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Section 2
Executive Summary

Howard County completed its first update to the original 2004 Natural Hazards Mitigation Plan in 2012. This updated plan provides County residents with an increased awareness of various natural hazards and their potential to impact life and property. The County must have an approved hazards mitigation plan in place to remain eligible for several grants that are administered by the Maryland Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA). The abbreviation *NHMP* is used throughout the update in place of Natural Hazards Mitigation Plan.

The 2012 NHMP was prepared by a Natural Hazards Mitigation Plan Steering Committee (NHMPSC) composed of County departments and offices. A Stakeholder group comprised of County departments and offices, as well as community representatives from the Community Emergency Response Network (CERN), the Columbia Association, the Howard County Community College and the neighboring counties' Offices' of Emergency Management, also participated in the update process. In addition, the general public was an instrumental part of the NHMP update. Specifics of the process are discussed in Section 5, *Planning Process*.

Howard County has experienced multiple natural hazard events between 1971 and 2012. Since 1971, Howard County has received ten Major Disaster Declarations. These events are summarized as part of Table 6.2.1-1 in the 2012 NHMP. Of the ten Major Disaster Declarations that occurred in Howard County between 1971 and 2012, there were four snow events, two flooding-severe storms-related events, two hurricanes, and two tropical storms. The winter storm events in 2009-2010, and Hurricane Irene and Tropical Storm Lee in the fall of 2011, have created lasting impressions on County residents and officials.

The original 2004 plan set the stage for long-term disaster resistance through the identification of mitigation actions that would reduce the exposure of people and property to natural hazards. The NHMPSC thoroughly reviewed all actions from the original plan, as well as created new mitigation actions suitable for future projects. These are outlined in Section 8, *Mitigation Strategy*.

Sections of the NHMP include:

- Characterize the people and property that are exposed to the risk of hazards (Section 3, *Background*).
- Outline the planning process (Section 5, *Planning Process*).
- Overview of the hazards that threaten the County (Section 6, *Hazard Identification, Profiling and Ranking*).
- Identify vulnerabilities and assess risks from specific hazards (Section 7, *Risk Assessment*).
- Identify and prioritize mitigation action items (Section 8, *Mitigation Strategy*).
- Ways to incorporate the NHMP into other local planning documents (Section 9, *Incorporating Other Planning Documents*).
- Overview of how the County will implement, monitor and maintain the plan (Section 10, *Plan Monitoring and Maintenance*).

The primary County point of contact for the NHMP is:

Mr. Dan Cornwell, M.S.
Emergency Management Specialist II
Department of Fire and Rescue Services
Office of Emergency Management
6751 Columbia Gateway Drive, Gateway Building, 4th Floor
Columbia, MD 21046
Phone: 410-313-5911
Email: dcornwell@howardcountymd.gov

The adopted NHMP is available for review on the Howard County Department of Fire and Rescue website at http://www.howardcountymd.gov/FAR/FAR_oemhazards.htm. The NHMP may also be obtained from:

Howard County Office of Emergency Management,
6751 Columbia Gateway Drive, Gateway Building, 4th Floor
Columbia, MD 21046

Residents may also access the NHMP through the County's libraries:

Central Branch
10375 Little Patuxent Parkway
Columbia, MD 21044

East Columbia Branch
6600 Cradlerock Way
Columbia, MD 21045

Elkridge Branch
6540 Washington Boulevard
Elkridge, MD 21075

Savage Branch
9525 Durness Lane
Luarel, MD 20723

Glenwood Branch
2350 State Route 97
Cooksville, MD 21723

Miller Branch
9421 Frederick Road
Ellicott City, MD 2042

Section 3
Background

Contents of this Section

3.1 Introduction

The Disaster Mitigation Act of 2000 (DMA2K) established a requirement that jurisdictions must develop and implement natural hazard mitigation plans in order to remain eligible for various Federal Emergency Management Agency (FEMA) grant programs.

Utilizing grant funding from FEMA, the Howard County Department of Fire and Rescue Services - Office of Emergency Management (OEM) was tasked with developing the County's first Natural Hazard Mitigation Plan (NHMP) in 2004. In June of that year, a Planning Group meeting was held to familiarize various County Departments and organizations with the mitigation plan process. The 2004 version of Howard County's NHMP established the County's long-term strategy for reducing its risks from natural hazards. On August 18, 2004, a public meeting was held to gather the public's views and comments on the draft plan. The 2004 final plan was officially approved by the Maryland Emergency Management Agency (MEMA) State Hazard Mitigation Officer (SHMO) and FEMA Region III in November 2004.

In July of 2008, Howard County was awarded another grant to update its second hazard mitigation plan. See Section 5, *Planning Process* for details about the NHMP update process.

3.1.1 Scope of the Plan

The original Howard County NHMP was a concerted county-wide effort to develop a plan to reduce damage from natural disasters. The County generally followed the planning process described in FEMA mitigation planning guides, Series 386. The original NHMP was approved by the County Council in November 2004 and has been used since to guide the County's efforts to develop and initiate policies and projects to reduce risk.

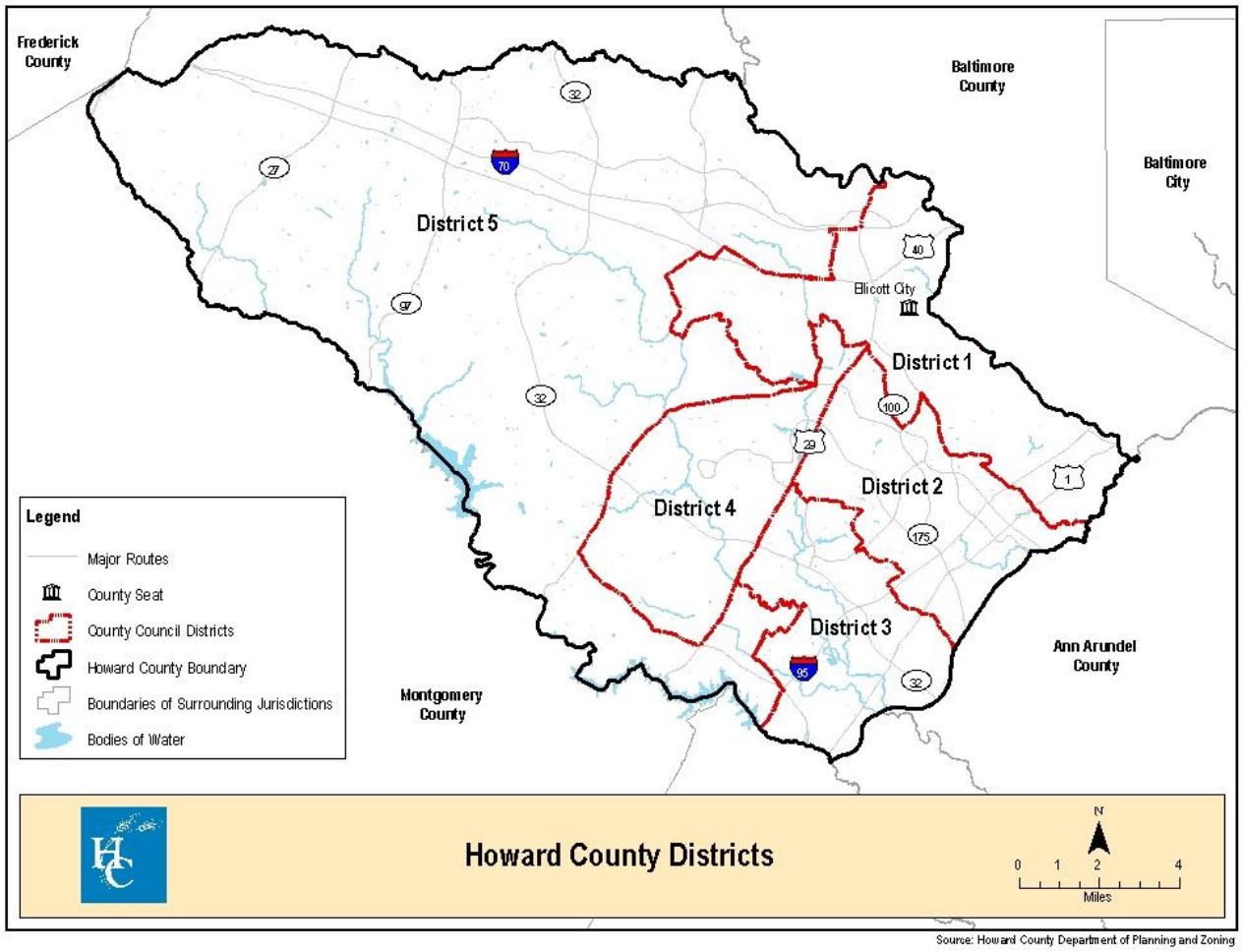
The updated 2012 NHMP included re-evaluating the original hazards, mitigation goals, strategies, and priorities. As part of the update process, these sections of the revised NHMP were reassessed to identify changes and updates that may have occurred since the approval and adoption of the original NHMP.

3.2 Howard County Government Organization

The Howard County government is comprised of a County Executive, five Council Districts, and the County Council.

Map 3.2-1 identifies the five Council Districts of Howard County.

Map 3.2-1
Howard County Districts



The County Council enacts local legislation, determines County policies and plans and establishes an annual budget.

County government consists of seventeen Departments, several of which are responsible for planning and responding to natural hazard events that occur within the County. The primary Departments that plan for, and respond to natural hazard events include:

- **Office of Emergency Management (OEM):** OEM is the local emergency organization for emergency management in Howard County[1] and is responsible for "implementing programs and establishing positions recommended by the Maryland Emergency Management Agency to meet Federal and State standards."[2] OEM also develops and implements local and State emergency management plans for the County. OEM has the responsibility for coordinating all components of the County's emergency response capabilities. Those components include, but are not limited to: the civil defense efforts, fire and police, public health and emergency medical services, public works, volunteer and any other groups or agencies contributing to the management of emergency situations. OEM also facilitates public, multi-government agency planning efforts that enhance domestic preparedness for all hazards.

- **Department of Planning and Zoning (DPZ):** DPZ is responsible for "comprehensively planning for the growth and development of the County"[3] by creating innovative plans and strategies to address environmental concerns, economic development, housing, transportation and land use within the jurisdiction. DPZ reviews variances as well as zoning and subdivision regulations to enhance and protect the health, safety and welfare of its citizens.

