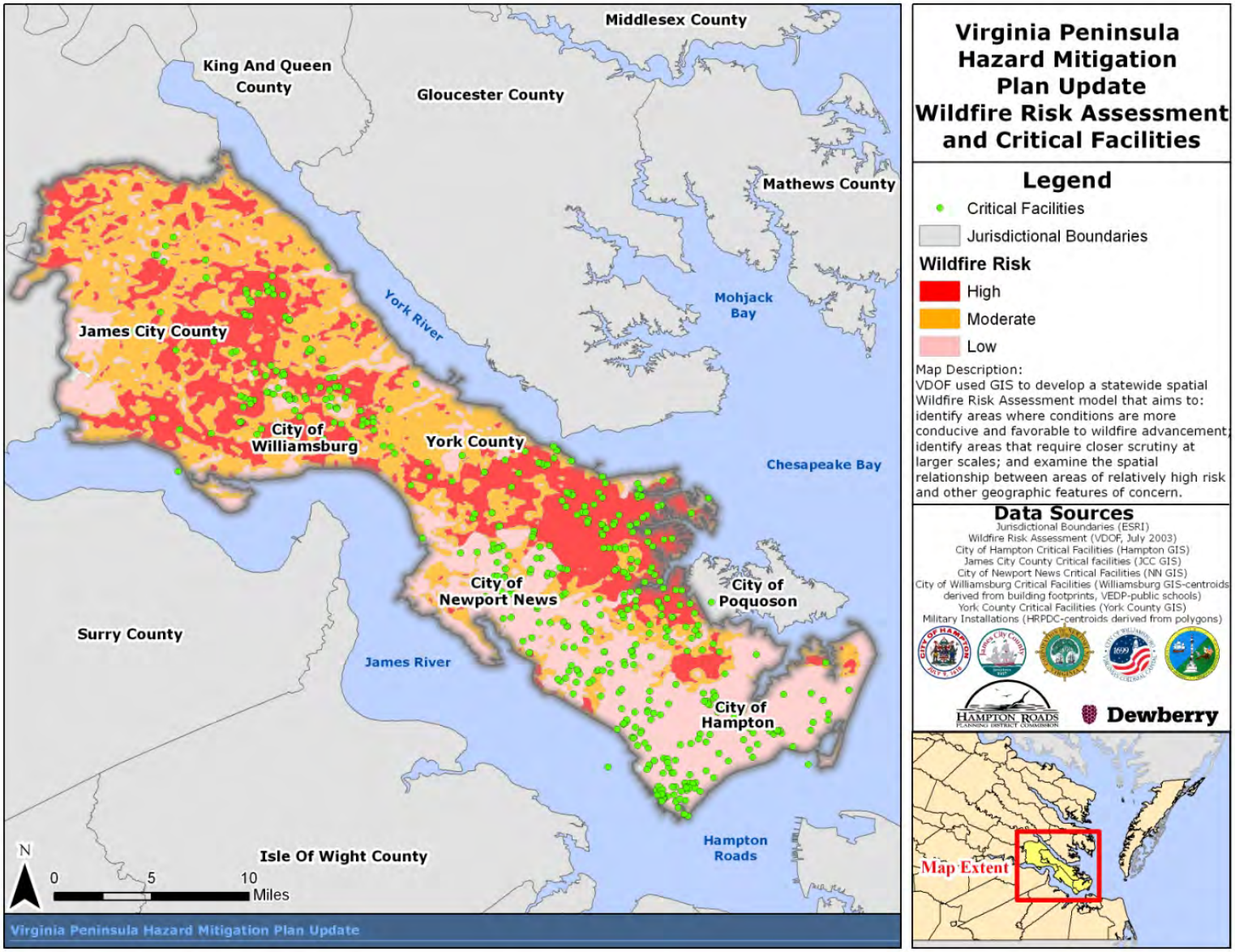


Figure 4-52: Critical Facility locations within the Wildfire Risk Zones from VDOF

Existing Buildings and Infrastructure Risk

According to VDOF statistics collected in 2003, Virginia has more than 4,000 woodland home communities. These areas are defined by VDOF as "clusters of homes located along forested areas at the wildland-urban interface that could possibly be damaged during a nearby wildfire incident." In the Peninsula region, there are 106 woodland home communities. Table 4-90 lists the number of woodland home communities in each of the participating jurisdictions. Figure 4-53 shows the location of these woodland home communities in relation to the identified wildfire hazard areas. More information on these communities is readily available through the VDOF.

Table 4-90: Number of Woodland Communities

Jurisdiction	Number of Woodland Communities	Number of Homes
City of Hampton	7	1,407
James City County	151	12,129
City of Newport News	40	20,605
City of Williamsburg	0	0
York County	106	11,203

Source: VDOF

Historically, wildfires have been larger and caused more damages in these counties mainly due not only to increased vegetative fuel loads but also because the areas are more sparsely settled and have less rapid fire response capabilities. The most at-risk properties within these areas are considered to be those structures located along the wildland-urban interface, defined by the National Wildfire Coordinating Group[48] as "the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels." Structures with combustible roofs and less than 30 feet of cleared defensible space are particularly at risk.

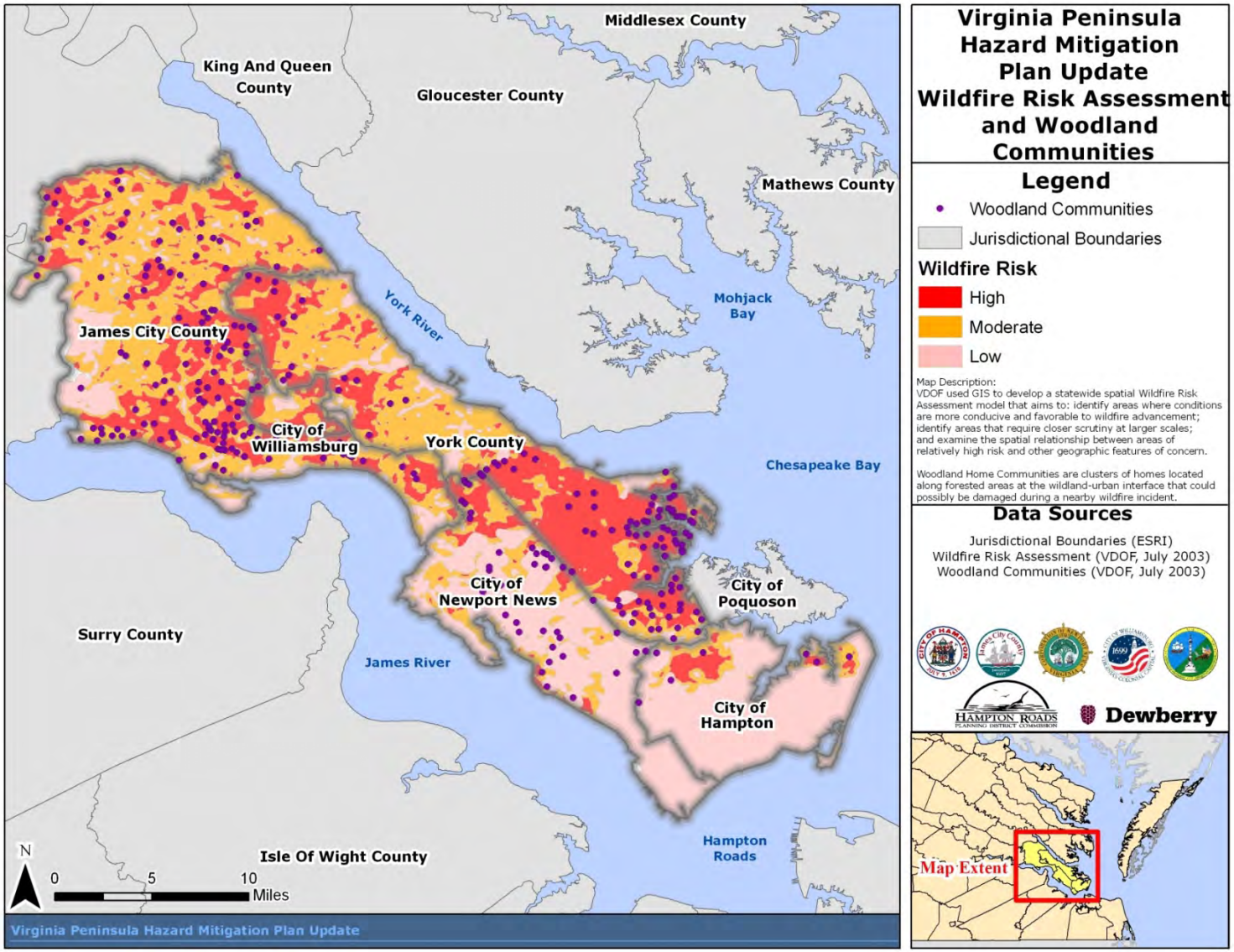


Figure 4-53: Wildfire Risk Assessment and location of Woodland Communities on the Peninsula

Analysis completed for the 2006 plan highlighted the number of parcels and building values in the VDOF wildfire risk zones. Table 4-91 summarizes the results of this analysis.

Table 4-91. Parcels within VDOF Wildfire Risk Zones

Jurisdiction	# Parcels in High	Improvement Value
City of Hampton	456	$986,342,500
City of Newport News	1,856	$1,388,486,700
City of Williamsburg	*	$14,582,700 residential $9,304,700 commercial
James City County	13,678	$3,881,690,400
York County	14,584	$4,711,794,700

*Number available through the City

Parts of the Peninsula are experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, by placing structures in close proximity to large amounts of vegetation, which in turn increases the risk of wildfire.

Hazard Summary

Between 1995 and 2008, the VDOF recorded 110 wildfire events on the Peninsula totaling approximately $12,400 in damages or roughly $954 annually. It should be noted that there are likely instances of wildfire that have occurred that went unreported to VDOF and are not represented in the data.

No wildfire events were recorded in the NCDC database for the Peninsula; as a result no NCDC annualized loss estimate was calculated. The Commonwealth of Virginia's 2010 Hazard Mitigation Plan ranking was based on the NCDC database. The update to the Peninsula plan used this same framework to establish a common system for evaluating and ranking hazards. While this ranking methodology makes sense for the majority of the hazards in this plan the data is limited/non-existent for wildfires with artificially low hazard rankings a likely result. Because of this, the ranking methodology was not applied.

Based on the updated analysis of the available data, consideration of new data and several discussions with jurisdictional officials familiar with the wildfire hazard in their community, the decision was made to rank the wildfire hazard High for York County and Newport News, Medium-High for James City County and Williamsburg, and Medium for Hampton.

Earthquake

Hazard Profile

NOTE: As part of the 2011 plan update, the Earthquake hazard was reexamined and new analyses performed. This new analyses included, but was not limited to: 1) refreshing the hazard profile; 2) updating the previous occurrences; 3) determining annualized number of hazard events and losses by jurisdiction using NCDC and other data sources where available; 4) updating the assessment of risk by jurisdiction based on new data; 5) ranking of the hazard by jurisdiction using the methodology described in detail in the HIRA Introduction section. Each section of the plan was also reformatted for improved clarity, and new maps and imagery, when available and appropriate, were inserted.

Description

The Earth's outer surface is broken into pieces called tectonic plates, which move away from, towards, or past each other. Because the continents are part of these plates, they also move. An earthquake occurs when the stresses caused by plate movements are released. The abrupt release of stored energy in the rocks beneath the Earth’s surface results in a sudden motion or trembling of the earth. The epicenter is the point on the Earth's surface directly above the source of the earthquake.

Smaller earthquakes occur much more frequently than large earthquakes. These smaller earthquakes generally cause little or no damage. However, very large earthquakes can cause tremendous damage and are often followed by a series of smaller aftershocks lasting for weeks after the event. This phenomenon, referred to as “minor faulting,“ occurs during an adjustment period that may last for several months.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology, as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter

Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Geographic Location/Extent

Virginia and the eastern side of the North American continent are in the middle of a tectonic plate. The states east of the Mississippi River have fewer earthquakes than the western portion of the country. Quakes occurring in the west are typically stronger, but eastern earthquakes can cause more damage away from their origin because the underlying bedrock is well-connected (like a concrete slab). This geology allows eastern earthquakes to travel farther than in the west, where the underlying topography is so disconnected (like a brick patio) that the energy of a quake is dissipated closer to the epicenter.

According to the Virginia Department of Mines, Minerals and Energy, Virginia has a moderate earthquake risk (similar to most states on the eastern seaboard). This risk assessment is further supported by the USGS. The USGS rates areas of the United States for their susceptibility to earthquakes based on a 2% or 10% probability of a given peak force, being exceeded in a 50-year period. Based on the map shown in Figure 4-54, the Peninsula lies in an area of moderate seismic risk, with a 10% chance in the next 50 years that a peak acceleration of 1% to 3% will be equaled or exceeded.

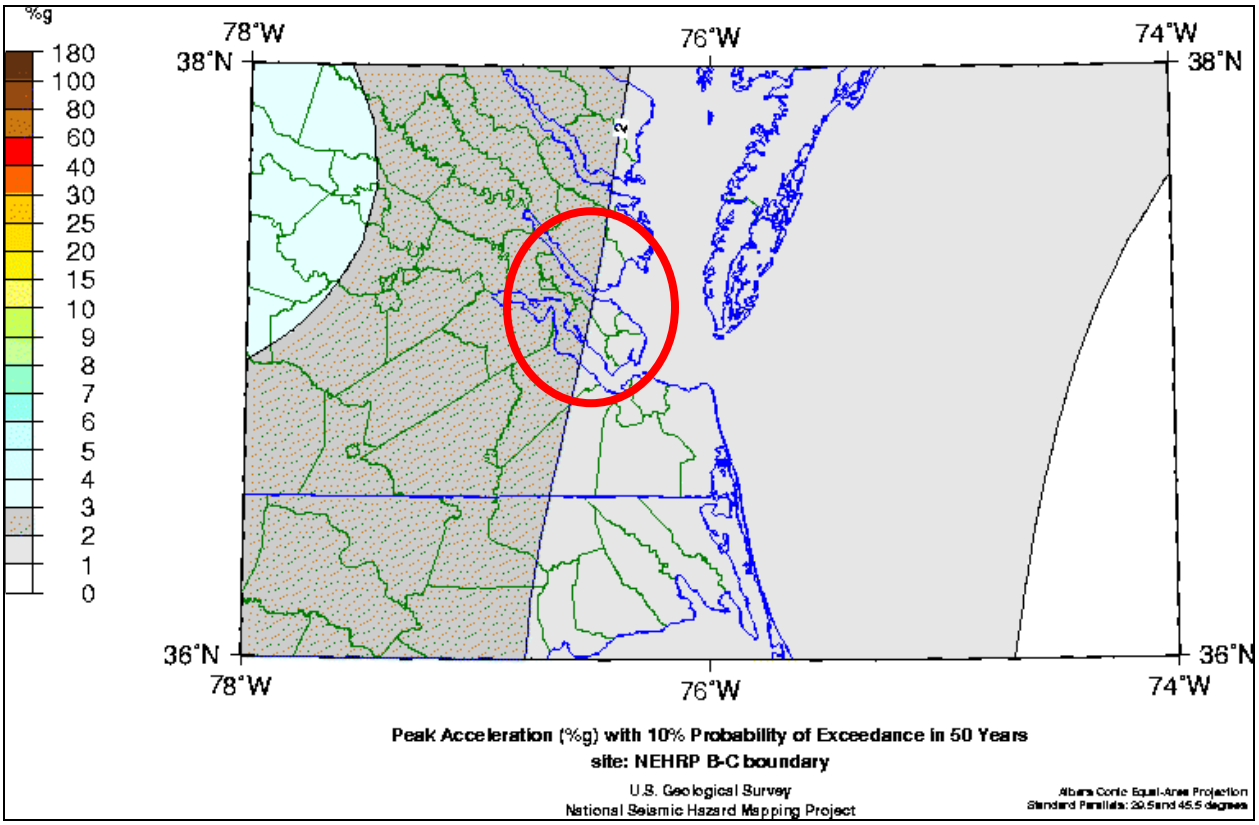


Figure 4-54: Peninsula Seismic Risk

Magnitude or Severity

Ground shaking can lead to the collapse of buildings and bridges; disrupt gas, life lines, electric, and phone service. Death, injuries, and extensive property damage are possible vulnerabilities from this hazard. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure.