- **Department of Inspection, Licensing and Permits (DILP):** DILP is responsible for the protection of public health, safety and welfare through the issuance of licenses and permits. The Department also conducts inspections as required by law and enforces codes, laws, rules, and regulations relating to facilities and utilities. [4]

- **Department of Fire and Rescue Services (DFRS):** DFRS is responsible for the administration of fire suppression and prevention, fire training, arson investigation, rescue services, and emergency medical emergencies, within the County. [5] The Department is devoted to protecting the citizens of Howard County and their property from fire and other hazardous conditions through public education, fire prevention, code enforcement and professional emergency response. DFRS is considered a "combination" Department, made up of both career and volunteer firefighters.

- **Howard County Police Department (HCPD):** The HCPD is responsible for the operation and enforcement of the laws, rules, and regulations concerning the following: the preservation of the public peace, the prevention of crime, the apprehension of criminals and the protection of the rights of person and property. [6] The Police Department is dedicated to protecting life and property, enforcing the law, and assisting victims.

[1] Howard County Code tit. 17 § 109 (a)(2) (2009).
[2] Id. at 17 § 109 (a)(1).
[3] Howard County Code tit. 16 § 801 (c) (2009).
[4] See Howard County Code 6 tit. § 301(c)(1) – (4) (2009).
[5] Howard County Code 17 tit. § 100 (d)(1)(i-vi), (d)(3) (2009).
[6] Howard County Code 17 tit. § 200a (d)(1) (2009).

- **Department of Public Works (DPW):** DPW is responsible for the County's capital projects and also designs, constructs, oversees, and maintains the County's public facilities and utilities (roads, bridges, water systems, sewerage systems, and draining operations). [7] The protection of these facilities and infrastructure against natural hazards is of utmost importance to the advancement of quality of life for County citizens.

3.3 Background

Prior to addressing the hazards that the community faces, the updated NHMP presents a brief overview of Howard County by taking into account geography, history, climate, population and growth, transportation and community assets.

3.3.1 Geography

Howard County is located in the central part of Maryland between two major metropolitan areas. The City of Baltimore is roughly fifteen miles to the north/northeast, and Washington, DC is located approximately thirty miles to the south. The County is 253 square miles, which makes it Maryland's second smallest County geographically. Located on the Piedmont Plateau, the County can be characterized by gently rolling hills and agricultural land, particularly in western Howard County. The area is moderately to heavily vegetated with a mix of hardwoods, pines, and grasses.

The County is bound by two major tributaries that flow into the Chesapeake Bay - the Patapsco River to the north and the Patuxent River to the south. Approximately three-quarters of Howard County lies within the Patuxent watershed, which includes the main Patuxent River and two branches, the Middle Patuxent and Little Patuxent. The remaining quarter of the County is within the Patapsco watershed. The Patapsco River serves as the political boundaries for Baltimore and Carroll Counties, while the Patuxent River separates Howard County from Montgomery and Prince George's County. Howard County shares a small portion of its western border with Frederick County and the eastern portion of the County is bounded by Anne Arundel County.

The average elevation in Howard County is 401 feet above sea level, with the highest point being 883 feet above sea level. The lowest point is only eight feet above sea level. The rock formations found in the area are dominated by schist and gneiss rock formations. The Atlantic Fall Line runs through the County, north to south, just west of Interstate 95. The land located east of the Fall Line can be characterized by the Coastal Plain, creating a much flatter topography than the land west of the Fall Line.

Howard County is part of the Baltimore-Towson Metropolitan Statistical Area (MSA), which includes the City of Baltimore, Towson, and six other Counties in addition to Howard County. Howard County is also part of the Baltimore-Washington-Northern Virginia Combined Statistical Area (CSA), one of the largest populous metropolitan areas in the United States.

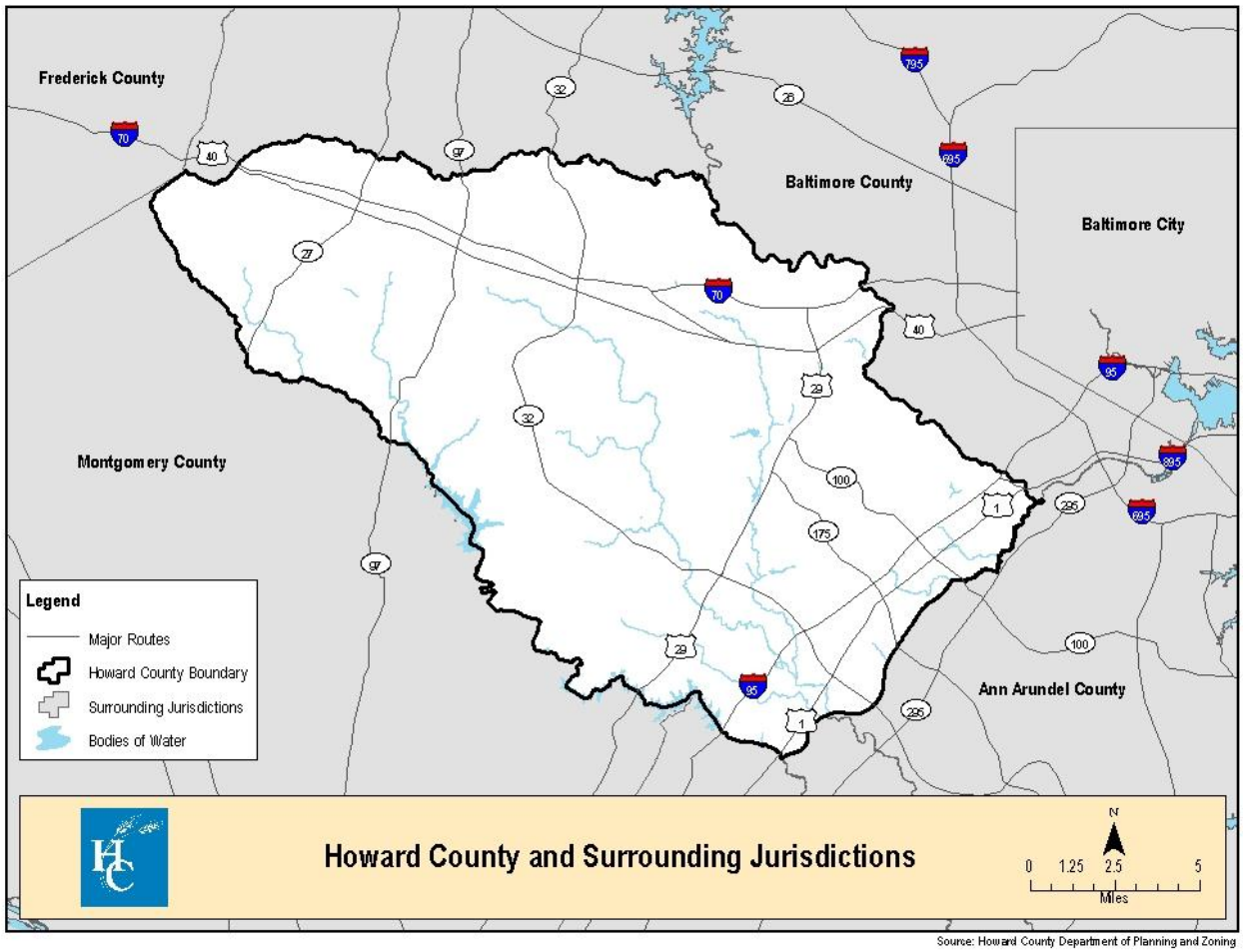
There are no incorporated municipalities in the County. The major population centers include: Columbia, Ellicott City, Elkridge, Savage, North Laurel and West Friendship. Developed in 1965 by James Rouse, the "New Town" of Columbia was designed to be a self-sustaining community and a model for future urban

[7] See Howard County Code 18 tit. § 1001 (c) (2009).

development. Today, Columbia's population is estimated at 90,527 and would be Maryland's second largest city if incorporated.[8] Ellicott City serves as the County Seat.

Map 3.3-1 is a visual representation of Howard County and the surrounding jurisdictions.

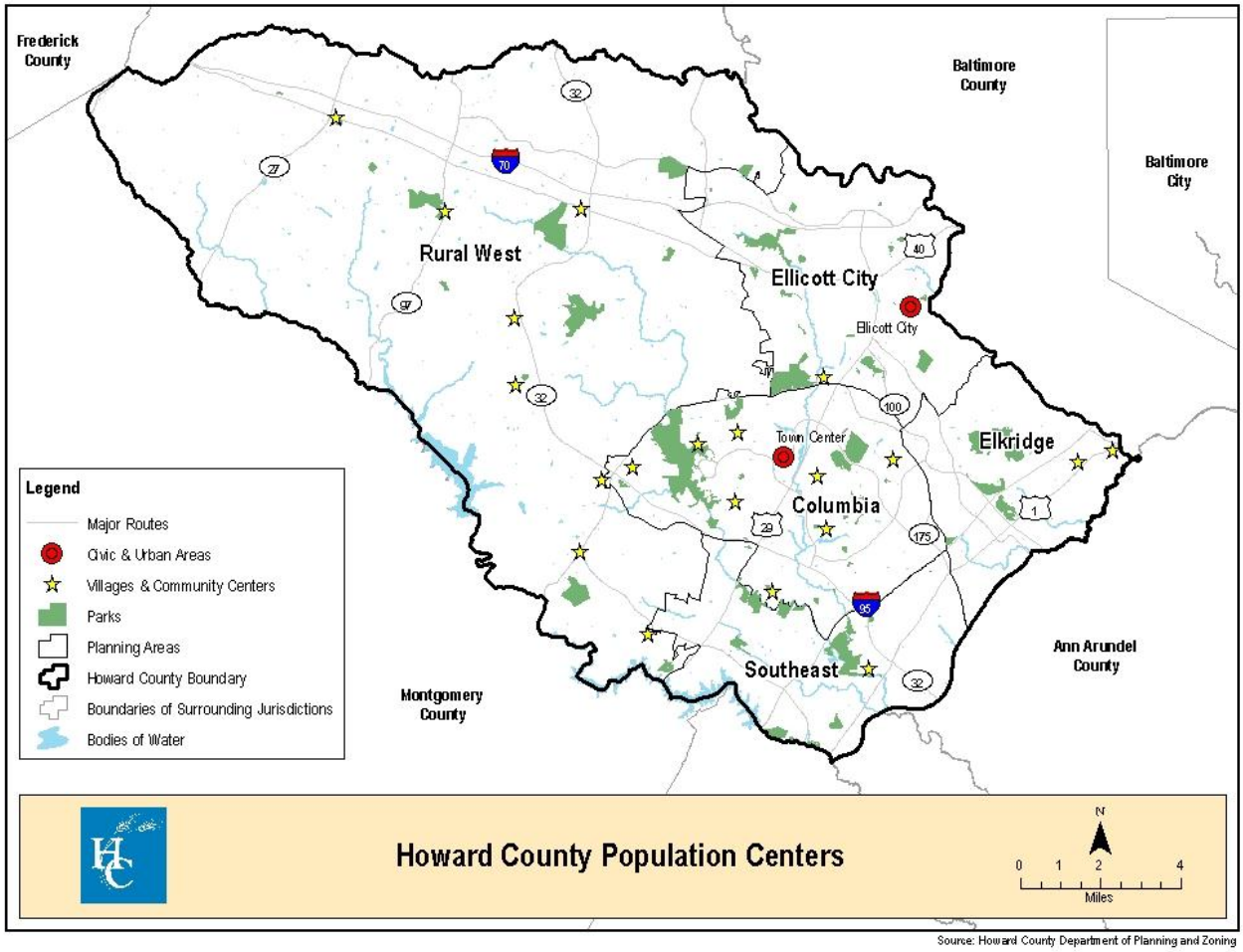
Map 3.3.1-1
Howard County and the Surrounding Jurisdictions



[8] United States Census Bureau's *2005-2009 American Community Survey*, 2011, available at http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS&_submenuId=&_lang=en&_ts=.

Map 3.3.3-2 is a visual representation of Howard County and its major population centers.

Map 3.3.3-2
Howard County Population Centers



3.3.2 Climate

Howard County's climate is temperate, characterized by warm, humid summers and moderate winters. The average annual temperatures and precipitation are based on a 30-year average from 1981 to 2010 for the Baltimore area.[9] The average temperature in July is 77.6 degrees, while the average in January is 33.6 degrees. The average annual temperature is 55.7 degrees. Winter months are usually cold, just above freezing (35.8 degrees) with moderate snowfall, an annual average of 20.7 inches. Every seventh year since 1995, the Baltimore area has experienced a seasonal snowfall of 58 inches or more. The average annual rainfall is 41.9 inches, with July being the wettest month with an average of 4.1 inches.

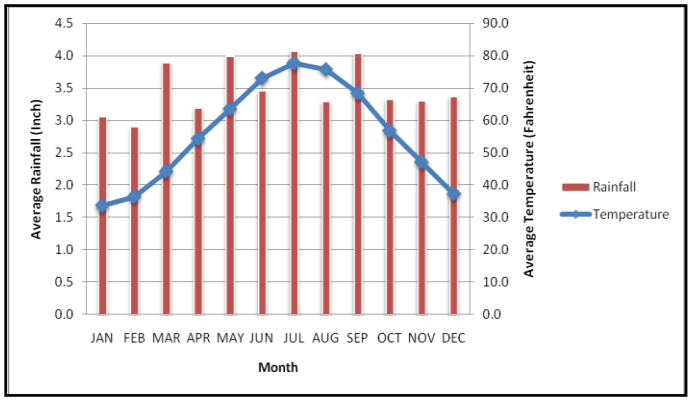
[9] Maryland State Climatologist Office's *Maryland Monthly Averages*, 2009, available at http://www.atmos.umd.edu/~climate/Weather/marylandnormals.htm.

Table 3.3.2-1 and Figure 3.3.2-2 summarizes the climate of Howard County.

Table 3.3.2-1
Howard County – Climate Statistics
Source: Maryland State Climatologist Office

Climate Category	Annual Average
Average annual temperature	55.7 degrees
Average January temperature	33.6 degrees
Average July temperature	77.6 degrees
Average annual rainfall	41.9 inches
Average annual snowfall	20.7 inches

Figure 3.3.2-2
Howard County Climatic Averages
Source: Maryland State Climatologist Office



3.3.3 History of Howard County

Howard County had a strong presence in the creation of our nation. Howard County's most prominent resident, Charles Carroll of Carrollton, was the only Roman Catholic signer of the Declaration of Independence. Howard County is named after John Eager Howard, a Revolutionary War hero and three-term governor of Maryland.

Howard County's strategic location and natural resources were both instrumental to the early development of the County. Prior to the 1700's, settlement in the area was slow, until tobacco became a valuable export. Elk Ridge Landing (now known as Elkridge) initially developed as farmers looked to sell tobacco to their English counterparts. With the advancement of the Industrial Revolution, iron became a prominent export through the port. As the Industrial Revolution progressed, milling became a large industry along the Patapsco and Patuxent Rivers. In 1772, three Pennsylvanian Quakers known as the Ellicott Brothers bought land on the Patapsco River. Attracted to the Patapsco River's strong currents, the three brothers constructed a mill and settled in what was then known as Ellicott's Mills (now Ellicott City). Shortly, the Ellicott Brothers expanded and acquired several flour and iron mills. Even though industrial advancement

encouraged settlers to settle in the Patapsco River Valley region, settlements were relatively sparse initially. By 1851, the area was officially recognized as a separate jurisdiction from Anne Arundel County.[10]

The advent of the railroad system changed everything. The first section of the Baltimore and Ohio Railroad was laid west of Ellicott's Mills in the early 1900's. As the first station along the railroad, a renewed economic presence was brought to the valley. After the Ellicott Brothers improved the road networks surrounding the region, Ellicott's Mills became a thriving center of trade. However, by the 1950s, the town slowly declined as people began to move to the suburbs.

During the 1960s, James Rouse quietly purchased land in the region. He planned to create a community designed to eliminate racial, religious and income segregation. Named Columbia, this community was to be completed with jobs, schools, shops, and medical services. The process of developing this area included a panel of experts in social sciences, which led to the physical development of the community and innovations to improve schools, recreation and social interaction. This "New Town District," the downtown zoning district, gave developers flexibility on where they were allowed to develop without official approval from the County.

3.3.4 Population

The 2010 Decennial Census estimates Howard County's population at 287,085 residents.[11] Over the past ten years, Howard County has grown significantly, adding an estimated 39,243 people, a growth rate of about 16%. From 2000 to 2009, Howard County added an additional 15,525 housing units. The population projections for 2020 were completed by the State in December 2008. Combining these projections with the statistical information from the Decennial Census paints a clear picture of Howard County's growth and development. A comparison of population growth indices shows growth in Howard County is expected to remain slow and become on par with the State, but will continue to grow faster than the region overall. Although there might be a slight slowing in the growth rate, Howard County is still expecting an additional 25,815 residents over the next ten years. Much of this new population growth is expected in the next 5 to 7 years, as the Federal Base Realignment and Closure (BRAC) is anticipated to add 22,000 new jobs to Fort Meade, a military installation located just across the border in Anne Arundel County.

[10] *Maryland Online Encyclopedia,* 2005, available at http://www.mdoe.org/.
[11] United States Census Bureau's *2010 Decennial Census*, 2011, available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

Table 3.3.4-1 below provides past and future population projections for the County, Region and the State of Maryland (for years 2000, 2010 and 2020).

Table 3.3.4-1
Population Estimates for 2000, 2010, and 2020[12]
Source: 2010 Decennial Census and Maryland State Data Center

Location	Estimated Population			Growth Rate Per Decade		
	2000	2010	2020	1990-2000	2000-2010	2010-2020
Howard County	247,842	287,085	312,900	32.3%	15.8%	8.3%
Baltimore Region	2,512,431	2,662,691	2,852,050	6.5%	5.6%	6.6%
Maryland	5,296,486	5,773,552	6,339,300	9.7%	8.3%	8.9%

A further breakdown of Howard County's population growth data is compiled in the following Tables: Tables 3.3.4-1 – 3.3.4-5. Table 3.3.4-1 and Table 3.3.4-2 use the 2010 Census data, while, Table 3.3.4-3, Table 3.3.4-4 and Table 3.3.4-5 use the 2005-2009 American Community Survey 5-Year Estimates.[13] The characteristics in Table 3.3.4-3, Table 3.3.4-4 and Table 3.3.4-5 have not been released for the 2010 Census and are the most current information at the time of the NHMP update.

Table 3.3.4-2
2010 Census Data: Demographic and Housing Statistics
Source: 2010 Decennial Census

General Characteristics	Estimate	Percent	U.S.
Total population	287,085	---	---
18 years and over	212,609	74.0%	76.0%
One race	276,630	96.4%	97.1%
White	178,523	62.2%	72.4%
Black or African American	50,188	17.5%	12.6%
American Indian and Alaska Native	866	0.3%	0.9%
Asian	41,221	14.4%	4.8%
Native Hawaiian and Other Pacific Islander	123	.04%	0.2%
Some other race	5,709	2.0%	6.2%
Two or more races	10,455	3.6%	2.9%
Hispanic or Latino (of any race)	16,729	5.8%	16.3%
Total housing units	109,282	--	--
Occupied housing units	104,749	95.9%	88.6%
Vacant housing units	4,533	4.1%	12.8%

[12] Maryland Department of Planning's *Maryland State Data Center*, 2011, available at http://www.mdp.state.md.us/msdc/home.shtml.
[13] United States Census Bureau's *2005-2009 American Community Survey*, 2011, available at http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS&_submenuId=&_lang=en&_ts=.

Table 3.3.4-3
2005-2009 American Community Survey 5-Year Estimates: Demographic and Housing Statistics
Source: 2005-2009 American Community Survey

General Characteristics	Estimate	Percent	U.S.
Total population	274,328	---	301,461,533
Male	134,978	49.2%	49.3%
Female	139,250	50.8%	50.7%
Median age (years)	37.5	---	36.5
Under 5 years	17,864	6.5%	6.9%
18 years and over	201,558	73.5%	75.4%
65 years and over	25,524	9.3%	12.6%
Occupied housing units	98,994	---	112,611,029
Owner-occupied housing units	74,787	75.5%	66.9%
Renter-occupied housing units	24,207	24.5%	33.1%

*Note all characteristics are based on estimates from the 2005-2009 American Community Survey

Table 3.3.4-4
2005-2009 American Community Survey 5-Year Estimates: Social Characteristics
Source: 2005-2009 American Community Survey

Social Characteristics	Estimate	Percent	U.S.
Population 25 years and over	179,126	---	197,440,772
High school graduate or higher	168,912	94.3%	84.6%
Bachelor's degree or higher	102,429	57.2%	27.5%
Civilian veterans (civilian population 18 years and over)	200,340	9.7%	10.1%
Foreign born	42,624	15.5%	12.4%

*Note all characteristics are based on estimates from the 2005-2009 American Community Survey

Table 3.3.4-5
2005-2009 American Community Survey 5-Year Estimates: Economic Characteristics
Source: 2005-2009 American Community Survey

Economic Characteristics	Estimate	Percent	U.S.
In labor force (population 16 years and over)	153,927	73.2%	65.0%
Mean travel time to work in minutes (workers 16 years and over)	30.2	---	25.2
Median household income (in 2005 inflation-adjusted dollars)	$101,003	---	$62,363
Median family income (in 2005 inflation-adjusted dollars)	$120,835	---	$81,537
Per capita income (in 2005 inflation-adjusted dollars)	$44,120	---	$27,041

*Note all characteristics are based on estimates from the 2005-2009 American Community Survey

3.3.5 Land Use

Maryland has been progressive in adopting state-wide land use planning and resource protection policies. The Maryland State Legislature passed the Economic Growth, Resource Protection, and Planning Act of 1992, which outlines seven goals to guide economic growth. It also mandates local plans to include an environmentally sensitive areas section. In 1997, the Maryland State Legislature passes several programs known as the Smart Growth and Neighborhood Conservation initiatives. The main initiative was the "Priority Funding Areas," which limited State infrastructure funding and economic development in areas local government found unsuitable for growth. The Rural Legacy Program of 1997 provides financial resources to protect agricultural land and natural resources.