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 shear strength and the ability to support foundation loads. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

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 (Table 4-92). 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.

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and, finally, total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity (MMI) Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.

The MMI value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at a particular place.

The lower numbers of the intensity scale deal with the manner in which people feel the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. A detailed description of the MMI Scale of earthquake intensity and its correspondence to the Richter Scale is given in Table 4-93.

Table 4-92: 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 4-93: 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

Table 4-93: Modified Mercalli Intensity Scale for Earthquakes			
Scale	**Intensity**	**Description of Effects**	**Corresponding Richter Scale Magnitude**
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

Previous Occurrences

Significant earthquakes were first recorded in Virginia in 1774. Virginia has had over 160 earthquakes since 1977, of which 16% were felt. This averages to approximately one earthquake per every month, with two felt each year.[49] Figure 4-55, from the 2010 Virginia Hazard Mitigation Plan, shows the significant earthquakes to impact Virginia from 1568 – 2009.

There have been no significant earthquakes recorded in the Peninsula region. The closest earthquake happened on February 21, 1774. A strong earthquake was felt over much of Virginia and southward into North Carolina. Many houses were moved considerably off their foundations at Petersburg and Blandford (intensity MMI VII). The shock was described as "severe" at Richmond and "small" at Fredericksburg. However, it "terrified the inhabitants greatly." The total felt area covered about 57,900 square miles.

The three great earthquakes near New Madrid, Missouri, in 1811 - 1812 (December 11, January 23, and February 7) were felt strongly in Virginia. Reports from the Norfolk and Richmond newspapers describe the effects in detail.

The August 27, 1833, earthquake covered a broadly felt area from Norfolk to Lexington and from Baltimore, Maryland, to Raleigh, North Carolina - about 52,110 square miles. At Charlottesville, Fredericksburg, Lynchburg, and Norfolk, windows rattled violently, loose objects shook, and walls of buildings were visibly agitated (MMI V).

Another moderately strong, widely felt shock occurred on April 29, 1852. The felt area extended to Washington D.C., Baltimore, Maryland, and Philadelphia, Pennsylvania, and also included many points in North Carolina – totaling approximately 162,120 square miles. This pattern was repeated on August 31, 1861. The epicenter was probably in extreme southwestern Virginia or western North Carolina. This shock affected about 299,150 square miles and was felt along the Atlantic coast from Washington, D.C., to Charleston, South Carolina, and westward to Cincinnati, Louisville, and Gallatin, Tennessee, and southwestward to Columbus, Georgia.

A series of shocks in quick succession disturbed the eastern two-thirds of Virginia and a portion of North Carolina on December 22, 1875. At Manakin, many chimneys were broken and shingles on one store were shaken off (MMI VII). Damage to chimneys was reported from other places in Goochland and Powhatan Counties. The total felt area was about 50,180 square miles.

The famous 1886 earthquake in Charleston, South Carolina, was felt on the Peninsula, and in the Hampton Roads region. Plaster damage in Williamsburg, as well as broken chimneys in nearby Norfolk, were typical impacts throughout the Commonwealth. In Norfolk, light framework was thrown down, large warehouses were damaged, and the earthquake caused panic in the Opera House. The event led to reports of nausea among many residents of Norfolk, had an estimated magnitude of 6.6 to 6.9, and was felt as far north as Canada and as far south as Cuba. Residents of Missouri also felt the earthquake.

The largest earthquake to originate in Virginia in historic times occurred on May 31, 1897. The epicenter was in Giles County, where on May 3, an earlier tremor at Pulaski, Radford, and Roanoke had caused damage (MMI VI). Loud rumblings were heard in the epicentral region at various times between May 3 and 31. The shock on the latter date was felt from Georgia to Pennsylvania and from the Atlantic Coast westward to Indiana and Kentucky, an area covering about 279,850 square miles. Minor tremors continued in the epicentral region from time to time until June 6; other disturbances felt on June 28, September 3, and October 21 were probably aftershocks. In Newport News, there were reports that the earthquake "frightened a great many people." The shake was more perceptible "near the edge of the water, where it caused the piers and buildings to rock," but no damage was reported. In Williamsburg, the earthquake was felt by "nearly everybody in town."[50]

The April 23, 1959, earthquake was strongest in Giles County, at Eggleston and Pembroke. Residents there reported several damaged chimneys and articles shaken from shelves and walls. One chimney toppled at the Norfolk and Western Station in Eggleston. The quake was also felt in West Virginia.

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

The December 9, 2003, Powhatan County earthquake was a complex event consisting of two sub-events occurring 12 seconds apart and causing slight damage nearest the epicenter. The quakes were felt in much of Maryland and Virginia and in north-central North Carolina and a few areas of Delaware, New Jersey, New York, Pennsylvania, and West Virginia.

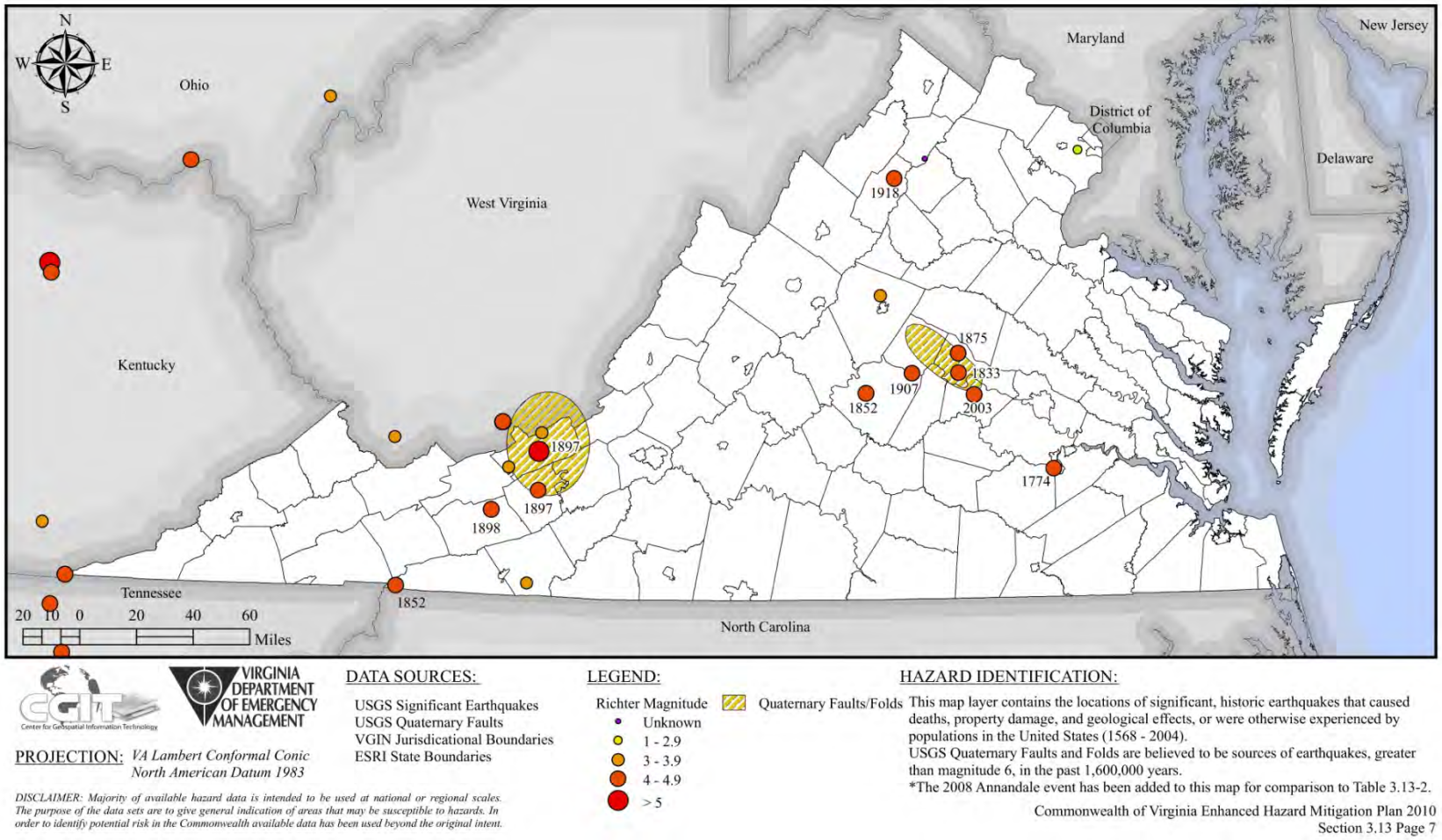


Figure 4-55. Significant Earthquake 1568-2004, with 2008 Annandale event

Source: 2010 Commonwealth of Virginia Emergency Operations Plan

Risk Assessment

Similar to other states on the eastern seaboard, the Commonwealth of Virginia is designated as a moderate risk state for earthquake occurrence by the USGS. Earthquake events can and occasionally do occur in the state, though of much less intensity than those that occur along the west coast. The greatest seismic risk in Virginia is in the Eastern Tennessee Seismic Zone, located in the southwestern portions of the state and far from the Peninsula.

Probability of Future Occurrences

Earthquakes are low probability, high-consequence events. Although earthquakes may occur only once in the lifetime of an asset they can have devastating impacts. A moderate earthquake can cause serious damage to unreinforced buildings, building contents, and non-structural systems, and can cause serious disruption in building operations. Moderate and even very large earthquakes are inevitable, although very infrequent, in areas of normally low seismic activity. Consequently, buildings in these regions are seldom designed to deal with an earthquake threat; therefore, they are extremely vulnerable.

Probabilistic ground motion maps are typically used to assess the magnitude and frequency of seismic events. These maps measure the probability of exceeding a certain ground motion, expressed as percent peak ground acceleration (%PGA), over a specified period of years. The severity of earthquakes is site specific, and is influenced by proximity to the earthquake epicenter and soil type, among other factors. Figures 4-56 and 4-57[51] show the PGA zones for the 100-year and 2500-year return periods derived from the HAZUS-MH data. The 2,500-year return period, or 0.04% annual chance of occurrence, is much more varied than the 100-year return period, or the 1.0% annual chance of occurrence. Southwest and Central Virginia have an increased likelihood of experiencing a significant earthquake.

The recurrence interval for significant earthquake events on the Peninsula is very low; however, the potential impact of a major seismic event along the Eastern Tennessee or Central Virginia seismic zone could be moderately destructive.