Initially, the adopted State resolutions strengthened Howard County's informal growth boundary. The concept was implemented as the "Residential Zoning and Development Stage Plan" in the 1960s. Today, the Planned Service Area has a defined boundary. The area is contained in the eastern proportion of the County, which is roughly 40% of the County's land area. The rest of the County is located in the Rural West, and has been preserved through programs such as the Rural Legacy Program, the County's Agricultural Land Preservation Program, Cluster Zoning, and Density Exchange Option. Although development can occur outside this Rural West boundary, public sewer and water is not provided by the County.

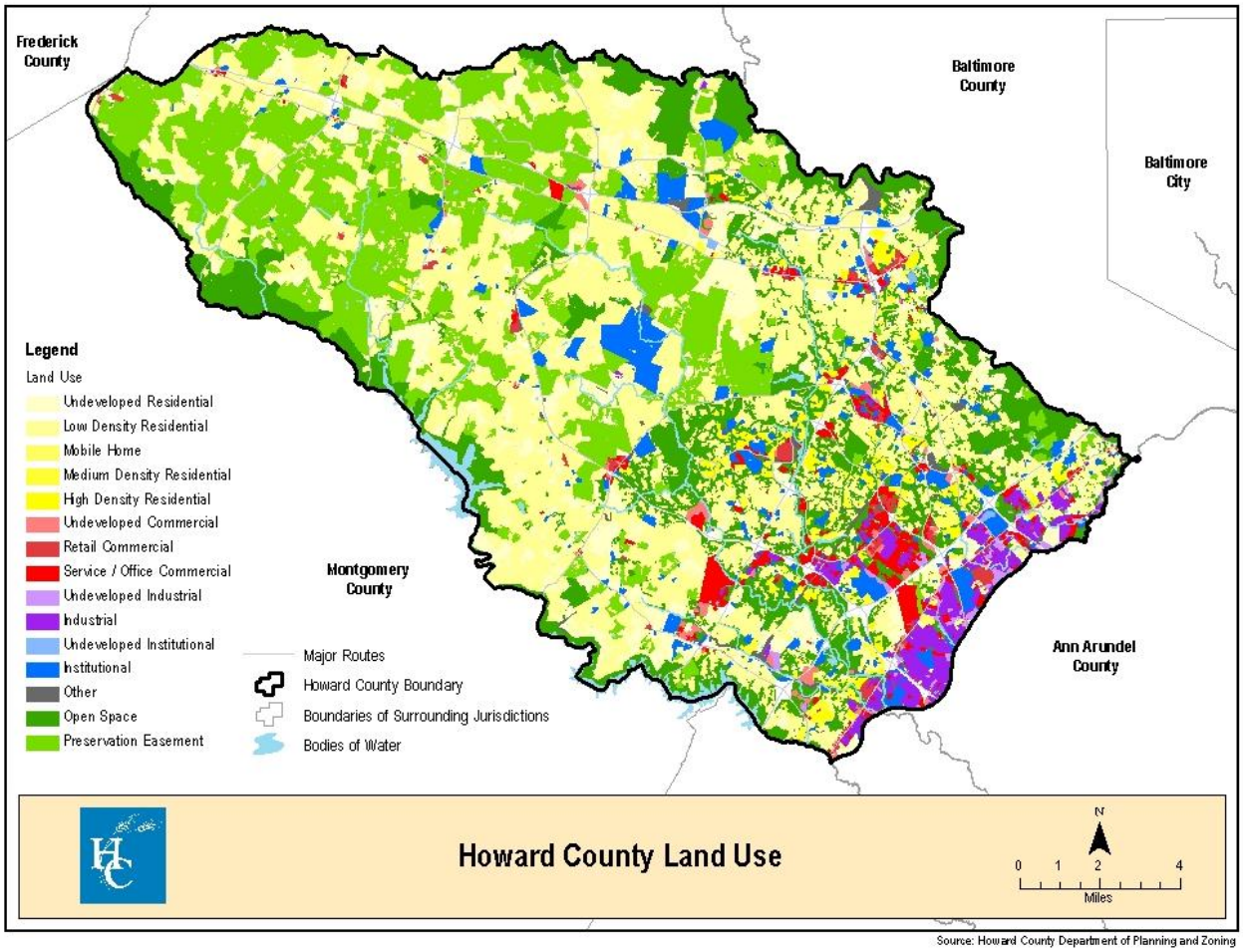
There are fifteen different types of land uses in Howard County, which includes five residential, three commercial, two industrial, and two institutional. In addition, there are two types of park space (open and preserved), as well as an all inclusive use that includes transportation, communications, and utility right-a-way. The Planned Service Area contains all five residential land uses, with the High Density Residential land use typically located in Columbia, Elkridge, Ellicott City, Savage, and North Laurel. The residential land use in the Rural West are mainly characterized by Low Density Residential and Undeveloped Residential. The combination of the Preservation Easements, Park and Open Space, and the two previously residential land use make up a significant portion of the Rural West. In the Planned Service Area, the Park and Open Space land use is located around residential development, which acts as a buffer between the floodplain and residential properties.

Howard County's three commercial land use's are comprised of retail, office/service, and undeveloped commercial. The commercial land use is primarily located in the Planned Service Area, with several small defined locations on the Route 32, Route 97, and Interstate 70 corridors in the Rural West. The majority of the commercial land use is retail and these are typically found near major population centers, such as Columbia, Jessup, Elkridge, Ellicott City, Savage, and North Laurel. The Mall in Columbia, located in the Town Center, serves as a major retail center. Another retail cluster can be found on the Interstate 95 corridor, particularly between Route 32 and Route 175, and off of Snowden River Parkway.

The Route 1 corridor is the principal location of the County's industrial land uses. The majority of the industrial land is located east of Route 1 and makes up a significant portion of the land between Route 1 and Howard County's border with Anne Arundel County. There are numerous institutional land uses scattered throughout the County. The most prominent institutional land use is the University of Maryland's Central Maryland Research & Education Center -Clarksville facility, a dairy research center. The land use named "other" is characterized by long narrow tracts of land. Typically, this land use includes major routes and their right-a-ways.

Map 3.3.5-1 is a visual representation of Howard County's Land Use.

Map 3.3.5-1
Howard County Land Use

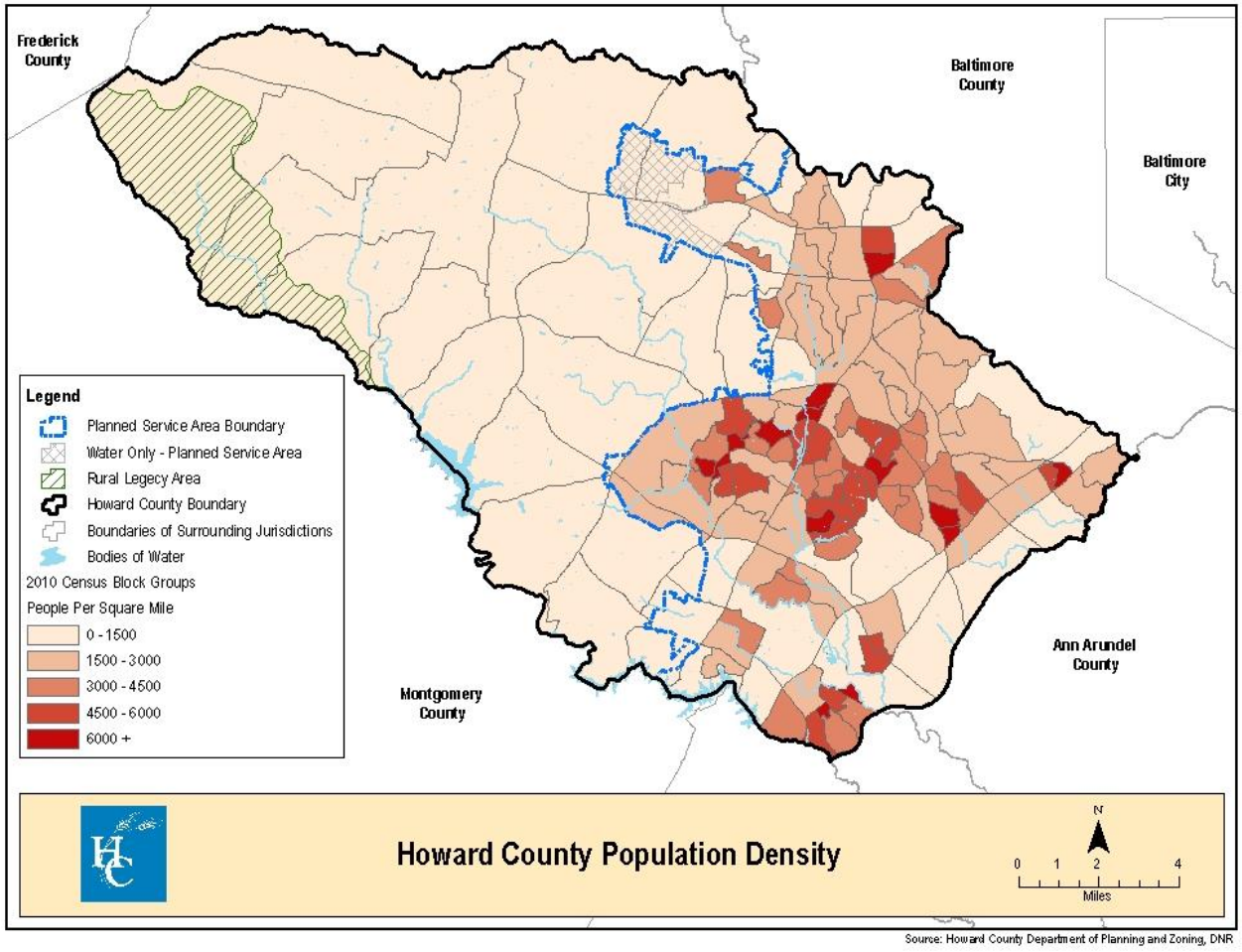


3.3.6 Growth and Development

The County-wide population density average is roughly 1,135 persons per square mile. The eastern portion of the County, inside the Planned Service Area, has a population density of roughly 2,298 persons per square mile. The population density decreases rapidly once outside the Planned Service Area.