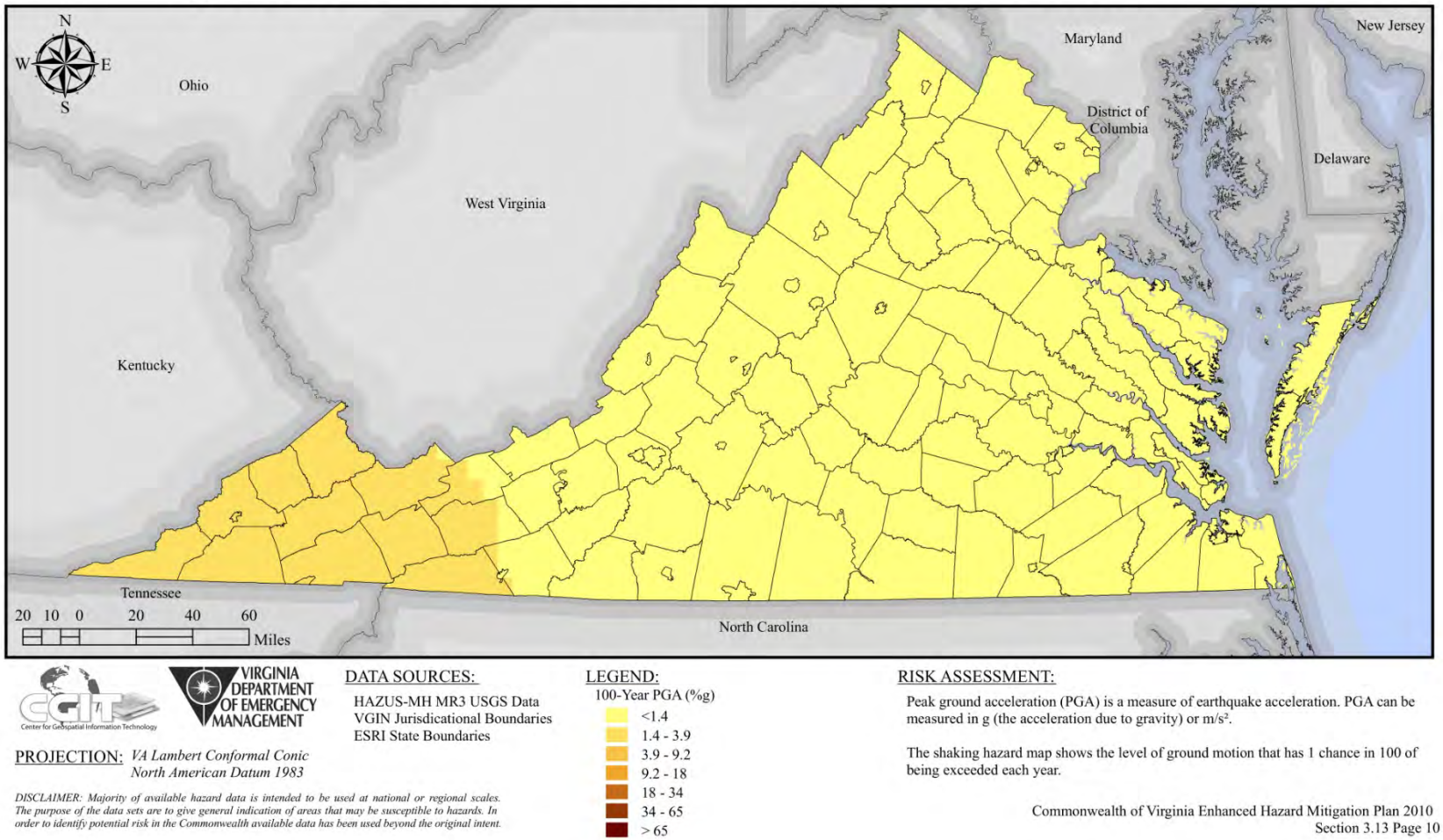


Figure 4-56: 100-year Return Period Peak Ground Acceleration

Source: 2010 Commonwealth of Virginia Emergency Operations Plan

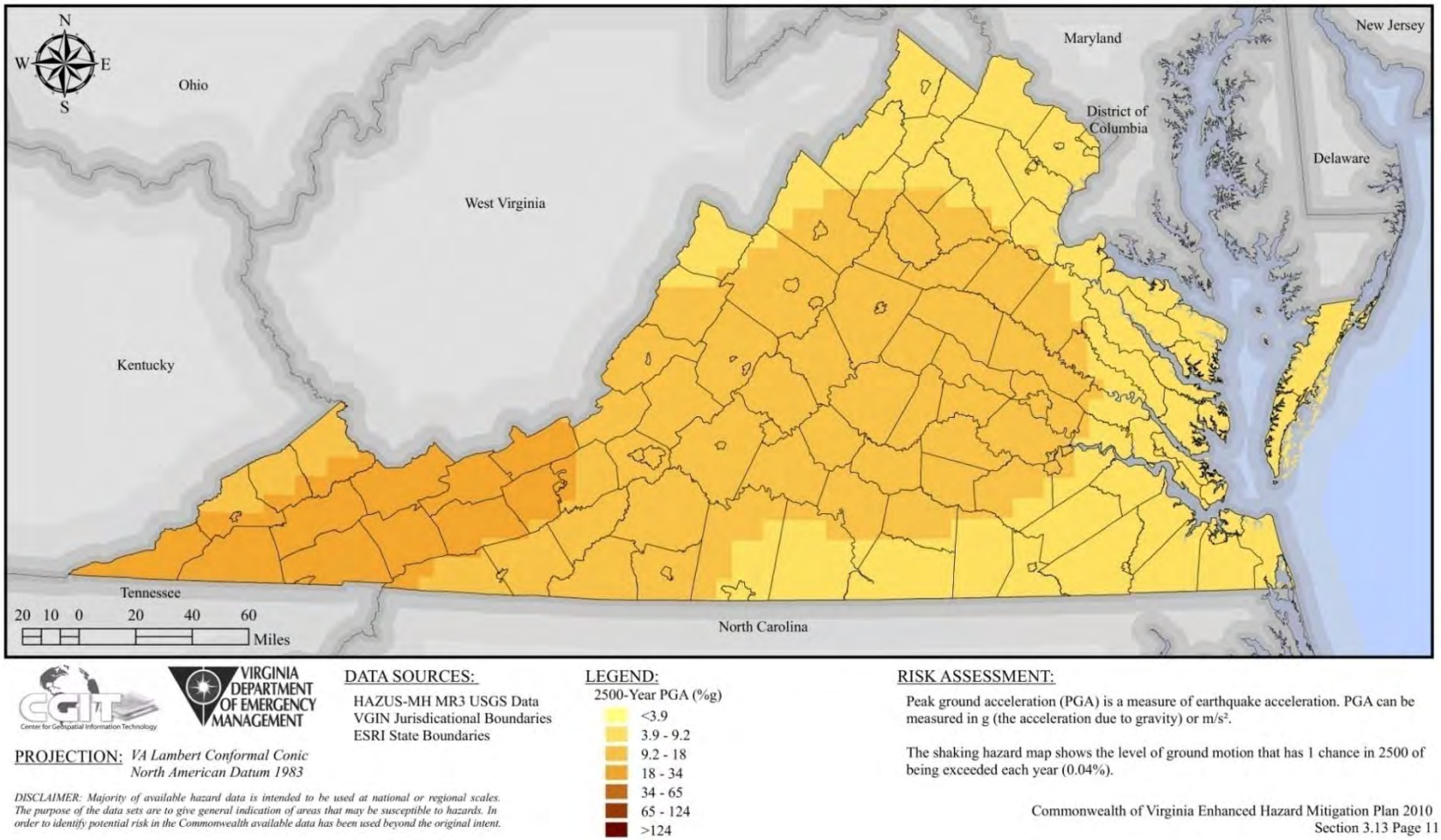


Figure 4-57: 2,500-year Return Period Peak Ground Acceleration (PGA)

Source: 2010 Commonwealth of Virginia Emergency Operations Plan

Impact & Vulnerability

Impacts from earthquakes can be severe and cause significant damage. Table 4-94 provides the corresponding intensity equivalents in terms of MMI as well as perceived shaking and potential damage expected for given values.

Table 4-94: Modified Mercalli Intensity (MMI) and PGA Equivalents

MMI	PGA (%g)	Perceived	Potential
I	<0.17	Not Felt	None
II	0.17 - 1.4	Weak	None
III	0.17 - 1.4	Weak	None
IV	1.4 -3.9	Light	None
V	3.9 -9.2	Moderate	Very Light
VI	9.2 -18	Strong	Light
VII	18 -34	Very Strong	Moderate
VIII	34 - 65	Severe	Moderate to Heavy
IX	65 - 124	Violent	Heavy
X	> 124	Extreme	Very Heavy
XI	> 124	Extreme	Very Heavy
XII	> 124	Extreme	Very Heavy

The Peninsula vulnerability and impact has been calculated in terms of total direct economic loss, as defined by HAZUS. This includes damage to structural, non-structural, building, contents, inventory loss, relocation, income loss, rental loss, and wage loss.

Risk

Moderate and even very large earthquakes are inevitable, although very infrequent, in areas of normally low seismic activity. Earthquake HAZUS-MH MR3 analysis was completed as part of the 2010 Commonwealth of Virginia Emergency Operations Plan. The results of this analysis were still considered valid for the Peninsula and are included below.

HAZUS was used to update damage and loss estimates for the probabilistic ground motions associated with each of eight return periods (100, 250, 750, 1,000, 2,000, and 2,500 years). The building damage estimates were then used as the basis for computing direct economic losses. These include building repair costs, contents and business inventory losses, costs of relocation, capital-related, wage, and rental losses. Annualized loss was

computed, in HAZUS, by multiplying losses from the eight potential ground motions by the respective annual frequencies of occurrence, and summing the values.

HAZUS-MH can be used to evaluate a variety of hazards and associated risk to support hazard mitigation. This revision utilized only Level 1 analysis for the earthquake module. Level 1 analysis involves using the provided hazard and inventory data with no additional local data collection. This is an acceptable level of information for mitigation planning; future version of this plan can be enhanced with Level 2 and 3 analyses. The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Based on HAZUS analysis, the Peninsula can expect $428,303 in annualized losses due to earthquakes (Table 4-95). The study area represents 2.5% of Virginia's annualized losses for earthquake, relatively low compared to the rest of the state (which is also low compared to the rest of the Country). City of Newport News accounts for 38.8% of the total loss followed by the City of Hampton, which accounts for 23.4% of the total loss. James City County accounts for 18.6% of the total loss for the region.

Figure 4-58 illustrates the total annualized loss per census tract on the Peninsula. The City of Newport News and James City County contain two of the highest loss estimates by census tract, $19,724 and $18,965 respectively.

Table 4-95: HAZUS Annualized Loss for Earthquake

Jurisdiction	Annualized Loss
City of Newport News	$166,376
City of Williamsburg	$26,181
Hampton	$100,124
York County	$55,830
James City County	$79,792
Region Total	**$428,303**
Virginia Total	**$17,429,103**

**Source: 2010 Commonwealth of Virginia Emergency Operations Plan*

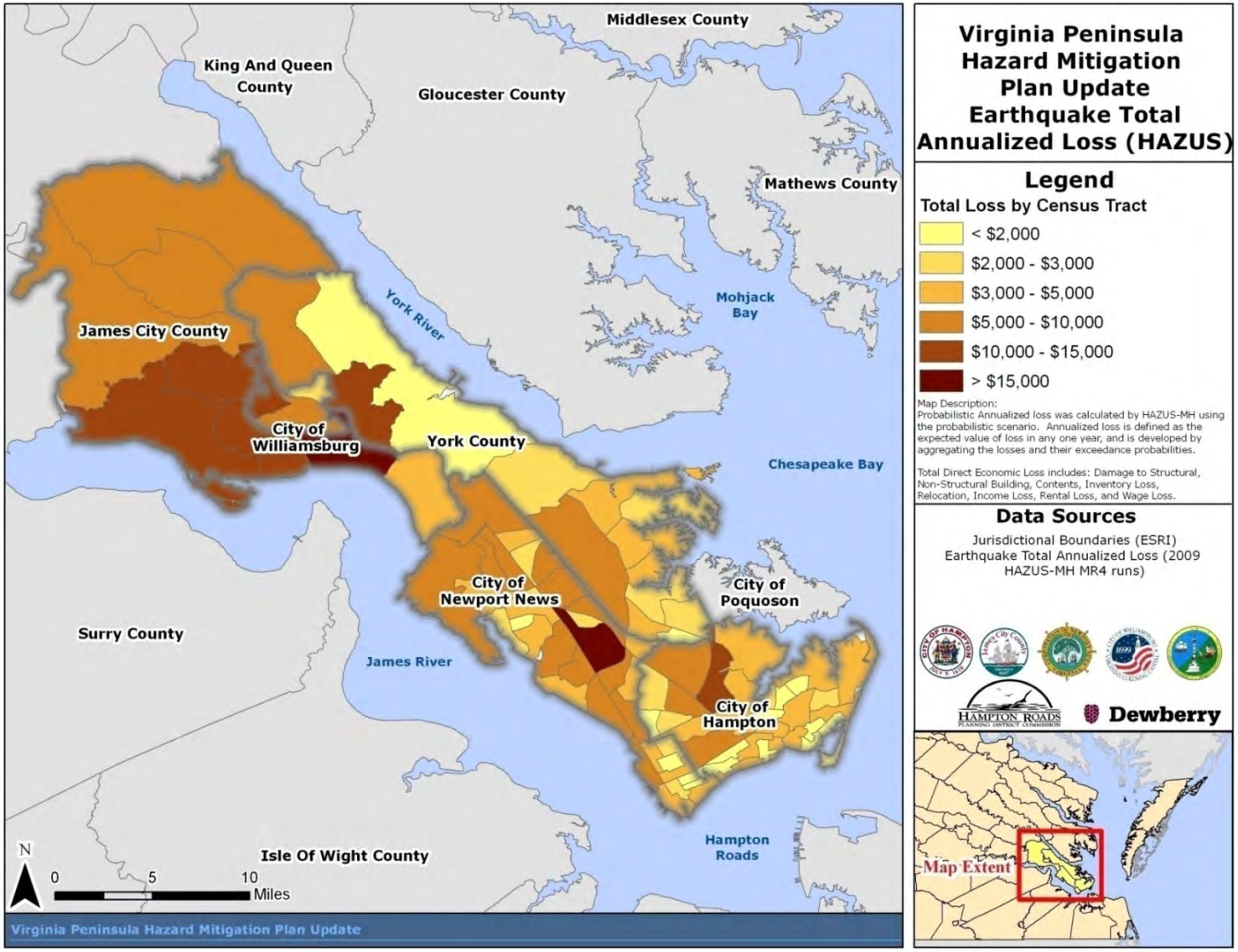


Figure 4-58: Earthquake HAZUS Annualized Loss

Critical Facility Risk

Earthquakes pose a threat to buildings and infrastructure, including facilities that are critical to the health and welfare of the population. There are a total of 491 critical facilities (as identified through GIS data provided by each jurisdiction; facility dollar values not provided) located within the participating jurisdictions. In addition to police, fire, hospital, and other facilities, utility companies and the services they provide also have significant vulnerabilities to various hazards. For instance, Hampton Roads Sanitation District has over $1.4 billion in infrastructure (pipes, stations, treatment plants, etc.) exposure. Newport News Waterworks has approximately $715 million in infrastructure exposure. The intensity of earthquakes that have previously impacted the area suggest that only minor damage, if any, would be experienced by these and other types of critical facilities and infrastructure.

Additional, in-depth analysis for risk to critical facilities was not completed due to the limited impacts to population and infrastructure of the typical earthquake intensity experienced on the Peninsula.

Existing Buildings and Infrastructure Risk

Additional analysis for risk to existing building and infrastructure was not completed due to the limited impacts to population and infrastructure.

As discussed in the HIRA Introduction, HAZUS general building stock section, there is an estimated 152,936 buildings in the region with a total building replacement value (excluding contents) of $28.5 billion dollars. The majority of the buildings in the region are associated with residential housing. Wood frame construction makes up over 50% of the building inventory.

One-third of the estimated losses with the probabilistic scenario (annualized loss) are related to business interruption in the region. The largest loss is sustained by the residential occupancies, which make up over 77% of the total loss estimates.

Hazard Summary

The 2006 plan considered the risk of earthquake on the Peninsula to be low, and "non-critical."

No earthquake events were recorded in the NCDC database for the Peninsula; as a result, no NCDC annualized loss estimate was calculated**.** The Commonwealth of Virginia's 2010 Hazard Mitigation Plan ranking was based on the NCDC database. The update to the Peninsula plan used this same framework to establish a common system for evaluating and ranking hazards. While this ranking methodology makes sense for the majority of the hazards in this plan, the data is limited/non-existent for earthquakes with low hazard rankings a likely result. Because of this, the ranking methodology was not applied.

Based on committee discussions and feedback and a review of historical data, including the very limited data on previous losses associated with the hazard, earthquake is considered a "Low" risk for the Peninsula and, as a result, not ranked as part of the 2010 plan update.

Landslides and Expansive Soils

Hazard Profile

NOTE: As part of the 2011 plan update, the Landslides and Expansive Soils hazards were consolidated and reexamined. This included, but was not limited to, refreshing the hazard profiles and investigating previous occurrences. This and all other sections of the plan were also reformatted for improved clarity.

Description

Landslides

Landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states. Landslides cause $1-2 billion in damage annually and more than 25 fatalities on average each year.[52] Landslides can and do occur in conjunction with other natural hazards, such as heavy rain events, volcanoes, wildfires, floods, and earthquakes, or human activities like excavations. Landslides can be broken down into falls, flows, or slides based on the type of earth movement.[53]

Landslides are the downward movement of large volumes of surface materials under gravitation influences.[54] Types of movement include: rotational, translational, block, falls, topples, avalanche, earth flow, creep, and lateral spreading.[55] Landslide materials in motion generally consist of fractured or weathered rock, loose or unconsolidated soils, and vegetative debris. 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 failure surface. Mudflows, sometimes referred to as mudslides, 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.

Most of the Peninsula is classified as low landslide risk on the Landslide Incidence and Susceptibility Map. The landslide data set shows areas in the United States where large numbers of landslides have occurred and areas that are susceptible to landslides. This data set is a digital representation of USGS Open-File Report 97-289, which is a PDF version of the 1997 USGS Digital representation of Landslide Overview Map. The report classifies the major physical subdivision of the United States and assesses the vulnerability based on subdivision characteristics.

Figure 4-59 shows the Landslide Incidence and Susceptibility from the *Commonwealth of Virginia Emergency Operations Plan*. There are small areas that are listed as Moderate incidence for the Peninsula. These areas occur in the Cities of Hampton and Newport News, and the counties of James City and York. The data used to generate this map was highly generalized (scale 1:4,000,000); therefore, it is unsuitable for local planning or actual site selection and further investigation at the local level is recommended.

While some neighboring states with similar terrain have experienced landslide events, no notable incidences of landslide have been recorded on the Peninsula.

Due to the limited impacts to population and infrastructure, this hazard was not analyzed in detail as part of this plan update.