As clearly shown in Map 3.3.6-1, population density reflects the residential land use and the Planned Service Area, with the eastern part of the County being more densely populated.

Map 3.3.6-1
Population Density



The U.S. Census Bureau estimates the region's population growth has steadily increased in the last ten years, with a 13.7% increase between 2000 and 2010. The region is projected to continue to grow, but at a slightly slower rate. This increase in population also leads to an increase in development and buildings in the County.

Table 3.3.6-2 provides the total number of residential building permits in the County from 2006 to 2010.

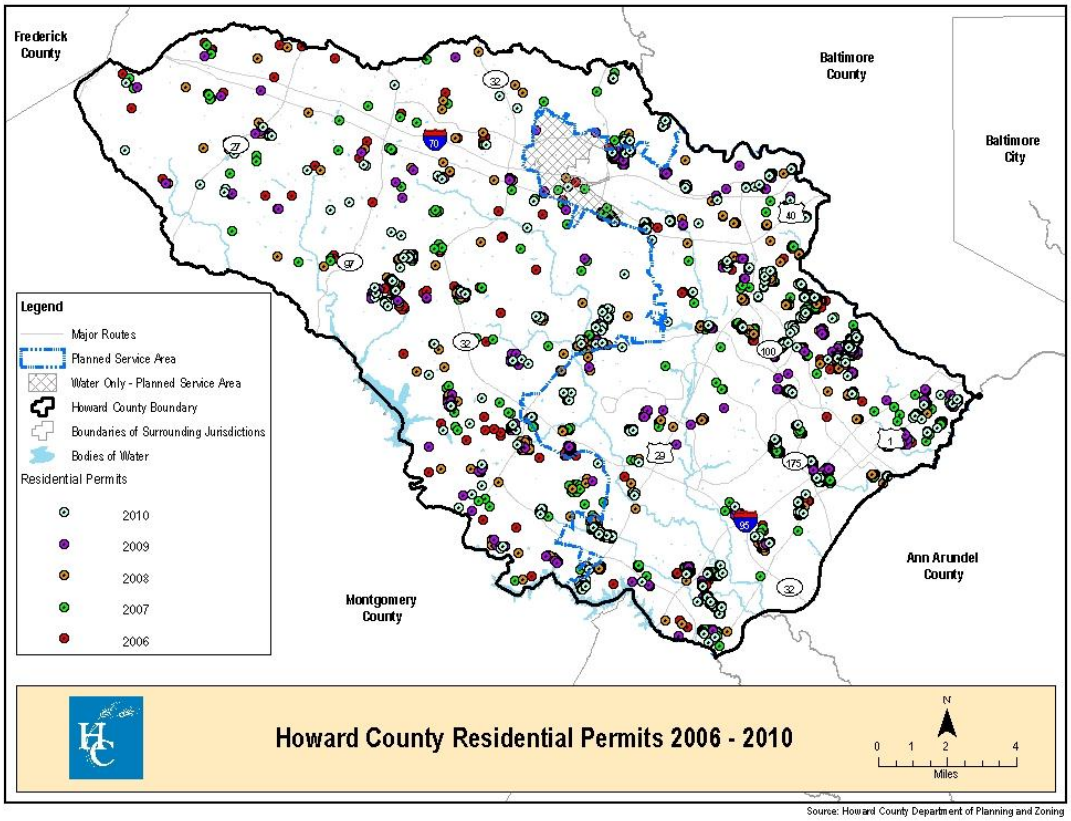
Table 3.3.6-2
Howard County: Residential Permits (2006-2010)
Source: Howard County Department of Planning and Zoning, Research Department

Permit Type	2006	2007	2008	2009	2010
Single Family Detached	354	453	405	306	460
Single Family Attached/Townhome	274	499	408	490	488
Apartment	2	13	25	18	5
Multi-Family	3	11	22	0	4
Total	**633**	**976**	**860**	**814**	**957**

Using requests for residential building permits as a metric, this new development has mostly occurred within the Planned Service Area. Between 2006 and 2010, there were 4241 residential building permits issued, with 86% of those permits located in the Planned Service Area (3654 out of 4241). As the Planned Service Area continues to reach capacity, the building of detached single family housing units is expected to decline and be replaced by the construction of more townhouses and apartment buildings. The County has anticipated this shift and has developed plans like the Route 1 Manual and the Downtown Columbia Plan to reflect this transformation.

Map 3.3.6-3 is a visual representation of Howard County's Residential Permits 2006 to 2010.

Map 3.3.6-3
Howard County Residential Permits 2006 – 2010



Howard County has experienced rapid employment growth over the last few decades, but this has slowed in recent years. Historically a manufacturing and agricultural County, Howard County has shifted to a diverse mix of retail, office, and industrial employers. There were 81,000 jobs in the County in 1990. Almost two decades later, the total number of jobs had increased to roughly 148,000 by 2008. That amounts to an increase of 67,000 jobs and an average of 3,700 jobs annually.[14] From 1998 to 2000, the County added over 6,000 jobs annually, with 7,310 jobs in 2000. Even despite the economic downturn, the County was still able to increase the number of jobs - 1,209 jobs were added in 2008. A recent estimate conducted by the Maryland Department of Planning (MDP) estimated that Howard County had a total of 159,760 jobs.[15]

According to a recent released MDP study, an additional 6,590 jobs are expected to be added by the year 2015 and 11,490 jobs by 2020. This brings the overall total to roughly 171,000 by 2020.

Table 3.3.6-4 lists the top ten employers in Howard County.

Table 3.3.6-4
Top 10 Employers in Howard County[16]
Source: Howard County Economic Development Authority

Rank	Name	Product or Services	No. of Employees
1	Howard County Public Schools	Public School System	4,500
2	Johns Hopkins University Applied Physics Laboratory	Engineering, Research and Development	4,400
3	Howard County Government	County Government	2,430
4	Verizon Wireless	Regional Headquarters and Customer Service and Operation Center	2,028
5	Lorien Health Systems	Corporate Headquarters – Healthcare Services	2,000
6	Giant Food, Inc.	Food Distribution and Retail Stores	1,950
7	Howard County General Hospital	Acute-care facility – healthcare services	1,720
8	U.S. Government	Federal Government	1,600
9	Northrop Grumman	Engineering Consulting	1,200
10	SAIC	Research, Engineering Information Systems, Technology Solutions	1,060

[14] Howard County Economic Development Authority's *Overview*, 2011, available at http://www.hceda.org/business.aspx?details=general.
[15] Maryland Department of Planning's *Projections 2010-2040*, 2011, available at http://planning.maryland.gov/msdc/S3_Projection.shtml.
[16] Howard County Economic Development Authority *Howard County's Major Employers: As of December 2009*, 2011, available at http://www.hceda.org/PDF/DB_MajorEmployersList_122009.pdf.

3.3.7 Transportation

The main mode of transportation for Howard County residents is the automobile. The County is bisected by Interstate 95, which serves as the Nation's main freeway on the East Coast. The 2010 Annual Average Daily Traffic numbers for the section of Interstate 95 that runs through Howard County ranges from 186,781 to 194,069.[17] Interstate 70 connects the northern portion of Howard County with the city of Frederick and Interstate 695, the Baltimore Beltway. US Route 1 and US Route 29 run parallel to Interstate 95. Whereas Route 1 runs to the east, Route 29 runs to the west. Both act as supplemental commuter routes to Baltimore and to the District of Columbia. Route 40, the Baltimore National Pike, connects northern Howard County with downtown Baltimore City. West of Ellicott City, Route 40 joins with Interstate 70 to link Howard County with Western Maryland. The State routes of 32 and 100 run east to west, connecting each of these major arteries with the Baltimore-Washington Parkway, another regional freeway between the District of Columbia and Baltimore.

Howard County offers a variety of public transit options. The local transit service, Howard Transit, provides residents with a fixed route bus service. The service provides eight fixed lines connecting major County locations, as well as the Baltimore-Washington International Thurgood Marshall Airport (BWI) in nearby Anne Arundel County. Howard Transit also offers specialized transit service, for individuals with disabilities and aged 60+ individuals.

There are ten Park and Ride lots located throughout the county. The Maryland Transit Administration (MTA) facilitates commuter buses to either Baltimore City or the District of Columbia. The MTA also provides a rail line for commuters in the area. The Maryland Area Regional Commuter (MARC) train has three stations (Dorsey, Savage, and Laurel Racetrack) on the Camden Line that connects Union Station in the District of Columbia to Camden Station in Baltimore.

Baltimore Washington International Thurgood Marshall Airport (BWI) is Maryland's primary airport and serves the Baltimore-Washington Metropolitan region. It is located several miles east of the Howard County border. Opened in 1957 as Friendship International Airport, BWI has expanded multiple times over its 50 years to become a leader among mid-size international airports.[18] Today, it provides access to national and international destinations and serves as a hub for two leading airlines, Southwest Airlines and AirTran.

3.3.8 Community Assets

The following statistics for law enforcement, fire departments, medical services, and schools are current as of publication of the updated 2012 NHMP. However, they are subject to change and will be updated appropriately.

- **Law Enforcement** – Howard County is served by the Howard County Police Department. The Police Department has two stations, Northern District (Headquarters) and Southern District. Also, the Maryland State Police – Waterloo Barrack is located in Howard County.

[17] Maryland Department of Transportation's State Highway Administration *Traffic Volume Maps by County*, 2010, available at http://www.marylandroads.com/Index.aspx?PageId=792.
[18] Maryland Aviation Administration, Baltimore/Washington International Airport's *BWI Timeline: BWI History at a Glance*, 2011, available at http://www.bwiairport.com/en/about-bwi/bwi-timeline/#1949.