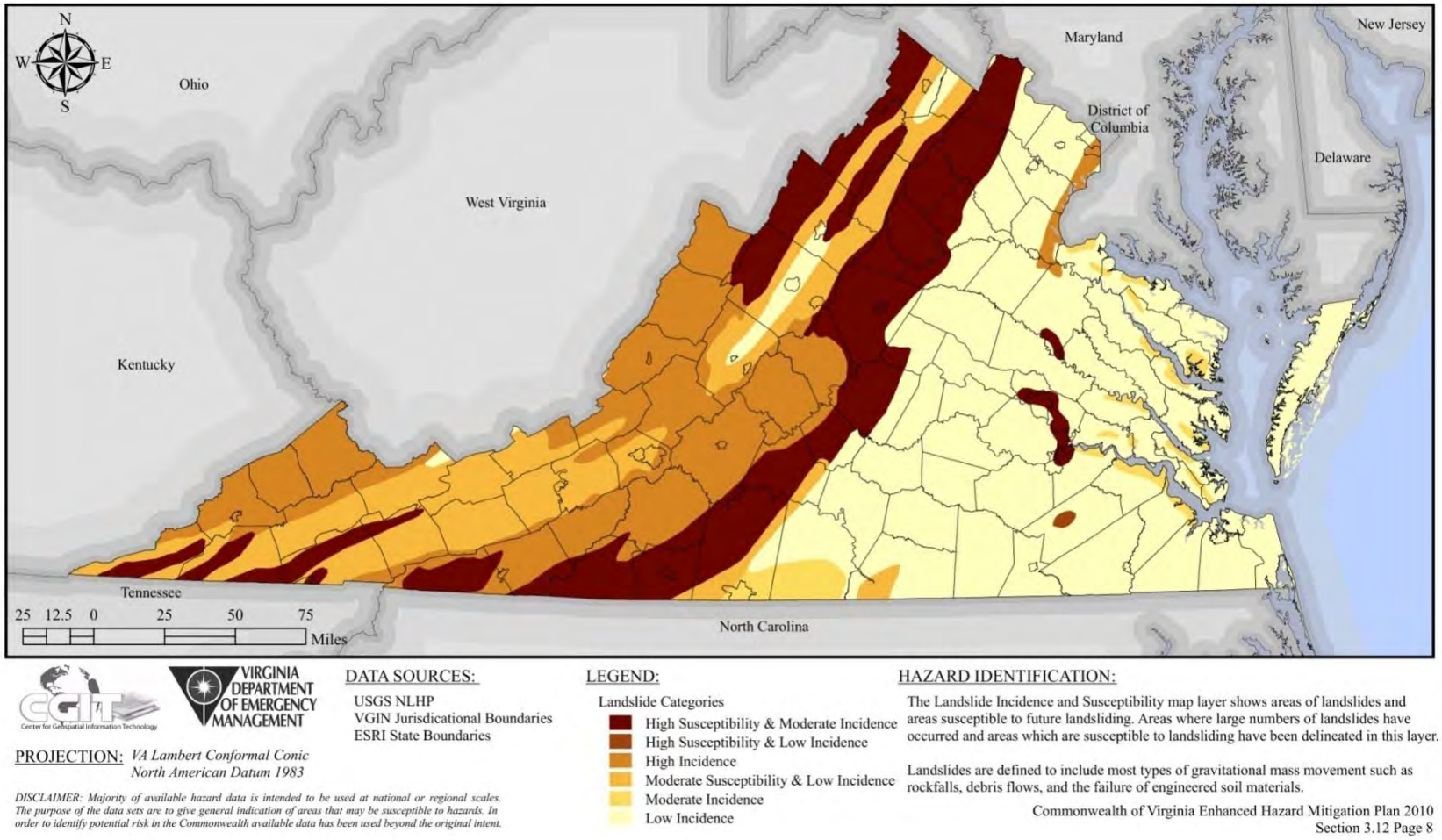


Figure 4-59: Landslide Incidence and Susceptibility

Source: Commonwealth of Virginia Emergency Operations Plan.

Expansive Soils

Soils with a sufficient content of certain types of clay experience a change in volume during a transition from dry to wet conditions. These soils are called expansive soils, or "shrink-swell" soils. Hazards associated with expansive soils arise from the change in volume experienced. This physical factor can result in slope instability and cause damage to building foundations.

Each community within the Peninsula addresses the issue of expansive clay in their respective comprehensive plans, and addresses soil conservation based on state standards set forth in the Virginia Erosion and Sediment Control Law and Regulations.

Due to the limited impacts to population and infrastructure, this hazard was not analyzed in detail as part of this plan update.

Biological Hazards/Epidemics

Hazard Profile

NOTE: As part of the 2011 plan update, the Biological Hazards/Epidemics hazards were reexamined. This included, but was not limited to, refreshing the hazard profiles and investigating previous occurrences. This and all other sections of the plan were also reformatted for improved clarity.

Description

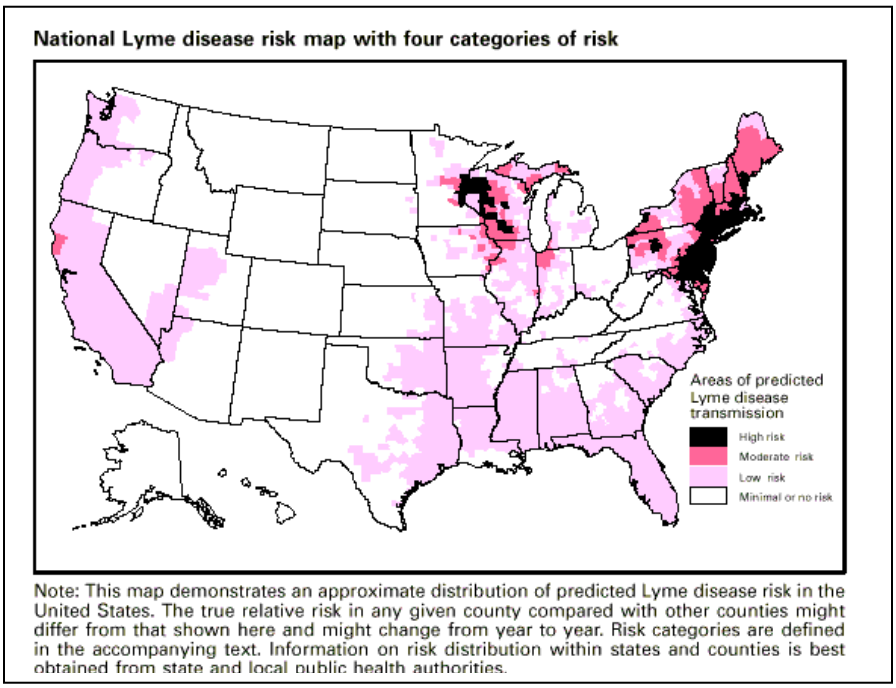
Biological hazards originate from naturally occurring substances such as bacteria, fungi, molds, and viruses. In many cases, these hazards are not visible, yet they can cause serious health effects to humans, plants, and animals. West Nile Virus, Lyme disease, and bacterial epidemics have all been documented in the Peninsula region within the last ten years.

West Nile Virus (WNV) was first reported in the United States in 1999. Since then, almost 10,000 people have fallen ill across the country. WNV is transmitted to humans through mosquito bites and usually causes little reaction. However, a small percentage of those infected develop mild symptoms that include fever, headache, body aches, skin rash, and swollen lymph glands. Less than 1% of infected people develop a more severe illness that can include meningitis (inflammation of one of the membranes covering the brain and spinal cord) or encephalitis. The Peninsula communities have taken a proactive stance against WNV by attempting to eliminate mosquito populations and breeding grounds, especially those created by fallen trees during Hurricane Isabel. Some of the techniques

used are low volume spraying, draining areas of standing water, and introducing mosquito-eating fish. Additionally, York County coordinates with the VDOT to maintain easements and right-of-ways that contain standing water.

According to the Virginia Department of Health, there were 101 positive WNV cases for animals (birds, horses, and mammals) in the Peninsula region from 2000 to 2003. There was one probable case of human WNV in the City of Newport News in 2003. WNV continues to be a threat nationally, though incidence has declined significantly over the last five years, from 4,268 human cases in 2006 to 959 in 2010. This decline is witnessed in the City of Newport News, where incidences have all but disappeared in animals over the past five years. According to the USGS Disease Map, there were only four positive WNV cases for animals (birds, horses, and mammals) in the Peninsula region from 2006 to 2010. There were no probable cases of human WNV in this region, but one confirmed case in nearby Norfolk during this period. It is worth noting that decreased testing and surveillance due to budget constraints may play some role in the decrease in incidences.

Conversely, Lyme disease has been on the rise in the region. Lyme disease is a bacterial infection that can afflict humans and animals. It is most commonly transmitted to humans bitten by deer ticks. If Lyme disease goes untreated, some patients may develop arthritis, including intermittent episodes of swelling and pain in the large joints; neurological abnormalities, such as meningitis, facial palsy, motor and sensory nerve inflammation, and encephalitis; and cardiac problems, such as an enlarged heart and inflammation of the heart tissue. Incidence in Virginia climbed from only 274 cases in 2005 to 908 confirmed and probable cases in 2009.



Source: CDC 2004

Figure 4-60: National Lyme Disease Risk Map

A coinciding but not comparable rise has occurred nationally, with 23,763 cases in 2002 compared to 28,921 cases in 2008.[56] The unusual nature of Virginia's increase has encouraged Governor McDonnell to establish a Lyme Disease Task Force as of October 2010.[57] The Centers for Disease Control (CDC) previously ranked the Peninsula as an area of low risk for Lyme disease transmission, but does not currently provide statistics below the state level. As of November 2010, the American Lyme Disease Foundation ranks a majority of the Peninsula as "common" in the prevalence of infected ticks, with some areas ranking "rare."

H1N1, commonly known as Swine Flu, is one of a number of variations on seasonal influenza (including H5N1 Avian Flu) that has troubled the Nation in recent years. H1N1 was first detected in humans in April 2009 and quickly declared a pandemic. It spreads from person to person, coming in waves similar to regular seasonal influenza. It likewise produces similar symptoms – fever, cough, sore throat, runny or stuffy nose, body aches, headache, chills, and fatigue. What separates H1N1 from regular seasonal influenza is the severity of symptoms, resulting in serious complications and even death for certain at-risk groups. These groups include people over the age of 65, children under five, pregnant women, and people with chronic medical conditions. The most severe effects have occurred in individuals who fall into multiple at-risk categories (i.e., children with chronic medical conditions), and while one third of adults over the age of 60 possess natural antibodies against the virus, those who are infected have more severe than average symptoms. H5N1 produces similarly harsh effects but rarely spreads from person to person, resulting mainly from contact with infected poultry. H5N1 also has a longer history in humans, with the first cases reported in 1997. Both variations on seasonal influenza continue to be of concern nationally and in the Peninsula region.[58]

Bacteria and viruses can cause water contamination and have disastrous effects on the animals living within polluted waterways. In some instances, pollution from storm flooding and combined sewer overflow may produce high levels of fecal coliform bacteria and viruses in rivers and drinking water. The Poquoson River, Chisman Creek, Patrick's Creek, Lambs Creek, Roberts Creek, and Lyons Creek are all listed as bacteria-impaired water body segments on the Virginia Department of Environmental Quality's 2003-2004 Total Maximum Daily Load schedule.

Due to data and scope limitations, this hazard was not analyzed in detail as part of this plan update.

Overall Hazard Results

The preceding sub-sections discuss the probability, impacts, vulnerability, and risks for each of the natural hazards that have been determined to have a significant impact on the Peninsula planning region. The final section of the HIRA provides an overall assessment, summary, and comparison of the hazard ranking and estimated losses.

Risk to critical facilities has been discussed, to the extent possible, in each of the hazard sub-sections. These sections highlight the results of the analysis completed during the 2006 plan creation and 2011 plan update. Refer to the tables in these sections to determine what facilities or facility types are at greater risk for each hazard. This information is ideal for determining structural mitigation strategies. The names and information for the critical facilities in the hazard risk zones are available in Appendix E4.

Hazard Ranking

For the 2006 plan creation, hazards were grouped into two categories: critical and non-critical hazards based on available data, local knowledge, and observations as well as PHMPC input. The hazards were then ranked based on the threat each was considered to pose to citizens. The 2011 plan update considered the 2006 plan's hazard assessment and reexamined hazards in light of new or more complete data. Based on a thorough analysis, the most significant hazards were then ranked into five categories of High, Medium-High, Medium, Medium-Low, and Low. For the sake of consistency and consideration of the PHMPC 2006 plan input, the 2011 plan update maintained the 2006 plan's categorization of critical and non-critical for each hazard. Table 4-96 summarizes the jurisdiction-specific and overall regional ranking. Of all of the natural hazards assessed, the Hurricanes/Tropical Storms hazard ranked "High" for all jurisdictions in the planning area.

The ranking methodology used in the 2011 update to the HIRA is a modified version of the methodology developed for the VDEM by the CGIT at Virginia Tech for the Commonwealth of Virginia Emergency Operations Plan. During the Peninsula HIRA kick-off meeting, the PHMPC agreed to utilize this scoring and ranking framework.

To determine the overall hazard risk, the total hazard ranking values for each of the hazards were separately averaged to determine what hazards should be considered the most significant in the region. Through this

analysis, it was determined that the Flood, Significant Thunderstorms, Tornado, and Tropical Storm/Hurricane hazards pose the highest risk for communities in the Peninsula planning area, followed by Winter Weather and Drought. Figure 4-61 illustrates the jurisdictional rankings for these significant hazards.

It should be noted that although some hazards are classified as posing Medium-Low risk, their occurrence of varying or unprecedented magnitudes is still possible and should continue to be re-evaluated during future updates of this Plan. Hazards that were considered low risk or negligible were included as textual descriptions in the major hazard sections.