- **Fire Departments** – Howard County is served by the Howard County Department of Fire and Rescue Services. The County maintains eleven fire stations throughout the County.

- **Medical Services** – Howard County has two hospitals - Howard County General Hospital (238 beds) and Sheppard Pratt Hospital (66 beds)[19,20] Howard County General is an acute-care medical center and a member of Johns Hopkins Medicine, while Sheppard Pratt Hospital is a psychiatric facility serving a range of patients. The County is also home to four nursing homes, eight assisted living, and sixty-nine group senior assisted-living institutions.

- **Schools** – Howard County has an extensive school system. There are a total of 72 public schools in the County. The public school system consists of 40 elementary schools, 19 middle schools and 13 high schools. Additionally, there are 22 private schools located in the County, ranging from pre-school to high school levels.

- **Colleges and Universities** – Howard County Community College is the main higher education institution fully located within the County. The college has roughly 9,500 enrolled students, 79% of its student body is compromised of Howard County residents.[21] Also in Howard County is the Tai Sophia Institute, which offers graduate level programs in wellness-based education, clinical care, research, and public policy.[22] John Hopkins University, Loyola College, the University of Maryland, and the University of Phoenix all offer satellite educational opportunities. Additionally, there are a number of colleges and universities in close proximity to Howard County.

- **Parks and Recreation** – As of 2005, the Howard County Department of Recreation and Parks (DRP) offers 40 parks covering over 3,000 acres, including the Robinson Nature Center opening in September 2011.[23] In addition, DRP manages 266 natural resource areas, 9 historic/cultural sites and over 4,700 acres of open space. The Maryland Department of Natural Resources manages two State parks and a wildlife management area in the County, totaling over 9,700 acres.[24]

- **Critical Facilities** – The list of County critical facilities and infrastructures were re-evaluated and updated. The HCPD and OEM identified 32 facilities/infrastructures that are considered the most critical to County Government. Planners and engineers evaluated a subset of these facilities as part of the vulnerability assessment process used in the updated NHMP.

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[19] John Hopkins Medicine, Howard County General Hospital *About Use*. 2008, available at http://www.hcgh.org/content/AboutUs.htm.

[20] Sheppard Pratt Health System. (2003). *Sheppard Pratt at Ellicott City*. Retrieved from http://www.sheppardpratt.org/sp_htmlcode/sp_locations/sp_loc_hc_ellicot.aspx.

[21] Howard County Community College. (2011). *About HCC: HCC at a Glance*. Campus Profile. Retrieved from http://www.howardcc.edu/about_hcc/campus_profile/hcc_at_a_glance.html.

[22] Tai Sophia Institute. (2011). *About Tai Sophia*. Retrieved from http://www.tai.edu/.

[23] See Howard County Department of Parks and Recreation. (2005). *The 2005 Howard County Land Preservation, Recreation, and Park Plan*. Retrieved from http://www.co.ho.md.us/RAP/rap_compplan.htm.

[24] Id.

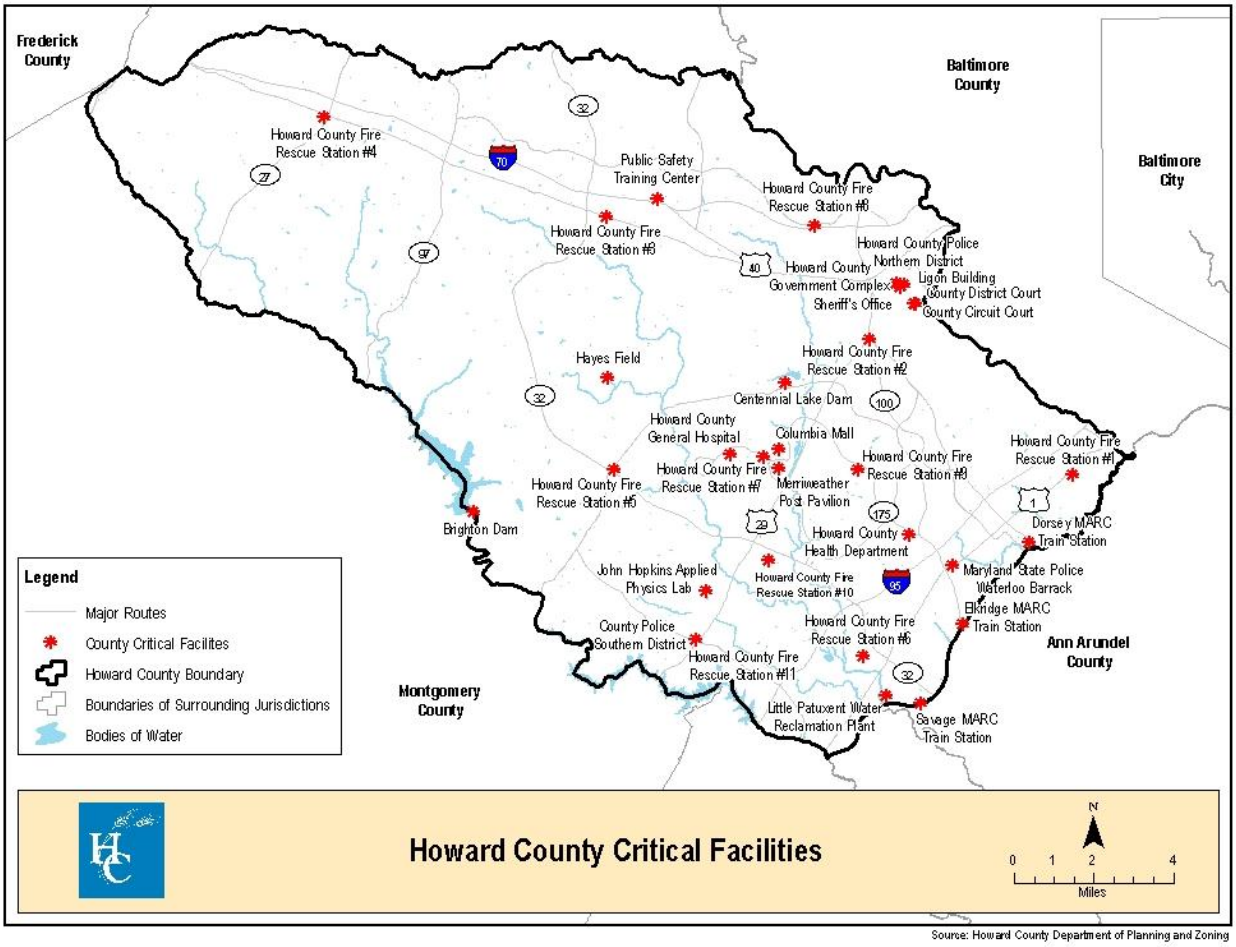
Table 3.3.8-1 contains information regarding the County's most critical facilities/infrastructures.

Table 3.3.8-1
Howard County – Critical Facilities/Infrastructures
Source: Howard County Office of Emergency Management

Building Name	General Function	Street Address
Howard County Fire & Rescue Station #1	Emergency Services	6275 Old Washington Road
Howard County Fire & Rescue Station #2	Emergency Services	4150 Montgomery Road
Howard County Fire & Rescue Station #3	Emergency Services	12460 Frederick Road
Howard County Fire & Rescue Station #4	Emergency Services	1330 Woodbine Road
Howard County Fire & Rescue Station #5	Emergency Services	5000 Signal Bell Lane
Howard County Fire & Rescue Station #6	Emergency Services	8925 Lincoln Street
Howard County Fire & Rescue Station #7	Emergency Services	5815 Banneker Road
Howard County Fire & Rescue Station #8	Emergency Services	9601 Old Frederick Road
Howard County Fire & Rescue Station #9	Emergency Services	5950 Tamar Drive
Howard County Fire & Rescue Station #10	Emergency Services	10155 Old Columbia Road
Howard County Fire & Rescue Station #11	Emergency Services	11226 Scaggsville Road
Ligon Building, OEM, 911 Call Center	Emergency Services	3450 Courthouse Drive
Sheriff's Office Howard County	Emergency Services	8360 Court Avenue
Howard County Police - Northern District	Emergency Services	3410 Courthouse Drive
Howard County Police - Southern District	Emergency Services	11226 Scaggsville Road
Maryland State Police Waterloo Barrack	Emergency Services	7777 Washington Boulevard
Howard County Health Department	Public Health and Healthcare	7178 Columbia Gateway Drive
Howard County General Hospital	Public Health and Healthcare	5755 Cedar Lane
Brighton Dam	Dam	Brighton Dam Road
Centennial Lake Dam	Dam	Centennial Park - East
Little Patuxent Water Reclamation Plant	Water Treatment	8900 Greenwood Place
Jessup MARC Train Station	Transportation	8 Old Jessup Road
Dorsey MARC Train Station	Transportation	7000 Route 100
Savage MARC Train Station	Transportation	9009 Dorsey Run Road
Howard County Government Complex	Government	3430 Courthouse Drive
Howard County District Court	Government	3451 Courthouse Drive
Howard County Circuit Court	Government	8360 Court Avenue
Public Safety Training Center	Government	2200 Scott Wheeler Drive
John Hopkins Applied Physics Lab	Research Facility	11100 Johns Hopkins Road
Haysfield	Airport	4994 Sheppard Lane
Merriweather Post Pavilion	Commercial Facility	10475 Little Patuxent Parkway
Columbia Mall	Commercial Facility	10300 Little Patuxent Parkway

Map 3.3.8-2 is a visual representation of the County's most critical facilities/infrasturctures.

Map 3.3.8-2
Howard County Critical Facilities



3.4 The Maryland State Hazards Mitigation Plan

The State of Maryland is also required to conduct a State Hazard Mitigation Plan in accordance with Federal regulation. To comply with the Disaster Mitigation act of 2000, the Maryland State Hazard Mitigation Plan (MSHMP) was completed in 2005, updated in 2008, and updated again to 2011.[25] Even though an update to the plan is required every three years, a State has the option to revise the plan prior to the three year deadline if certain conditions occur, such as the declaration of a disaster within a State. At that point, a State can review its plan and determine if an update is appropriate under the circumstances.

[25] Disaster Mitigation Act of 2000, Pub. L. No. 106-309, 114 Stat. 1552 (2000) (current version at 42 U.S.C. § 5121 et seq. (2010)).

For the updated 2011 MSHMP, MEMA's developed an over-arching mitigation goal, namely "to protect life, property, and the environment from hazard events."[26] To support this goal, the State is committed to the following actions:

- Increased public awareness of hazard events, mitigation and preparedness;
- Enhanced coordination with jurisdictions to develop a relationship at the State and local level; and,
- Efficient use of State resources. [27]

During the update process, MEMA also updated its mitigation objectives, which are listed below:

- Provide State guidance and technical assistance to enhance mitigation planning and project efforts by public and private stakeholders;
- Enable MEMA to encourage each Maryland County or Municipality to secure funding and initiate critical facility mitigation by obtaining Hazard Mitigation Assistance (HMA) sub-grants;
- Support Unified HMA grant programs that acquire and demolish hazard prone structures or elevate, retrofit, and relocate existing structures and facilities (including non-residential structures) in vulnerable locations with a priority on repetitive loss and severe repetitive loss structures;
- Develop a comprehensive mitigation and preparedness program to educate private and public stakeholders, academia, government employees, and elected officials on the hazards pertinent to the State;
- Identify both State and local statutory, regulatory or policy-based initiatives that support Maryland mitigation planning actions and leverage support for their inclusion in upcoming updates (i.e. building code regulations);
- Promote, identify, and undertake three infrastructure mitigation projects to improve the State's resiliency to potential hazards; and,
- Integrate the mitigation planning process, including the hazard vulnerability assessment, into related local and State plans (i.e. environmental plans, land use plans, comprehensive plans, mitigation plans).

The development of the updated MSHMP required a partnership between State agencies, private entities, committees, groups, and individuals. The Maryland Mitigation Advisory Committee (MAC) was established to facilitate this partnership. Chaired by the State Hazard Mitigation Officer (SHMO), this committee provides policy guidelines and assesses mitigation project requests for funding purposes. The agencies on the committee include:

- Maryland Emergency Management Agency
- Maryland Department of the Environment
- Maryland Department of Housing and Community Development
- Maryland Department of Natural Resources
- Maryland Department of Planning
- Maryland Insurance Administration

[26] Maryland Emergency Management Agency, *2011 Maryland State Hazard Mitigation Plan update*, ES-xiii (August 26, 2011), available at http://www.mema.state.md.us/MEMA/content/pdf/programs/mitigation/MD_HMP_Update_Complete-Public_Copy.pdf [hereinafter as *MSHMP*]. ,

[27] Id.

- Maryland Department of General Services
- Maryland Department of Transportation
- Maryland State Treasurer's Office
- Maryland Department of Human Resources
- Maryland Economic and Community Development
- Maryland Emergency Management Agency – Local Representative

Brief summaries of these primary agencies are provided in the State's plan.[28] The partnership with these agencies has led to a coordinated effort in the implementation of the State's mitigation goals, objectives, policies, and projects.

Previously, the plan's mitigation actions were sub-divided by hazards. For this update, the MAC chose to divide the mitigation actions based on the following five actions:

- Policy, Planning, Programs and Funding
- Mitigation of High Hazard Structures
- 2011 Vulnerability Assessment
- Local Planning Interface
- Education and Outreach

Based on the plan's mitigation goal and the MSHMP risk assessment, 108 mitigation actions were developed for a number of natural hazards.[29] For a comprehensive list of mitigation actions, please see Table 4-3 of the MSHMP.[30] The MSHMP also included measures to support local mitigation efforts, a hazard analysis, and an evaluation of mitigation measures.

Some of the most significant high/medium priority mitigation actions are listed below:

Policy, Planning, Programs and Funding

The MAC reviewed the previous plan's policy, programs, planning and funding mitigation strategies, many of which are also incorporated into this new update. In all, 20 mitigation actions are identified which serve to advance State agencies and local jurisdictions' ability to implement their own mitigation actions.

State mitigation strategies include:

- Ensure that local flood damage prevention regulations are up-to-date and consistently enforced.
- Develop statewide strategy to provide funding and technical assistance to local jurisdictions for mitigation planning and project development.
- Work with State commercial insurance carriers to provide recommendations on preventative loss measures.
- Identify utilities and other facilities that could contaminate the Potomac River and other major drinking water sources Statewide if impacted by disaster (i.e. chemical spill due to flood). Work with them to ensure appropriate risk reduction measures are in place.

[28] Id. at 21-23.
[29] Id.
[30] Id. at 304 – 322.

- Review how information is shared statewide (between MEMA and jurisdictions) during an incident or event, and implement corrective actions.
- Ensure the State is taking full advantage of Risk MAP and obtain full participation by all Counties.
- Prioritize HMA funding for mitigation of repetitive loss properties and severe repetitive loss properties.
- Require, through policy, that new State capital improvement projects incorporate hazard mitigation principles (e.g., prohibit new projects in hazard-prone areas such as floodplains or the coastal high hazard area; requiring above code design requirements for critical facilities).
- Maintain and implement the State of Maryland Drought Monitoring and Response Plan, which outlines the methods and steps the State will take to monitor and respond to drought conditions when they occur.
- Utilize the State Mitigation Advisory Committee and add local plan information affecting the State to quarterly agendas. Review regional trends and/or region specific mitigation strategies for inclusion into the *2011 Maryland State Hazard Mitigation Plan Update*.

Mitigation of High Hazard Structures

This particular group consists of State agencies, local representatives, and other stakeholders. The group collectively reviewed the status of various code-related and structure-related mitigation actions from the 2008 plan, as well as identified and developed 30 new items. These statewide and local actions involve mostly retrofitting buildings and improving current infrastructures to promote life and safety of Maryland citizens.

State mitigation strategies include:

- Investigate increasing the minimum wind standard in the Statewide Building Code for critical facilities.
- The Department of Housing and Community Development will provide continued support to ensure that local building codes are up to date and consistently enforced.
- Incorporate climate change and coastal hazard considerations into building codes for coastal communities (e.g. freeboard, septic sitting).
- Incorporate hazard and risk analysis into databases of publicly owned structures.
- Identify flood protection techniques for flood-prone wastewater treatment plants.
- Install traffic maintenance and evacuation message signing along flood-prone highways and investigate evacuation and detour messaging in flood-prone areas throughout the State.
- Identify mitigation measures for nuclear power plant.
- Develop and implement a plan to improve pump stations susceptible to damage in flood-prone areas.
- Identify flood-prone roads and replace/mitigate undersized and clogged culverts.
- Install trash racks upstream of critical bridges to preserve structures.
- Re-profile and reconstruct roads in low-lying areas that are prone to flooding.
- Support the construction of tornado safe rooms in critical facilities, public schools or individual residences.
- Assess all police and fire facilities, designated shelters, and other State structures statewide for current and potential use as safe rooms.

- Develop shelter-in-place plans/provisions for public facilities.
- Identify and mitigate sinkholes. Evaluate drainage in the area to prevent development of new sinkholes.
- Improve stormwater management throughout the state.
- Examining the FEMA-MEMA repetitive loss and severe repetitive loss data sets to seek candidate properties that could potentially be mitigated through the FEMA National Flood Insurance Plan (NFIP) Repetitive Flood Claim (RFC), Severe Repetitive Loss (SRL), other HMA funding programs or any other available funding sources on an annual basis. Prioritize jurisdictions that will receive planning and project grants through HMA programs to those jurisdictions with SRL and RL properties.

2011 Vulnerability Assessment

This subcommittee focused on the 2014 vulnerability assessment and provided insights on how to expand the assessment to include hazard mitigation principles and goals. The group identified eight high-priority items and three medium-priority items for inclusion in the 2011 MSHMP.

State mitigation strategies include:

- Define "critical facility" for 2014 plan update.
- Further develop, centralize, and maintain a critical facility database.
- Inventory hazard risks to State owned facilities and identify their risks to hazards including climate change-related (sea level rise, coastal and riverine stream erosion, and increased flooding) hazards.
- In coordination with the Maryland State GIS Council (MSGIC) and local jurisdictions, organize and convene a 2014 Vulnerability Assessment working group to discuss the review/refinement of the 2011 HIRA.
- Develop tools, data templates, etc., to assist the jurisdictions in developing rating systems for vulnerability assessments and to ensure consistency across the state.
- Expand hazard profiles and mapping analysis for the 2011 hazards that are text-analysis only, in the 2014 vulnerability assessment (VA).
- Determine feasibility of adding human-caused hazards into the 2014 VA (i.e. nuclear, terrorism, utilities).
- Determine feasibility of adding human-health and safety risks in conjunction with other hazard occurrences (i.e. vector-borne illnesses, pandemic outbreaks, water contamination) in the 2014 VA.
- Maintain access to the Data Exchange System NFIP database of repetitive loss properties through continued relationships with Department of Environmental Protection's State NFIP Coordinator's office.
- Continue to pursue and develop clean data sets. Improve existing geo-coding by researching matches for properties with incomplete addresses and out of date addresses based on rural road designations that have changed.
- Align Maryland RL property data and SRL property data with validated FEMA NFIP RL and SRL property data, annually.
- Align Greatest Savings to the Fund (GSTF) data and the new 2011 methodology to inventory and further demonstrate the cost effectiveness of potential RL and SRL mitigation projects. Evaluate

projects further for environmental soundness and technical feasibility to create successful HMA grant sub-applications.
- Update listing of completed RL and SRL mitigated properties and FEMA's RL database with Maryland's mitigated properties database annually. Update of the merged database can also occur at HMA grant close-out or whenever improved local data becomes available.
- Complete FEMA Form AW-501s for each mitigated property. Provide to FEMA through current FEMA databases or submittal to the region upon project close-out and archive at MEMA.
- MEMA will provide State direction to ensure that local jurisdictional plans must address the mitigation of RL and SRL structures in the mitigation strategies section of every local jurisdiction §322 plan with RL and SRL properties.

Local Planning Interface

The Local Planning Interface subcommittee consisted of State, County, and Municipal level of government officials. They are tasked with the question of how to better facilitate communication and interaction between the various entities during their own hazard mitigation plan development process. In addition to previously developed mitigation actions, the group also thought of six new actions to incorporate into the plan. These six inter-related actions establish guiding principles for the dissemination of hazard mitigation plan developments for both the State and local jurisdictions through Maryland.