Table 4-96: 2011 Update Overall Hazard Ranking by Jurisdiction							
Jurisdiction	**Flood**	**Thunderstorm**	**Tornado**	**Tropical Storm / Hurricane**	**Winter Weather**	**Drought**	**Wildfire**
James City County	Med-High	Med-High	Med-High	High	Med	Med-Low	Med-High
York County	Med-High	High	Med	High	Med-Low	Med-Low	High
City of Hampton	Med-High	Med-High	Med-High	High	Med-Low	Med-Low	Med
City of Newport News	Med-High	Med-High	High	High	Med	Med-Low	High
City of Williamsburg	Med	Med-Low	Med	High	Med-Low	Med-Low	Med-High
OVERALL RESULTS	Med-High	Med	Med-High	High	Med-Low	Med-Low	Med-High

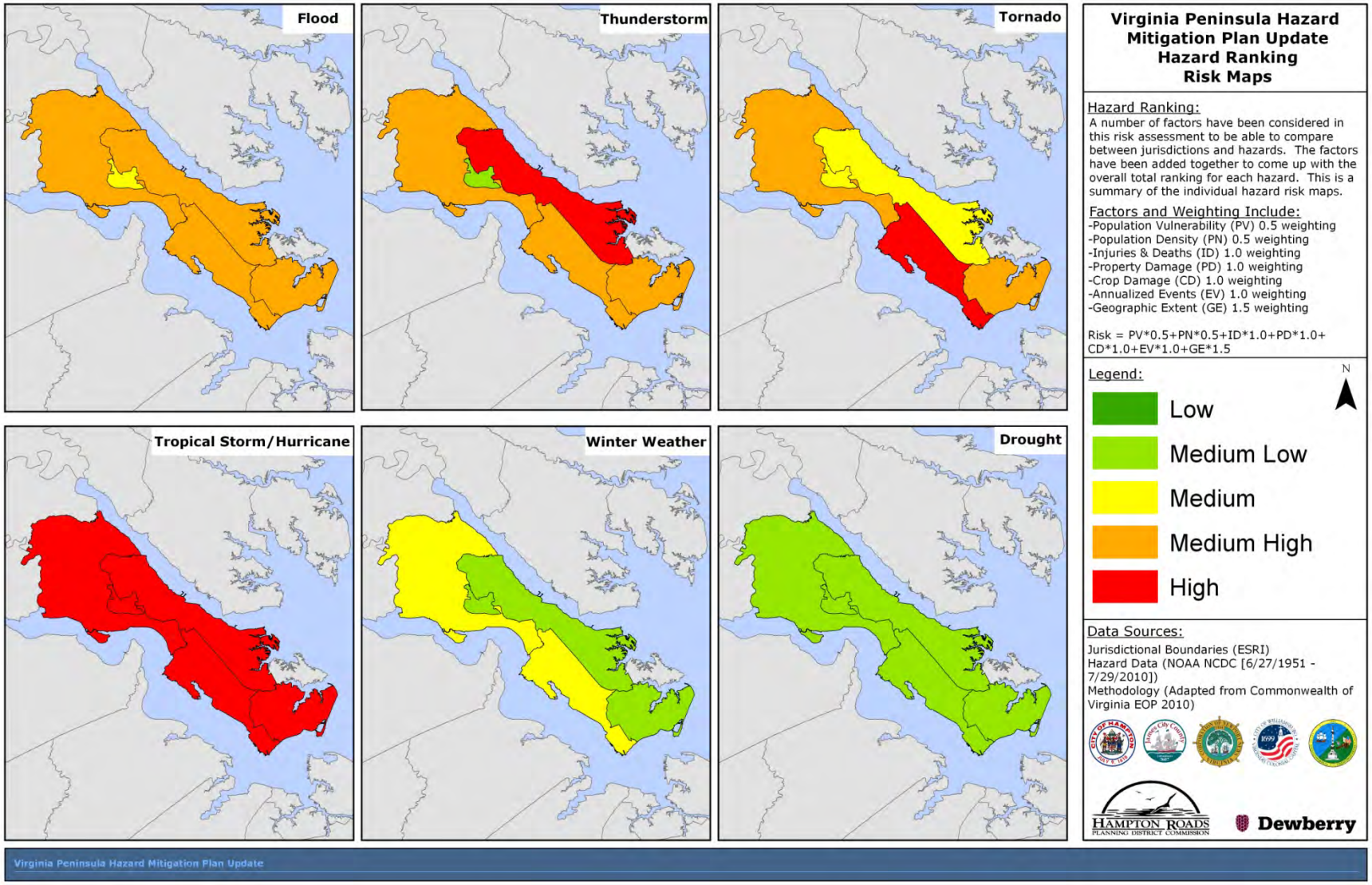


Figure 4-61: Overall Hazard Ranking

A comparison of the qualitative assessment for the 2006 plan and that completed for the 2011 plan update are shown in Table 4-97. This table summarizes the degree of risk or ranking assigned to the identified hazards in the Peninsula region. Assigned risk levels were based on historical and anecdotal data, as well as input from the PHMPC. For the 2011 plan update, each hazard's categorization as being critical or non-critical is unchanged from the 2006 plan. Similar hazards were consolidated or combined into one hazard section where doing so made sense and the result made for a more fluid assessment.

Table 4-97: Summary of Qualitative Assessment

2006 Plan			2011 Plan Update	
Hazard type	Non-Critical/Critical	Hazard Ranking	Hazard type	Hazard Ranking
Hurricanes	Critical	High/Medium	Hurricanes	High
Flooding	Critical	High	Flooding	Medium-High
Tornadoes	Critical	Medium	Tornadoes	Medium-High
Thunderstorms	Non-Critical	Low	Thunderstorms	Medium
Winter storms	Critical	Medium/Low	Winter storms	Medium-Low
Drought	Non-Critical	Low	Drought	Medium-Low
Wildfire	Critical	Medium	Wildfire	Medium-High
Nor'easters	Critical	Medium/Low	Incorporated into Winter Storm section	Winter Storm is Medium-Low
Earthquakes	Non-Critical	Low	Earthquakes	Low
Biological Hazards/Epidemics	Non-Critical	Low	Biological Hazards/Epidemics	Low
Dam Failure	Non-Critical	Low	Incorporated into Flood section	Flood is Medium-High
Extreme Heat	Non-Critical	Low	Incorporated into Drought section	Drought is Medium-Low
Expansive Soils	Non-Critical	Low	Combined section with Landslides	Low
Landslides	Non-Critical	Low	Combined section with Expansive Soils	Low
Sea Level Rise	Non-Critical	Low	Incorporated into Flood section	Flood is Medium-High

Table 4-97: Summary of Qualitative Assessment				
2006 Plan			2011 Plan Update	
Hazard type	Non-Critical/Critical	Hazard Ranking	Hazard type	Hazard Ranking
Tsunamis	Non-Critical	Low	Incorporated into Flood section	Flood is Medium-High

Loss Estimation

The Peninsula planning area can expect $18.5 million or more in annualized damages due to natural hazards impacting the region. These totals have been based on the available records from the NCDC storm events database, adjusted for inflation. Of the five participating jurisdictions in the 2011 plan update, total annualized losses are highest and estimated at approximately $4.1 million for York County. Not surprisingly, the NCDC data shows that York County also experienced the most hazard events of the jurisdictions. Tables 4-98 and 4-99 below include the total of all the hazards available in the NCDC storm events database.

Table 4-98: Annualized Loss (based on property and crop damages and number of years of record)							
Jurisdiction	Flood	Significant Thunderstorm	Tornado	Hurricane	Winter	Drought	Totals
James City County	$57,412	$31,573	$195,654	$2,629,539	$38,240	$255,038	$3,207,456
York County	$800,408	$315,695	$65,485	$2,926,931	$37,812	$439	$4,146,770
City of Hampton	$560,234	$26,925	$183,951	$2,926,883	$37,812	$439	$3,736,244
City of Newport News	$532,558	$31,128	$160,794	$2,926,883	$37,812	$439	$3,689,614
City of Williamsburg	$795,813	$1,545	$0	$2,926,931	$37,812	$439	$3,762,540
Totals	**$2,746,425**	**$406,867**	**$605,884**	**$14,337,167**	**$189,486**	**$256,794**	**$18,542,623**

Table 4-99: Total NCDC Storm Events Data and Annualized Loss Estimates						
Jurisdiction	Total Events	Total Crop Damage	Total Property Damage	Annualized Crop Damage	Annualized Property Damage	Total Annualized Loss
James City County	149	$8,719,507	$49,844,849	$532,938	$2,674,518	$3,207,456
York County	178	$4,215,962	$73,740,286	$281,006	$3,865,764	$4,146,770
City of Hampton	153	$4,215,962	$61,581,421	$281,006	$3,455,238	$3,736,244
City of Newport News	160	$4,215,962	$59,995,109	$281,006	$3,408,608	$3,689,614
City of Williamsburg	104	$4,215,962	$53,153,170	$281,006	$3,481,535	$3,762,540
Total	**744**	**$25,583,356**	**$298,314,835**	**$1,656,960**	**$16,885,663**	**$18,542,623**

Supplemental annualized loss estimates for flooding, hurricane winds, and earthquake have also been derived from the other sources as described in each of the individual hazard sections. NCDC did not include any historical information about damages due to land subsidence (karst/sinkholes), landslides, or wildfires and, as a result, are not included in the loss estimates.

Based on the information from the NCDC storm events database, the Peninsula can expect approximately $18.5 million in annualized damages due to the most significant hazards that impact the region. As discussed, this data has limitations due to the amount of historical data available, and reporting of events. By substituting the supplemental annualized loss values for flood and hurricane wind, the region could expect approximately $106 million in annualized damages due to hurricanes, floods, tornadoes, thunderstorms, winter storms, and drought.

Hurricanes/Tropical Storms and Flooding make up approximately 92% of the NCDC loss estimates for the region. Even so, these estimates are believed to be an underrepresentation of the actual losses experienced due to both hazards. Losses from events that go unreported or that are difficult to quantify are not likely to appear in the NCDC database. The HAZUS loss estimates for flooding appear high in comparison to the other hazards. It should be kept in mind that the HAZUS results take into account many additional factors that are not represented in the NCDC values and which only account for property and crop damages. The factors considered in the flood module are further explained in the flood section of this report.

Refer to the HIRA Introduction section for a full description of the methodology and the limitations of the data used for ranking the hazards and loss estimation. For most natural hazards, the NCDC data, although somewhat limited, provides the most comprehensive historical record of events and damages available. This analysis is only representative of the NCDC data that was used. It is known that the time period of this data is small in comparison to the known historical events. As such, the data does not fully represent geological hazards, but in the absence of better data NCDC was used to represent the risk.

Table 4-100: Hazard Ranking and Loss Estimate Comparison					
2011 Ranking	Hazard Classification		2011 Annualized Loss from NCDC	Annualized Loss from Other Sources	Data Source
	2011	*2006*			
High	Hurricane/Tropical Storm	Hurricanes & Tropical Storms	**$14,337,167**	**$9,666,524**	FEMA HAZUS MH MR4
Med-High	Flood	Flooding	**$2,746,425**	**$94,507,000**	FEMA HAZUS MH MR4
		Dam Failure			
		Tsunami			
		Sea Level Rise			
Med-High	Tornado	Tornadoes	**$605,884**	**N/A**	
Medium	Thunderstorm	Thunderstorms	**$406,867**	**N/A**	
Med-Low	Winter Weather	Winter Storms	**$189,486**	**N/A**	
		Nor'easters			
Med-Low	Drought (Extreme Heat)	N/A	**$256,794**	**N/A**	
Medium-High	Wildfire	Wildfire	**$0**	**$12,400**	VDOF
Low	Earthquake	Earthquake	**$0**	**$428,303**	FEMA HAZUS MH MR4
Low	Landslides & Expansive Soils	Landslides	**$0**	**N/A**	
		Expansive Soils			
Low	Biological/Epidemics	Biological/Epidemics	**$0**	**N/A**	

Limitations of Data

It should be noted that the data sources used in the hazard ranking and loss estimation are varied in their degree of completeness, accuracy, precision, etc; the ability to accurately prioritize some of the hazards would be improved with better information (e.g., landslide, karst, etc.). Further discussion on the data limitations and how the data was adapted for analysis is available within the Hazard Ranking Methodology discussion of the HIRA Introduction section.

Chapter 5 – Goals, Objectives, and Strategies

This section of the Hazard Mitigation Plan describes the most challenging part of such planning effort – the development of a Mitigation Strategy. It is a process that requires:

- Setting mitigation goals;
- Considering mitigation alternatives;
- Identifying objectives and strategies; and
- Developing a mitigation action plan.

When a community decides that certain risks are unacceptable and that certain actions to mitigate those risks are achievable, the development of *goals* and *objectives* takes place. Goals and objectives help to describe what actions should occur, using increasingly narrow descriptors. Initially, long-term and general statements, known as broad-based goals, are developed. Goals are then accomplished by meeting objectives, which are specific and achievable in a finite time period. In most cases there is a third level, called *strategies,* which are more detailed and specific methods for meeting the objectives. This chapter explains the process by which the Peninsula Hazard Mitigation Planning Committee (PHMPC) identified the goals, objectives, and strategies for this plan.

Planning Process for Setting Mitigation Goals

The development of the mitigation strategies included a thorough review of the hazards and an assessment of current strategies, as well as the identification of new strategies intended to reduce the future impacts of hazards, while assisting jurisdictions to achieve compatible economic, environmental, and social goals. Development of the strategy ensures that all policies and projects are linked to established priorities and are assigned to specific departments or individuals for implementation within a target deadline. When available, funding sources are identified that can be used to assist in project implementation.

The hazard mitigation planning process conducted by the PHMPC used a typical problem-solving methodology:

- Describe the problem (Hazard Identification);
- Estimate the impacts the problem could cause (Risk Assessment);
- Assess what safeguards exist that lessen or could potentially lessen those impacts (Capability Assessment); and

- Using this information, determine what, if anything, can be done, and select those actions that are appropriate for the community in question (Develop an Action Plan).

The PHMPC discussed regional goals and objectives for this plan at a Committee Meeting on January 28, 2011. At this meeting the results of the hazard identification and risk assessments were presented and discussed. The committee was then presented with the 2006 goals and objectives. The relationship of plan goals and objectives to the recommended actions that they would later be tasked to formulate was explained. The committee reviewed the previous goals understanding that they could continue the same goals, combine them, or develop new goals. The PHMPC determined that in general, the original 2006 goals remained applicable to the 2011 plan update. However, the language in Goal 1 was revised to make it more comprehensive and the associated objectives were reorganized for clarity and prioritization. Goal 2 was revised to include visitors and two new objectives were added. Goal 3 and its objectives were unchanged. The revised 2011 Goals were presented and reviewed by participants at each of the jurisdictional meetings in February 2011. The summary of changes to the 2006 goals is described in the table below.

Summary of Changes to the 2006 Goals and Objectives		
	2006 Goal/Objective	**2011 Changes**
Goal 1	Reduce impacts and losses from natural hazards	Changed language from natural hazards to all hazards.
Objective 1.1	Strengthen community Emergency Management programs	Moved to goal 1.3
Objective 1.2	Minimize exposure of existing development from likely hazard impacts	Combined with 1.3
Objective 1.3	Minimize exposure of new development to likely hazard impacts	Combined with 1.2
Objective 1.4	Strengthen community Floodplain Management programs	Moved to goal 1.1

Summary of Changes to the 2006 Goals and Objectives		
	2006 Goal/Objective	**2011 Changes**
Goal 2	Promote awareness of hazards and vulnerability among citizens, business, industry and government	Added consideration for visitors.
Objective 2.1	Develop a seasonal multi-hazard public education campaign to be implemented annually	No change
Objective 2.2	Manage expectations for residential mitigation grant availability.	New
Objective 2.3	Develop targeted campaigns to address flood and hurricane hazard risks including public awareness and personal preparedness responsibility.	New
Goal 3	Maximize use of available funding	No change
Objective 3.1	Maintain FEMA eligibility	No change
Objective 3.2	Identify, analyze and establish Mitigation project cost share options	No change

The complete 2011 Goals and objectives are listed below:

GOAL 1: Reduce impacts and losses from all hazards

Objective 1.1: Minimize exposure of re-development as well as new development from likely hazard impacts

- Protect at-risk critical facilities
- Implement and maintain existing hazard loss reduction programs
- Mitigate repetitive hazard-related losses
  - Integrate Mitigation Planning into each community's Comprehensive Planning program

- Enforce/enhance floodplain and zoning regulations or limitations in vulnerable areas, as appropriate

Objective 1.2: Strengthen community Floodplain Management Programs

- Coordinate and maintain local floodplain management ordinances with the Virginia Uniform Statewide Building Code
- Address repetitive flood losses
- Participate in the National Flood Insurance Program's (NFIP) Community Rating System, as appropriate

Objective 1.3: Strengthen community Emergency Management programs

- Minimize exposure of re-development as well as new development from likely hazard impacts (Formerly Objective 1.1)
- Maintain each community's all- hazards Emergency Operations Plan (EOP) to support and promote Public Safety
- Establish and maintain ability to coordinate with the public in disasters
- Provide Disaster Recovery Training for employees and volunteers
- Initiate, coordinate, and support Business Continuity/Contingency planning
- Achieve and maintain National Weather Service "Storm Ready" Certification
- Establish and maintain baseline information resource systems (GIS)

GOAL 2: Promote awareness of hazards and vulnerability among citizens, businesses, industry, and government

Objective 2.1: Develop a seasonal multi-hazard public education campaign to be implemented annually

- Hurricanes and coastal storms, flooding, tornados, winter storms, and wildfires
- Flood Insurance
- Availability, Coverage, Floodplain Management, the "50 percent" rule (and impact of inflation, market versus assessed value, and Increased Cost of Compliance)
- Business Continuity/Contingency planning
- Self-help guidance

GOAL 3: Maximize use of available funding

Objective 3.1: Maintain FEMA Eligibility

Objective 3.2: Identify, analyze, and establish Mitigation project cost share options

- Multi-Objective Opportunities
  - Public/Private Partnerships
  - Coordination with other community goals, programs, and projects
    - Housing, Transportation, Recreation, Stormwater Management
- Community contributions
  - Cash (grants, budgeted)
  - In-Kind
- Property Owner Contributions

The following table depicts how goals and objectives are addressed by associating them with the applicable action items by jurisdiction.

Table 5-1. Jurisdiction Objective and Strategy Crosswalk					
	City of Hampton	City of Newport News	City of Williamsburg	York County	James City County
Goal 1: Reduce impacts and losses from all hazards					
Objective 1.1 Minimize exposure of re-development as well as new development from likely hazard impacts	H1(2011) H2(2011) H6(2011) H13(2011) H14(2011) H19(2011) H24(2011)	NN4(2006) NN12(2006) NN10(2011)	W6(2006) W5(2011)	Y3(2006) Y1(2006) Y10(2011)	JC2(2006) JC7(2006) JC3(2006)
Objective 1.2 Strengthen community Floodplain Management programs	H8(2006); H7(2011) H11(2011) H21(2011) H22(2011) H24(2011)	NN4(2006) NN6(2006) NN7(2011) NN8(2011) NN10(2011)	W6(2006) W2(2011) W5(2011)	Y13(2006) Y2(2006) Y2(2011) Y4(2011) Y7(2011) Y8(2011) Y10(2011)	JC4(2006) JC1(2006) JC6(2011) JC8(2011) JC9(2011) JC11(2011)
Objective 1.3 Strengthen community Emergency Management programs	H6(2006) H4(2011) H8(2011) H9(2011) H10(2011) H7(2006)	NN2(2011) NN3(2011) NN5(2006) NN4(2011) NN5(2011) NN8(2006) NN6(2011)	W2(2011) W7(2006) W4(2006) W1(2006) W3(2006) W8(2011)	Y1(2011) Y5(2006) Y8(2006) Y10(2006) Y5(2011) Y6(2011) Y12(2006)	JC1(2011) JC7(2006) JC6(2006) JC5(2006) JC2(2011) JC4(2011) JC7(2011)
Goal 2: Promote awareness of hazards and vulnerability among citizens, business, visitors, industry and government					
Objective 2.1 Develop a seasonal multi-hazard public education campaign to be implemented annually	H16(2011) H18(2011) H23(2011)	NN1(2011) NN5(2011) NN7(2006) NN9(2011)	W5(2006) W4(2011)	Y3(2011) Y9(2011)	JC5(2011) JC10(2011)
Objective 2.2 Manage expectations for residential mitigation grant availability.	H15(2011) H17(2011) H24(2011)	NN1(2011) NN10(2006) NN10(2011)	W1(2011) W5(2011)	Y2(2006) Y10(2011)	JC5(2011) JC11(2011)
Objective 2.3 Develop targeted campaigns to address flood and hurricane	H3(2011) H15(2011) H17(2011) H21(2011)	NN10(2006) NN7(2011) NN9(2011)	W1(2011) W2(2011) W4(2011)	Y2(2006) Y7(2011) Y9(2011)	JC5(2011) JC8(2011) JC10(2011)

hazard risks including public awareness and personal preparedness responsibility.	H23(2011)				
Goal 3: Maximize use of available funding					
Objective 3.1 Maintain FEMA eligibility	H7(2011) H21(2011) H22(2011)	NN11(2006) NN10(2006) NN7(2011) NN8(2011)	W1(2011) W2(2011) W3(2011)	Y13(2006) Y7(2011) Y8(2011)	JC4(2011) JC8(2011) JC9(2011)
Objective 3.2 Identify, analyze and establish Mitigation project cost share options	H12(2011)	NN12(2006)	W8(2006)	Y12(2006)	JC5(2011)

Following the development of regional goals, separate jurisdictional meetings were conducted February 23-25, 2011 with each of the five jurisdictions. At these jurisdictional meetings, the Regional Hazard Identification and Risk Assessment (HIRA) was presented and discussed with the attendees. The regional goals and objectives were then presented and reviewed. Having a clear understanding of the hazards facing the jurisdiction and the overall goals and objectives served as the basis for the development of the 2011 strategies. At each of the meetings, the jurisdiction's of local officials reviewed its 2006 strategies and the status of each was discussed. A determination was made for each of the strategies regarding whether or not it should be continued in the 2011 plan update. Continued strategies then served as a platform for the development of new strategies to meet the jurisdiction's goals to address the spectrum of hazards identified.

Following the jurisdictional meetings, the strategy tables were updated with the consolidated list of strategies and sent to the jurisdiction committee representatives for review, final approval, and prioritization. The 2006 strategies with updated status information were also sent for review and approval. Follow-up phone calls were conducted during May 2011, with each of the jurisdictions to collect any missing data points in the 2006 and 2011 strategy documents.

Considering Mitigation Alternatives

During the February 2011 separate jurisdictional meetings, members of each jurisdiction were presented with the HIRA findings. Discussions held during each meeting resulted in the generation of a range of potential mitigation

actions to address the hazards. A range of alternatives was then identified and prioritized by each jurisdiction. The alternatives can be found in the tables in Section III.

Identification and Analysis of Mitigation Techniques

In formulating the Peninsula's mitigation strategy, a wide range of activities were considered to help achieve the regional goals while addressing the specific hazard concerns of each participating jurisdiction. This included the following activities as recommended by the Emergency Management Accreditation Program[2] (EMAP):

1. The use of applicable building construction standards;
2. Hazard avoidance through appropriate land-use practices;
3. Relocation, retrofitting, or removal of structures at risk;
4. Removal or elimination of the hazard;
5. Reduction or limitation of the amount or size of the hazard;
6. Segregation of the hazard from that which is to be protected;
7. Modification of the basic characteristics of the hazard;
8. Control of the rate of release of the hazard;
9. Provision of protective systems or equipment for both cyber or physical risks;
10. Establishment of hazard warning and communication procedures; and
11. Redundancy or duplication of essential personnel, critical systems, equipment, and information materials.

All activities considered by the PHMPC can be classified under one of the following six broad categories of mitigation techniques:

1. Prevention

Preventative activities are intended to keep hazard problems from getting worse, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are constructed. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning;
- Building codes;
- Open space preservation;
- Floodplain regulations;
- Stormwater management regulations;

[2] The EMAP Standard is based on the NFPA 1600 Standard on Disaster/Emergency Management and Business Continuity Programs, 2004 Edition.

- Drainage system maintenance;
- Capital improvements programming; and
- Shoreline / riverine / fault zone setbacks.

2. Property Protection

Property protection measures involve the modification of existing buildings and structures to help them better withstand the forces of a hazard, or removal of the structures from hazardous locations. Examples include:

- Acquisition;
- Relocation;
- Building elevation;
- Critical facilities protection;
- Retrofitting (e.g., windproofing, floodproofing, seismic design techniques, etc.);
- Safe rooms, shutters, shatter-resistant glass; and
- Insurance.

3. Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Such areas include floodplains, wetlands, steep slopes, and sand dunes. Parks, recreation, or conservation agencies and organizations often implement these protective measures. Examples include:

- Floodplain protection;
- Watershed management;
- Beach and dune preservation;
- Riparian buffers;
- Forest/vegetation management (e.g., fire resistant landscaping, fuel breaks, etc.);
- Erosion and sediment control;
- Wetland preservation and restoration;
- Habitat preservation; and
- Slope stabilization.

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event through construction. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs;
- Dams / levees / dikes / floodwalls / seawalls;
- Diversions / detention / retention;
- Channel modification;
- Beach nourishment; and

- Storm sewers.

5. Emergency Services

Although not typically considered a "mitigation" technique, emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

- Warning systems;
- Evacuation planning and management;
- Emergency response training and exercises;
- Sandbagging for flood protection; and
- Installing temporary shutters for wind protection.

6. Public Education and Awareness

Public education and awareness activities are used to advise residents, elected officials, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Outreach projects;
- Speaker series / demonstration events;
- Hazard map information;
- Real estate disclosure;
- Library materials;
- School children educational programs; and
- Hazard expositions.

The PHMPC members were also provided with the *Dewberry All-Hazard Mitigation Plan Updates Goals, Objectives and Actions Ideas Book, February 2011.* This booklet provides lists of alternative multi-hazard mitigation actions for each of the above categories which have been successfully used in other State, regional, and local hazard mitigation plans.

Prioritizing Alternatives

Through discussion, each jurisdiction used the STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) Criteria when considering and prioritizing the most appropriate mitigation alternatives for the Region's communities. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions for the area's jurisdictions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on a jurisdiction's capabilities.

Table 5-2 provides information regarding the review and selection criteria for alternatives.

Table 5-2. STAPLE/E Review and Selection Criteria for Alternatives
Social
• Is the proposed action socially acceptable to the community(s)? • Are there equity issues involved that would mean that one segment of a community is treated unfairly? • Will the action cause social disruption?
Technical
• Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other community(s) goals?
Administrative
• Can the community(ies) implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political
• Is the action politically acceptable? • Is there public support both to implement and to maintain the project?
Legal
• Is the community(ies) authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? • Are there legal side effects? Could the activity be construed as a taking? • Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? • Will the community(ies) be liable for action or lack of action? • Will the activity be challenged?
Economic
• What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the community(ies)? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other community goals, such as capital improvements or economic development? • What benefits will the action provide?
Environmental
• How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and State regulatory requirements?

Table 5-2. STAPLE/E Review and Selection Criteria for Alternatives
• Are endangered or threatened species likely to be affected?

Ranking was completed in order of relative priority based on the STAPLE/E criteria, as well as the strategy's potential to reduce vulnerability to all hazards.

In formulating a mitigation strategy, a wide range of activities was considered in order to help achieve the goals and lessen the vulnerability of the Peninsula to the effects of hazards.

Strategies were ranked by each community. Ranking was completed in order of relative priority based on the STAPLE/E criteria, as well as the strategy's potential to reduce vulnerability to natural hazards. Actions were given a ranking of high, medium, or low, with the following meanings:

High (H) – implement in the short-term;
Medium (M) – implement in the long-term; and
Low (L) – implement only as funding becomes available.

When deciding on which strategies should receive priority in implementation, the communities considered:

- Time – Can the strategy be implemented quickly?
- Ease to implement – How easy is the strategy to implement? Will it require many financial or staff resources?
- Effectiveness – Will the strategy be highly effective in reducing risk?
- Lifespan – How long will the effects of the strategy be in place?
- Hazards – Does the strategy address a high priority hazard or does it address multiple hazards?
- Post-disaster implementation – Is this strategy easier to implement in a post-disaster environment?

In addition, the anticipated level of cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For structural measures, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure. Although detailed analysis was not conducted during the mitigation action development process, these factors were of primary concern when selecting measures. For those

measures that do not result in a quantifiable reduction of damages, such as public education and outreach, the relationship of the probable future benefits and the cost of each measure were considered when developing the mitigation actions. Each jurisdiction's mitigation strategy can be found below.

Identifying Strategies

Through a series of jurisdictional meetings the following goals for the Region were accepted by the PHMPC. The goals form the basis for the development of a Mitigation Action Plan and specific mitigation projects to be considered for the Region. The process consisted of 1) setting goals, 2) considering mitigation alternatives, 3) identifying strategies, and 4) developing an action plan.

Community officials should consider the regional goals and the strategies that follow before making community policies, public investment programs, economic development programs, or community development decisions for their communities.

The table below depicts a summary of the categories of mitigation measures that were developed by the jurisdictions and identifies which of the jurisdictions have strategies that address the mitigation measure.

Table 5-3. Categories of Mitigation Measures

Categories of Mitigation Measures	City of Hampton	City of Newport News	City of Williamsburg	York County	James City County
Repetitive loss management	●	●	●		●
Shoreline erosion reduction	●			●	N/A
Elevation Surveys/flood-prone structure elevation projects	●	●		●	●
Generator wiring/backup power maintenance at critical facilities	●		●	●	●
Public notification and communication systems	●	●	●	●	●
Evaluate and strengthen critical facilities	●	●	●	●	●
Evaluate/enhance existing floodplain management	●	●		●	●
Stormwater management/ drainage		●	●	●	●

Table 5-3. Categories of Mitigation Measures					
Categories of Mitigation Measures	**City of Hampton**	**City of Newport News**	**City of Williamsburg**	**York County**	**James City County**
improvements and maintenance					
Landscaping management	●		●		●
Public information/outreach/training	●	●	●	●	●
BFE plus 2 feet				●	●
Small business preparedness, mitigation, and contingency planning information		●		●	●
Forest/wildfire management		●	●	●	●
Flood proofing measures	●	●		●	●
Examine/revise related ordinances	●	●		●	●
Storm ready certification	●		●		●
Evaluate/incorporate technology improvements- GIS, social media, interoperability, communications	●	●	●	●	●
Evaluation and maintenance of critical facility readiness	●	●		●	●
Evaluate shelter programs and facilities	●	●			●

Each of the strategies are numbered in the action plans that follow and are listed in order of their prioritization (High, Medium or Low). Where a strategy number includes "(2011)", infers that particular strategy was developed (i.e., is a new action) for the 2011 plan update. A number with a "(2006)" after it, denotes that particular action was carried forward from the 2006 plan (utilizing the 2006 numbering system) and revised for the 2011 update. Preceding letters simply indicate the jurisdiction, taking the first letter of its name.

City of Hampton - 2011 Mitigation Actions

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
H1 (2011)	Mitigate flooding and other hazards at communication sites through elevating and hardening.	Emergency Communications	X		X	X	X		X	X	X	X				X	Locality Funding	December 31, 2011	Number of Communications Sites mitigated for wind, flooding, and power loss	H	New
H2 (2011)	Relocate EOC/911/311 facility outside of floodplain.	Emergency Management	X		X	X	X		X	X	X					X	Locality and/or Grant Funding	July 1, 2013	Completion of design; approval of funding	H	New
H3 (2011)	Continue Waterways Committee/Community Plan public outreach.	Community Development	X		X		X										Locality Funding	December 31, 2011	Development of Report and Incorporation into Community Plan	H	New
H4 (2011)	Expand hurricane shelter capacity through agreements with localities outside the flood hazard area to address the shelter capacity gap that exists in the event of a catastrophic hurricane.	Emergency Management	X				X										Locality and/or Grant Funding	December 31, 2015	Development of MOU's and update ESF 6 of the EOP	H	New
H5 (2011)	Work with neighboring localities who have entered into sheltering MOU's with Hampton to provide emergency generators and/or pre-wiring of shelter facilities for quick hook up at designated	Emergency Management	X	X			X			X						X	Locality and/or Grant Funding	December 31, 2015	Development of MOU's and update ESF 6 of the EOP	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
	shelters.																				
H6 (2011)	Continue evaluation of pump station upgrade assessments as funds are available.	Public Works	X		X		X									X	Locality and/or HMA Grant Funding	December 31, 2015	Completion of design; approval of funding	H	New
H7 (2011)	Adopt floodplain ordinance reflected by the new DFIRM; evaluate periodically.	Community Development	X		X		X										Local Staff	December 31, 2011	City Council Approval	H	New
H8 (2011)	Update the snow removal plan that incorporates the revised policies and procedures developed to maximize cost effectiveness and efficiencies of snow removal.	Public Works		X													Locality Funding	September 31, 2012	Analysis Complete; Plan Updated	H	New
H9 (2011)	Secure additional special needs supplies to support the special needs population.	Emergency Management	X	X	X	X	X		X	X	X					X	UASI Grant	September 31, 2011	Secure funding and order items	H	New
H8 (2006)	Continue evaluating regulations/program (ordinances) for strengthening floodplain management approaches as part of community planning.	Community Development	X		X		X										Locality Funding	January 31, 2012	City Council Approval	H	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
H6 (2006)	Evaluate/review options for more effective public warning systems to upgrading/replace existing reverse 911 system or implementing new public notification/warning system.	Emergency Management	X	X	X	X	X	X	X	X	X		X			X	Locality and/or DHS or HMA Grant Funding	December 31, 2013	Analysis Complete; Funding Approved	H	Ongoing
H10 (2011)	Conduct annual review of repetitive loss and severe repetitive loss property list requested of VDEM to ensure accuracy. Review will include verification of the geographic location of each repetitive loss property and determination if that property has been mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
H11 (2011)	Review locality's compliance with the National Flood Insurance program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
H12 (2011)	Educate elected officials and residents on the importance of the NFIP.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
H13 (2011)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, relocation, elevation and flood proofing of projects where feasible using FEMA HMA programs where appropriate.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
H14 (2011)	Implement city's revolving loan fund for residential elevation projects.	Emergency Management	X	X	X		X					X					FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Issuance of City loans to residents.	H	New
H15 (2011)	Maintain NOAA Storm Ready designation through required actions.	Emergency Management	X	X	X	X	X	X	X	X	X	X					EMPG Grants, CERT, local funds, media participation, HMGP 5% Initiative funds	December 31, 2011	Complete application process prior to expiration of current status.	M	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
H16 (2011)	Incorporate Hampton Repetitive Loss Plan into 2011 Peninsula Hazard Mitigation Plan	Emergency Management	X		X		X										HMGP Grant	December 31, 2011	Planning Commission Approval	M	New
H17 (2011)	Submit grant applications to elevate flood-prone homes to VDEM/FEMA for acceptance/approval and administer approved grants.	Emergency Management	X		X		X										HMA Grant Funding	December 31, 2014	Acceptance of Grant Awards by City Council	M	New
H18 (2011)	Continue developing storm-resistant beach along Hampton waterfront from Grandview to Fort Monroe. Integrate beach profile with existing hard structures.	Public Works	X	X	X		X						X		X		Locality Funding	December 31, 2015	Funding Programmed by City Council	M	New
H19 (2011)	Implement zoning recommendations from the Hampton-Langley Joint Land Use Study. (JLUS)	Community Development														X	Locality and/or Grant Funding	December 31, 2015	Planning Commission Approval	M	New
H20 (2011)	Prepare outreach materials to include: flood insurance availability, retrofitting existing structures, and information for homeowners.	Emergency Management	X		X	X	X									X	Locality and/or Grant Funding	December 31, 2015	Completion of design; approval of funding	M	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
H21 (2011)	Continue training related to preparing for/responding to pandemics.	Health Department														X	Locality, State, and/or Grant Funding	December 31, 2015	Completion of design; approval of funding	M	New
H22 (2011)	Provide outreach to repetitive loss and severe repetitive loss properties advising occupants of potential mitigation options.	Emergency Management and Public Works	X		X		X										Locality and/or Grant Funding	December 31, 2015	Provide Information to RL and SRL home - owners	M	New
H23 (2011)	Provide NOAA weather radios to high risk populations with available funding	Emergency Management	X	X	X	X	X	X	X	X	X					X	State and/or HMGP 5% Grant Funding	December 31, 2015	Number of radios deployed	M	New
H7 (2006)	Continue generator program including evaluating and implementing where feasible and funding available new generators at critical facilities as well as pre-wiring of critical facilities for quick hookup.	Emergency Management	X	X	X	X	X		X	X	X					X	Locality and/or HMA Grant Funding	December 31, 2015	Number of facilities pre -wired or generators added	M	Ongoin g
H24 (2011)	Examine feasibility of executing a pilot neighborhood-specific (i.e. Aberdeen & Riverdale) education and self-help organization for emergency notification and long-term mitigation of hazard	Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2012	Determine feasibility measures	M	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
	risks.																				
H25 (2011)	Seek funding to adapt NOAA tsunami warning system (citizen-based web-site) for coastal storms, surge and flooding based on known hazard risks.	Emergency Management	X				X										Locality, State, and/or Grant Funding	December 31, 2013	Secure funding	M	New
H26 (2011)	Examine feasibility of executing pilot small structural flood control measures, such as levee or tide gate.	Public Works	X	X	X		X					X					FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2012	Determine feasibility measures	M	New
H27 (2011)	Evaluate the relocation of Hampton City Schools Maintenance Facility out of repetitive flood area.	Hampton City Schools	X		X		X										Locality Funding	December 31, 2015	Funding Programmed by School Board	L	New
H28 (2011)	The city will seek sources for grants to fund needed SWM improvements related to rainwater and tidal flooding in areas identified via engineering studies for the following areas: Mill Creek Terrace, Pochin Place, Mary Peake, and	Public Works	X		X		X										Federal, state and local funding	December 2015	Identify potential sources of funding	L	N/A

Number	Agency / Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
	Riverdale.																				

City of Newport News - 2011 Mitigation Actions

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
NN1 (2011)	Evaluate the feasibility of a 311 informational system.	Information Technology Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local Funds	July 1, 2012	Select, design, purchase, and set up program to be utilized.	H	New
NN2 (2011)	Evaluate the feasibility of operating a joint municipal shelter.	Newport News Public Schools in concert with City of Hampton	X	X	X	X	X	X		X	X					X	HMPG	December 31, 2012	Complete MOU July 1, 2011	H	New
NN3 (2011)	Perform a needs assessment and identify potential locations for operating refuges of last resort.	Newport News Public Schools and Newport News Social services	X	X	X	X	X	X		X	X						Local and State Funds	Ongoing	Identify 6 sites and confirm capacity and logistics requirements June 2011	H	New
NN4 (2011)	Evaluate options for new community alerting system.	Office of Communications and Community Relations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local Funds	Ongoing	Evaluate City Watch Alerting System Dec 31, 2011	H	New
NN5 (2011)	Investigate the use of social media for community alerting, information and outreach.	Office of Communications and Community Relations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local Funds	December 31, 2011	Develop plan to utilize Twitter July 1, 2011	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
NN5 (2006)	Continue forest management program to mitigate wildfire hazards and promote health of forests within the City's reservoir watersheds.	Newport News Waterworks						X	X		X					X	Waterwork Enterprise Fund	Ongoing	No. of fires, Pine Beatle Infestation Thinning Ops	H	Ongoing
NN4 (2006)	Continued implementation of Flood Assistance Program (FAP), primarily through flood-prone structure acquisition.	Engineering Department	X		X		X										HMA Grant Programs	Ongoing	Acquire 2 structures per year	H	Ongoing
NN9 (2006)	Upgrade drainage system maintenance and increase maintenance frequency of stormwater drainage system.	Public Works Department	X	X	X		X										Waste Water User Fee, Capital Improvement Program	Ongoing CIP 5 year plan updated annually	15 projects in calendar year	H	Ongoing
NN6 (2011)	Conduct annual review of repetitive loss and severe repetitive loss property list requested of VDEM to ensure accuracy. Review will include verification of the geographic location of each repetitive loss property and determination if that property has been mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501.AW-501	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
NN7 (2011)	Review locality's compliance with the National Flood Insurance program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
NN8 (2011)	Educate elected officials and residents on the importance of the NFIP.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
NN9 (2011)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, relocation, elevation and flood proofing of projects where feasible using FEMA HMA programs where appropriate.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
NN10 (2011)	Evaluate options for and implement if feasible CAD interface to improve communications with other jurisdictions.	Information Technology Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local Funds Homeland Security Grants	December 31, 2012	Upgrade from 8.13 to 9.1 in 6 months	M	New
NN8 (2006)	Continue to provide contingency planning guidance to businesses.	Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	EMPG Grants, CERT, local funds, media participation, HMGP 5%	December 31, 2015	Outreach to 10 businesses annually.	M	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
																	Initiative funds				
NN12 (2006)	Conduct engineering feasibility study of flood-proofing alternatives for four flood-prone pumping stations, and pursue available funding for cost-effective solutions. Elevate these pumping stations out of the floodplain to reduce future loss and damages	Public Works Department	X	X	X	X	X										Local Funds	December 31, 2015 for pump station No. 2. No 53 and 99 not presently funded	Complete modifications to pump no. 2	M	Ongoing
NN7 (2006)	Continue development of natural hazards curriculum for public schools.	Fire Department Public Education Bureau	X	X	X	X	X	X	X	X	X	X	X	X		X	Operating Budget, State Public Safety Education Grants, Local, Civic, Business Donations	Ongoing	Deliver 115 classes per month	M	Ongoing
NN11 (2006)	Continue participation in the Community Rating System (CRS). Prepare outreach materials to include: flood insurance availability; retrofitting existing structures; and hazard packets for new	Engineering Department	X	X	X		X										Local Funds	Enroll by December 31, 2011	Develop Draft Program by July 1, 2011	M	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
	homeowners. Also prepare Repetitive Loss Plan as mandated.																			
NN10 (2006)	Continue flood hazard awareness program. Activities to include: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors of FEMA's map amendment process; and 3) incorporate flood hazard awareness.	Engineering Department	X	X	X		X										Local Funds	Ongoing	New flood maps ready March 2012	M	Ongoing
NN6 (2006)	Review floodplain management ordinance and enact new requirements based on local conditions.	Planning Department	X	X	X		X										Local Funds	Effective March 2012	Text Changes for plan to City Council October 2011	M	Ongoing

City of Williamsburg - 2011 Mitigation Actions

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
W1 (2011)	Conduct annual review of repetitive loss and severe repetitive loss property list requested of VDEM to ensure accuracy. Review will include verification of the geographic location of each repetitive loss property and determination if that property has been mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
W2 (2011)	Review locality's compliance with the National Flood Insurance program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
W3 (2011)	Educate elected officials and residents on the importance of the NFIP.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
W4 (2011)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, relocation, elevation and flood proofing of projects where feasible using FEMA HMA programs where appropriate.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
W2 (2006)	Maintain Storm Ready designation from the National Weather Service; complete all necessary NOAA requirements.	Fire Department	X	X	X	X	X	X	X	X	X	X					Local Funds	December 31, 2011	Complete application process prior to expiration of current status.	H	Ongoing
W7 (2006)	Continue Colonial Williamsburg Annual Tree Maintenance Program (includes monitoring conditions).	Colonial Williamsburg Foundation landscape crew		X	X		X										Private (CWF payroll)	Ongoing	Complete inspections & trimming seasonally	M	Ongoing
W6 (2006)	Continue programs and capital improvements to upgrade drainage system citywide, including Colonial Williamsburg.	CWF Facilities Maintenance	X		X		X										Private (CWF payroll)	Ongoing	Complete storm drain cleaning in Historic Area & Merchants Square annually.	M	Ongoing
W6 (2006)	Continue programs and capital improvements to upgrade drainage system citywide, including Colonial Williamsburg.	Public Works	X		X		X										Local Funds	Ongoing	Improve drainage Prince George to Scotland Street. Complete drainage system survey	M	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
W4 (2006)	Evacuation Shelter Generator Maintenance Program; evaluate the status of generators and the generator computer monitoring system on an annual basis (more frequently if necessary).	Fire Department	X	X	X	X	X			X	X	X		X		X	Local Fund	Ongoing	Daily monitoring of generator status through computer system	M	Ongoing
W1 (2006)	Evaluate citizen alerting systems; implement new system if it is determined feasible and funding is available.	Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local	December 2011	Research available systems to meet the needs of community	M	Ongoing
W3 (2006)	Continue strengthening GIS digital mapping program for cadastral and hazard planning purposes. Continue process of adding data layers, improving hardware capabilities, and expanding software availability across City departments.	IT Department	X	X	X	X	X	X	X	X	X	X					Local funds	Ongoing	New layers added to system. Staff trained on ability to make maps from existing data. Handheld GPS unit in place	M	Ongoing
W5 (2006)	Continue training CERT team members for personal pre-disaster planning and neighborhood response teams, and establish emergency communication system for same.	Department of Human Services	X	X	X	X	X	X	X	X	X	X				X	HSGP/CCP Grants Local Funding	Ongoing	Monthly Communications Drills, Required Refresher Trainings, CERT Trainings, Neighborhood Contacts & Outreach Efforts	M	Ongoing

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
W5 (2011)	Provide outreach to repetitive loss and severe repetitive loss properties advising occupants of potential mitigation options.	Emergency Management	X		X		X											Ongoing		L	New
W8 (2006)	Explore feasibility of developing Disaster-Resistant University (DRU) Plan for the College of William & Mary once funding is secured.	College of William & Mary	X	X	X	X	X	X	X	X	X	X	X	X	X	X	HMA, PDM or HMGP grant	William & Mary pursing funding from HMGP during 2011	Determination of feasibility and receipt of funding.	L	Ongoing

York County - 2011 Mitigation Actions

Number	Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
Y1 (2011)	Evaluate options for new or upgrades to existing community/citizen notification systems.	Department of Fire and Life Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, State and Local Grants, local funds	December 2011	Continue public outreach and preparedness education	H	New
Y2 (2011)	Conduct annual review of repetitive loss and severe repetitive loss property list requested of VDEM to ensure accuracy. Review will include verification of the geographic location of each repetitive loss property and determination if that property has been mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
Y3 (2011)	Review locality's compliance with the National Flood Insurance program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New

Number	Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
Y4 (2011)	Educate elected officials and residents on the importance of the NFIP.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
Y5 (2011)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, relocation, elevation and flood proofing of projects where feasible using FEMA HMA programs where appropriate.	Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
Y6 (2011)	Complete annual floodplain management report.	Environmental and Development Services Department	X				X										Local Funds	Annual	Annual Report and Public Meetings	M	New
Y7 (2011)	Develop public outreach materials to educate about wildland/urban interface (wildfire).	Department of Fire and Life Safety							X								Federal, State and Local Grants, local funds – Public/Private Funds – Local Media and VDEM Public Affairs	December 2012	Wildland fire reduction through public education, preparedness and mitigation.	M	New

Number	Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
Y8 (2011)	Maintain program for continued assessment of identified stormwater "choke points" when storms are approaching.	Environmental and Development Services Department	X		X		X										Local Funds	As Needed	Less Flooding and Repair	M	New
Y13 (2006)	Continue program to elevate flood-prone homes/reduce repetitive flood losses.	Environmental and Development Services Department and the Department of Fire and Life Safety	X				X					X					Have applied for grants; To date have not been awarded any	On-Going	Continue public outreach and preparedness education	M	Ongoing
Y5 (2006)	Evaluate critical facilities for safety and sustainability during emergencies and take appropriate corrective actions to include providing backup power to critical facilities to protect the public and maintain continuity of government.	Department and the Department of Fire and Life Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, State and Local Grants, local funds	On-Going	Completion of Several Projects	M	Ongoing
Y2 (2006)	Continue flood hazard awareness program to: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors	Environmental and Development Services Department and the Department of Fire and Life Safety	X				X										Local Funds	Annual	Conduct public outreach. Receive several calls associated with outreach	M	Ongoing

Number	Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
	of FEMA's map amendment process; and, 3) incorporate flood hazard awareness.																				
Y3 (2006)	Implement Storm Water Capital Improvement Projects.	Environmental and Development Services Department	X		X		X										Local Funds and VDOT Revenue Share	Annual	Completion of several CIP projects	M	Ongoing
Y8 (2006)	Maintain an awareness of and support for the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds.	Department of Fire and Life Safety							X								Federal, State and Local Grants, local funds	As Needed	Wildland fire reduction and public education.	M	Ongoing
Y10 (2006)	Continue to provide contingency planning guidance to businesses.	Department of Fire and Life Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, State and Local Grants, local funds – Public/Private Funds	As Needed	Conduct public outreach and continued interaction with business community as requested.	M	Ongoing
Y1 (2006)	Consider the adoption of an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus freeboard (possibly two feet) above 100 year flood elevation.	Environmental and Development Services Department	X				X										Local Funds	December 2012	Public Hearing for Ordinance revision	M	Ongoing

Number	Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
Y9 (2011)	Evaluate applicability and availability of emergency/crisis management systems & tools (web-based interoperability tools).	Department of Fire and Life Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, State and Local Grants, local funds – Public/Private Funds	On-Going As Needed	Implementation of emergency/crisis management/interoperability system.	L	New
Y10 (2011)	Continue PSA program; assess the need for and develop new hazard related PSAs as needed; assess the media outlets utilized for PSAs.	Department of Fire and Life Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, State and Local Grants, local funds – Public/Private Funds – Local Media	As Needed - Annually	Citizen comments and questions as well as continued media request with regard to preparedness activities.	L	New
Y12 (2006)	Continue the Comprehensive Plan element "protect County shorelines from erosion through a coordinated, unified area approach that utilizes properly designed methods of vegetative or structural stabilization, bank regrading, beach nourishment and/or relocation".	Environmental and Development Services Department and the York County Planning Division	X										X				Private Property Owners	As needed	Wetlands Board Permitting	L	Ongoing

James City County - 2011 Mitigation Actions

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
JC1 (2011)	Evaluate critical facilities, including shelter facilities for safety and sustainability during emergencies and take appropriate corrective actions to protect the public and maintain continuity of operations.	Emergency Management	X	X	X	X	X									X	Federal, State, Local	On-going	Conduct preliminary surveys	H	New
JC2 (2011)	Working in cooperation with FEMA, revise Flood Insurance Rate Maps to incorporate results of recent flood studies performed on the Powhatan Creek watershed.	General Services Stormwater	X	X			X										Local, Federal	June 30, 2012	Submitting application	H	New
JC3 (2011)	Construct improvements to mitigate flooding problems identified in the flood studies performed for Powhatan Creek watershed. These primarily involve improvement of VDOT road crossings by increasing flow capacity or installing over-topping protection.	General Services Stormwater	X	X			X										Seeking federal grant	June 30, 2012	Submit application	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
JC4 (2011)	Conduct annual meeting with VDOT and utilities to identify hazard areas and potential projects to mitigate those areas.	Emergency Management	X	X			X										Local	On-going	Conduct Annual Meeting	H	New
JC4 (2006)	Adopt an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus freeboard (possibly two feet) above 100 year flood elevation (7.5).	Development Management	X	X			X										local	December 31, 2011	Draft Ordinance October 2011	H	Ongoing
JC1 (2006)	Continue flood-prone structure elevation project, focusing on Chickahominy Haven and Powhatan Shores, and the county's repetitive and severe repetitive loss properties/areas.	Community Housing	X	X			X										HMA Grants and HMPG 5% Initiative Funds	On-going	Applications submitted	H	Ongoing
JC3 (2006)	Revise site plan application, building permit application and accompanying checklists to include/require detailed information on the flood hazard, to include flood zone, map number and date, and Base Flood Elevation.	Development Management	X	X			X										Local			H	Ongoing

Number	Agency / Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
JC5 (2011)	Conduct annual review of repetitive loss and severe repetitive loss property list requested of VDEM to ensure accuracy. Review will include verification of the geographic location of each repetitive los property and determination if that property has been mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501.	Emergency Management & Development Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
JC6 (2011)	Review locality's compliance with the National Flood Insurance program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Development Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
JC7 (2011)	Educate elected officials and residents on the importance of the NFIP.	Development Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New

Number	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
JC8 (2011)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, relocation, elevation and flood proofing of projects where feasible using FEMA HMA programs where appropriate.	Emergency Management & Community Housing	X		X		X										FEMA Unified Hazard Mitigation Assistance funding, Locality funding	December 31, 2015	Secure funding	H	New
JC7 (2006)	Convene a task force to study/assess the wildland fire hazard and the urban interface. The task force could make recommendations regarding additional building code requirements in a mapped "interface zone", outreach and complementary inspections for homeowners.	Fire Department, Emergency Management						X	X								Local	March 2013	Task Force Convened March 2012	MH	Ongoing
JC9 (2011)	Complete Storm Ready certification.	Emergency Management	X	X	X	X	X	X	X	X	X	X					EMPG Grants, CERT, local funds, media participation, HMGP 5% Initiative funds	December 31, 2011	Complete application process prior to expiration of current status.	M	New

Number	Agency / Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (High, Med, Low)	Action Status
JC10 (2011)	Evaluate the applicability and ability to integrate web-based hazard data analysis tools with current county capabilities.	Emergency Management	X	X	X	X	X	X	X	X		X					Local	On-going	March 2013	M	New
JC11 (2011)	Develop a program to educate and assist property owners in flood prone areas in techniques for dry and wet flood proofing.	General Services Stormwater	X	X	X		X										Local	June 30, 2012	Website and materials produced	M	New
JC2 (2006)	Conduct certified lowest floor elevation surveys of existing homes, manufactured homes, and commercial structures in identified floodplains. Include County-wide housing needs assessment.	Development Management	X	X	X		X										Local	June 30, 2012		M	Ongoing
JC6 (2006)	Continue and expand Drought-Resistant Landscaping Program elements, to include private property owners, commercial projects, and County lands.	James City County Service Authority						X		X							Local	Ongoing	Website and materials produced	M	Ongoing
JC5 (2006)	Provide disaster mitigation planning guidance to businesses.	General Services Stormwater	X	X		X	X	X								X	Local	On-going	Website and materials produced	M	Ongoing

Chapter 6: Plan Maintenance

This section discusses how the Virginia Peninsula jurisdictions will implement mitigation strategies and how the overall Plan will be evaluated and improved over time. This section also discusses public involvement in the hazard mitigation planning process. It consists of the following three subsections:

- Implementation;
- Monitoring, Evaluation, and Enhancement; and
- Continued Public Involvement.

Implementation

Each jurisdiction participating in the Peninsula Hazard Mitigation Plan Update (Plan) is responsible for implementing specific mitigation actions as prescribed in their section of the locally adopted regional plan. In each mitigation action plan, every proposed action is assigned to a specific local department or agency in order to assign responsibility and accountability and increase the likelihood of subsequent implementation. This approach enables individual jurisdictions to update their unique Mitigation Actions as needed without altering the broader focus of the Regional Plan. The separate adoption of locally-specific actions also ensures that each jurisdiction is not held responsible for monitoring and implementing the actions of other jurisdictions involved in the planning process.

In addition to designating a local lead department or agency, a completion date and interim measure of success date have also been assigned (where appropriate) to assess whether actions are being implemented in a timely fashion. Peninsula jurisdictions will seek outside funding sources to implement mitigation projects in “peace time” and post-disaster scenarios. Where feasible, potential funding sources have been identified and targeted for proposed mitigation actions and projects listed in the Mitigation Action Plans.

It will be the responsibility of each participating jurisdiction to determine additional implementation procedures beyond those listed within their Mitigation Planning Plan. This includes integrating the requirements of the Plan into other local planning documents, processes, or mechanisms such as comprehensive or capital improvement plans, when appropriate. The members of the Peninsula Hazard Mitigation Planning Committee (PHMPC) will continue to ensure that the goals and strategies of new and updated local planning documents for their jurisdictions or agencies are consistent

with the goals and actions of the Plan. It will also be their responsibility to integrate risk reduction principles into local actions, strategies, and projects so that hazard vulnerability is not increased regionally or locally.

Opportunities to integrate the requirements of this Plan into other local planning mechanisms shall continue to be identified through future meetings of the PHMPC and throughout the 5-year review process described in this document. Although it is recognized that there are many possible benefits to integrating components of this Plan into other local planning mechanisms, the PHMPC deemed the development and maintenance of this separate Hazard Mitigation Plan is the most effective and appropriate method to implement local hazard mitigation planning at this time. As such, the primary means for integrating mitigation strategies into other local planning and emergency management mechanisms will be through the revision, update, and implementation of each jurisdiction's individual Mitigation Actions portfolio, which will require annual review for reporting to VDEM. The Actions have been formatted consistent with VDEM reporting protocols to facilitate this annual process.

The PHMPC will continue to coordinate with local jurisdictions in creating processes by which the initiatives of this Plan will be incorporated into other local plans. During the planning process for new and updated local planning documents, such as a comprehensive plan, capital improvements plan, or emergency management plan, the PHMPC or Hampton, as the planning grant sponsor, will provide a copy of the Plan to the appropriate parties. The Hampton Roads Planning Commission will continue to support the process as appropriate.

Monitoring, Evaluation and Enhancement

Periodic revisions and updates of the Plan are required to ensure that the goals of the Plan are kept current and take into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with applicable Federal and State regulations. Periodic evaluation of the Plan will also ensure that specific mitigation strategies are being reviewed and carried out according to each participating jurisdiction's individual Mitigation Planning Plan.

The PHMPC will continue to meet bi-annually to specifically address the plan, and following any disaster events that may warrant a reexamination of the mitigation strategies being implemented or proposed by the participating jurisdictions. As this group generally meets at least monthly for regional purposes, discussion of mitigation initiatives or opportunities can be initiated

more frequently as necessary. This way the Plan is continuously updated to reflect changing conditions and needs within the region. Each participating jurisdiction will be encouraged by Hampton as the sponsoring jurisdiction to complete annual reviews on the progress of their respective Mitigation Plans for compilation and submittal to the Virginia Department of Emergency Management (VDEM). This will expedite the 2016 plan update and provide an annual opportunity to focus on accomplishments and re-evaluate mitigation actions, strategies, and projects. If determined appropriate or as requested, Hampton or one of the other participating jurisdictions will prepare an annual report on the Plan for submittal to the local governing bodies of participating jurisdictions in order to report progress on Plan strategies and to provide information on the latest legislative requirements and/or changes to those requirements.

If any participating jurisdiction no longer wishes to actively participate in the development and maintenance of the Plan, they must notify Hampton and VDEM in writing.

Five (5) Year Plan Review

The Plan will be reviewed by the PHMPC every 5 years to determine whether there have been any significant changes in the region to necessitate changes in the types of mitigation actions, strategies, and projects proposed. Examples of factors that may affect the necessary content of the Plan include:

- New development in identified hazard areas;
- An increased exposure to hazards;
- The increase or decrease in a Jurisdiction's ability to address hazards, and
- Changes to Federal or State legislation.

The plan review process provides regional and community officials with an opportunity to evaluate plans that have been successful and to explore the possibility of documenting potential losses avoided as a result of implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions, strategies, and projects that may not have been successfully implemented as assigned. The PHMPC will be responsible for conducting the 5-year review in coordination with the VDEM.

During the 5-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the regional goals address current and expected conditions?

- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the Plan?
- Are there local implementation problems, such as technical, political, legal, or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did the jurisdictions, agencies, and other partners participate in the plan implementation process as proposed?

Following the 5-year review, any necessary revisions will be implemented according to the reporting procedures and plan amendment process outlined herein. Upon completion of the review and update/amendment process, the 2016 Peninsula Hazard Mitigation Plan Update will be submitted to the State Hazard Mitigation Officer for final review and approval in coordination with the Federal Emergency Management Agency.

Disaster Declarations

Following a disaster declaration, the PHMPC will reconvene and the Plan will be revised as necessary to reflect lessons learned, or to address specific circumstances arising from the event. It will be the responsibility of the PHMPC to ensure that appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Reporting Procedures

The results of the 5-year review will be summarized by the PHMPC in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include an evaluation of the implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion along with recommended strategies to overcome them. This “report” will likely be included in the revised Peninsula Hazard Mitigation Plan consistent with FEMA and VDEM local plan requirements effective at the time of plan revision (2016)

Any necessary revisions to the Plan elements shall follow the plan amendment process outlined herein. For changes and updates to the individual Mitigation Plans, appropriate local designees will assign responsibility for the completion of the task.

Plan Amendment Process

Local participating jurisdictions have the authority to approve/adopt changes to their own Mitigation Plans without approval from the PHMPC; however,

these entities should be advised of all changes as a courtesy and for consideration for changes or modifications to the Plan. The PHMPC will be responsible for verifying that the proposed change will not affect the jurisdiction's compliance with current State and Federal mitigation planning requirements. Changes to either the Plan or local Mitigation Plans will necessitate the adoption of these changes by the appropriate governing body, and ultimately or upon request the updated Plan or plan component(s) will be submitted to VDEM.

The PHMPC and its participating jurisdictions will forward information on any proposed change(s) to all interested parties including, but not limited to, all affected county and municipal departments, residents, and businesses. When a proposed amendment may directly affect private individuals or properties, each jurisdiction will follow existing local, State or Federal notification requirements, which may include published public notices as well as direct mailings. Information on any proposed plan amendments will also be forwarded to VDEM. This information will be disseminated in order to seek input on the proposed amendment(s) for not less than a 45-day review and comment period.

At the end of the 45-day review and comment period, the proposed amendment(s) and all comments will be forwarded to the PHMPC for final consideration. The committee will review the proposed amendment along with the comments received from other parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan to each appropriate governing body within 60 days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered by the PHMPC:

- If there are errors, inaccuracies, or omissions made in the identification of issues or needs in the Plan;
- New issues or needs have been identified, but are not adequately addressed in the Plan;
- There has been a change in information, data, or assumptions from those on which the Plan is based;
- There has been a change in local capabilities to implement proposed hazard mitigation activities.

Upon receiving the recommendation from the PHMPC and prior to adoption of the Plan, each local governing body will hold a public hearing if required by their approval process. The governing body will review the recommendation from the committee (including the factors listed above) and

any oral or written comments received at the public hearing. Following that review, the governing body will take one of the following actions:

- Adopt the proposed amendments as presented;
- Adopt the proposed amendments with modifications;
- Refer the amendments request back to the PHMPC for further revision; or
- Defer the amendment request back to the PHMPC for further consideration and/or additional hearings.

Continued Public Involvement

Public participation is an integral component of the mitigation planning process and will continue to be essential as this Plan evolves over time. As described above, significant changes or amendments to the Plan may require a public hearing prior to any adoption procedures.

Additional efforts to involve the public in the maintenance, evaluation, and revision process will be made as necessary. These efforts may include:

- Advertising meetings of the PHMPC in the local newspaper, public bulletin boards, and/or municipal or county office buildings;
- Designating willing and voluntary citizens and private sector representatives as official members of the PHMPC;
- Utilizing local media to update the public of any maintenance and/or periodic review activities taking place;
- Using the Hampton Roads Planning District Commission website, as well as municipal or county Web sites, to advertise any maintenance and/or periodic review activities taking place; and
- Keeping copies of the Plan in public libraries and making it accessible via public websites.

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