State mitigation strategies include:
- Coordinate the distribution of mitigation related data produced by State agencies to local government entities and other State agencies. This data will include, but not be limited to, the State of Maryland Hazard Mitigation Plan, and the Maryland Hazard Analysis and Risk Assessment. These materials are important for both mitigation and other planning purposes. MEMA will also conduct training seminars for data recipients.
- Ensure State HIRA data is provided to local government. Expand distribution to include Planning Departments, Public Works, and Emergency Services. Provide technical assistance as necessary.
- Request that local governments advise MEMA when mitigation project locations are impacted by hazard events. Follow-up with regular contacts to ensure that information is consistently provided. Implement mechanisms and standards by which local mitigation related information may be shared with the State and stored.
- Provide technical assistance to local government with the administration and enforcement of building codes.
- Ensure that local hazard data is analyzed and incorporated into State data sets, specifically HIRA.
- Create and implement a more structured training program targeting smaller jurisdictions to provide hazard mitigation information strategies, resources, and methodologies using a regional approach incorporating seminars, webinars, and/or other communication methods.

Education and Outreach

This group is comprised of 14 participants from various State and local agencies. After the group reviewed the previous plan's hazard mitigation actions, they incorporated four new actions into the new updated plan. At the end of the plan development process, the Education and Outreach group submitted a total of 29 mitigation action items for the plan.

State mitigation strategies include:

- Continue to sponsor and host the Annual Severe Storms Conference before the start of hurricane season.
- Develop and execute Public Service Announcements.
- Provide factsheets and informational brochures on personal preparedness and hazards to the public.
- Prepare and provide an Emergency Preparedness course to State employees to ensure safety of socially vulnerable individuals in State care.
- Develop preparedness tips through Twitter/Facebook/text messaging/email and work with State agencies to incorporate.
- Provide list of hazard mitigation best practices to provide guidance and motivate local governments to reduce hazard impacts through mitigation.
- Develop public presentations to government leaders and legislators on the importance of emergency preparedness and hazards that the State faces.
- Maintain media advisory template based on risk.
- Offer a variety of emergency management training opportunities for State and local employees. Investigate emergency public broadcast protocol on telecommunication networks for notification of impending disaster
- Continue Coast Smart Program and expand outside of Coastal Region. Reach out to emergency management and planning personnel.
- Reach out to civic organizations to become partners on emergency preparedness outreach programs.
- Investigate establishing training for developing multi-lingual emergency management representatives.
- Investigate improving communication between State agencies' mitigation programs and activities.
- Enhance outreach to at-risk neighborhoods and new populations at-risk due natural hazards including climate change.
- Leverage relationships with universities/scientists to educate through Cooperative Extension on hazards and climate change.
- Develop and conduct education efforts that are targeted to RL property owners increase knowledge and awareness of mitigation grants by conducting various outreach activities.
- Promote mitigation of RL and SRL properties at regional meetings hosted by MEMA Regional Administrators attended by county and municipal emergency managers.

Section 4
Approval and Adoption

Contents of this Section

4.1 IFR Requirement for Approval and Adoption

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

4.2 Authority

Authority for both the original Natural Hazards Mitigation Plan (NHMP) and its update is derived from the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act)[1] The act was later amended by the Disaster Mitigation Act of 2000[2] (DMA2K), which added Section 322: "Mitigation Planning" to the Stafford Act. This new section placed a new emphasis on local mitigation planning. As a result, the Stafford Act now requires state and local governments to develop and submit mitigation plans as a condition to receive Hazard Mitigation Grant Program (HMGP) project grants.

An Interim Final Rule (IFR) for implementing Section 322 was published in the Federal Register on February 26, 2002. The IFR requires plans to meet a specified criterion as established by the Federal Emergency Management Agency (FEMA).[3] The requirements for local plans, or local mitigation plan criteria, are found in part 201.6.[4]

In addition to the hazard mitigation planning requirement, DMA2K also requires communities to utilize a specific planning process to develop an all-hazards approach to mitigation planning. This planning process involves four steps, namely: organize resources, assess risk, develop a mitigation plan, and implement plan and monitor progress. This specific planning process ensures a jurisdiction can effectively address the needs as required under DMA2K. This law also requires adoption by the local governing body and specifies a stringent review process, by which the State Mitigation Officer (SHMO) and the FEMA Regional Offices will review, evaluate, and approve hazard mitigation plans.

The NHMP was also prepared pursuant to the Flood Mitigation Assistance Program[5], the Hazard Mitigation and Pre-Disaster Mitigation Programs[6] and the process outlined in materials prepared by the FEMA for the National Flood Insurance Program's Community Rating System[7].

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[1] Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, Pub. L. No. 93-288, 88 Stat. 143 (codified as amended at 42 U.S.C. § 5121 et seq. (2010)).
[2] Disaster Mitigation Act of 2000, Pub. L. No. 106-309, 114 Stat. 1552 (2000) (current version at 42 U.S.C. § 5121 et seq. (2010)).
[3] 44 C.F.R. §§ 210, 206 (2010).
[4] Id. at § 201.6.
[5] Id. at § 78.6.

4.3 Approval and Adoption Procedure

On October 4, 2004, the County Council adopted and approved Howard County's first NHMP (Resolution No. 112-2004). After the resolution was adopted, the NHMP was submitted to the Maryland Emergency Management Agency (MEMA) SHMO for review in October 2004. After approval by the State, the NHMP was reviewed and approved by the FEMA Region III in November 2004.

Throughout the 2012 NHMP update process, the Natural Hazard Mitigation Plan Update Steering Committee (NHMPUSC), stakeholders, and general public had several opportunities to provide comments and feedback. See Section 5, *Planning Process* for details about the NHMP update process.

On August 13, 2012, Howard County submitted the initial draft of the NHMP update to the SHMO for review and comment. After addressing the SHMO's comments, the NHMP was resubmitted for final consideration and approval by the SHMO and FEMA Region III. After reviewing the plan, FEMA Region III provided a letter of approvability on [insert date]. FEMA's letter of approvability can be found in Appendix I. After FEMA's letter of approvability was received by Howard County, the updated HMP was presented to the County Council for adoption. The NHMP was formally adopted on [insert date]. The adoption resolution for the 2012 NHMP update is provided in Appendix J. Following the County Council's adoption, the plan was resubmitted to FEMA Region III for final approval, which occurred on [insert date]. FEMA's approval letter of the 2012 NHMP update is located in Appendix K.

4.4 Adoption Resolution

The Howard County Council adopted the original plan on October 4, 2004. The resolution is located in Appendix B of the original NHMP. Howard County formally adopted the updated version of the NHMP on [insert date].

[6] FED. EMERGENCY MGMT. AGENCY (FEMA), HAZARD MITIGATION ASSISTANCE UNIFIED GUIDANCE: HAZARD MITIGATION GRANT PROGRAM, PRE-DISASTER MITIGATION PROGRAM, FLOOD MITIGATION ASSISTANCE PROGRAM, REPETITIVE FLOOD CLAIMS PROGRAM, SEVERE REPETITIVE LOSS PROGRAM (2010).

[7] FEMA, *Community Rating System*, http://www.fema.gov/business/nfip/crs.shtm (last updated May 16, 2011).

Section 5
Planning Process

Contents of this Section

5.1 IFR Requirements for the Planning Process

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

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighbouring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

IFR §201.6(c)(1): *[The risk assessment shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

5.2 What is Hazard Mitigation?

The Federal Emergency Management Agency (FEMA) defines hazard mitigation as a sustained action taken to eliminate or reduce long-term risk to people and their property from various hazards. A hazard mitigation plan serves as a road map for a community's long-term strategy to reduce disaster losses and break the cycle of repeated destruction from natural disasters. The planning process used to develop hazard mitigation plans involves risk-based decision-making to reduce damage to people, property, and infrastructure from future disasters.

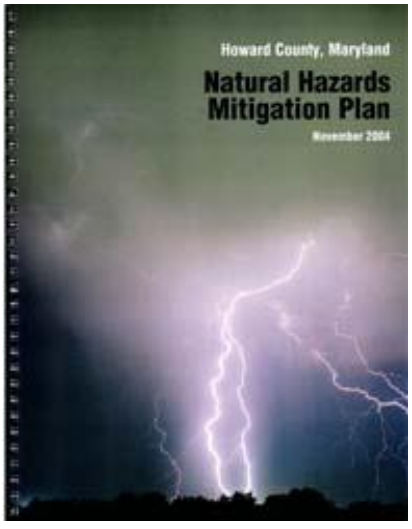
Figure 5.2-1
Lightning Storm in Howard County
(Credit: Baltimore Sun, April 2011)

5.3 Natural Hazards Mitigation Plan Update Process

Local governments are required to develop and update their hazard mitigation plan in order to remain eligible for certain types of non-emergency disaster assistance from FEMA, including mitigation funding.

Howard County developed their first Natural Hazards Mitigation Plan (NHMP) in 2004. The 2004 plan has been evaluated and updated as part of the five-year update cycle and in order to maintain eligibility for mitigation funds.

Figure 5.3-1
Cover of Howard County's 2004 Natural Hazards Mitigation Plan



The 2011 NHMP Update was undertaken by Howard County's Office of Emergency Management (OEM) in association with two local subject-matter experts from Vissering Pardue and Associates, and Vision Planning and Consulting. The update was developed between November 2010 and May 2012.

While the 2011 NHMP update includes the standard sections required for hazard mitigation plans, it also includes the following:

- Re-evaluation of 2004 NHMP's hazard profiles, risk assessment, mitigation goals, actions and priorities;
- Improved stakeholder coordination between county departments and involvement of outside agencies;
- Continued compliance with the National Flood Insurance Program;
- Integration of hazard mitigation principles with other planning processes (comprehensive plan, zoning ordinance, subdivision regulations, stormwater management plan, and recreation plan); and
- Incorporation of the County's Flood Mitigation Plan (FMP), which includes a detailed flood risk assessment and flood mitigation recommendations.

5.4 Planning Process

The Plan Update planning process comprised four main steps as mandated by FEMA, namely:

- Step 1: Organize Resources
- Step 2: Assess Risks
- Step 3: Develop a Mitigation Plan
- Step 4: Implement Plan and Monitor Progress

These four steps are addressed in-depth below in Sections 5.4.1 – 5.4.4.

5.4.1 Organize Resources

During the plan update process, a number of entities at the local, state, and federal levels were involved. Each of these groups was entrusted with specific responsibilities so that the outreach efforts were comprehensive and far-reaching.

- Natural Hazards Mitigation Planning Work Group (Planning Work Group) – plan preparation and facilitation of meetings;
- Natural Hazards Mitigation Plan Steering Committee (NHMPSC) – attendance at meetings, review of plan sections and draft plan;
- Stakeholders – involvement of the NHMP's update progress via emails and through the website;
- Public – plan input, and attendance at the Public Meeting;
- Maryland Emergency Management Agency (MEMA) – plan review and approval; and
- Federal Emergency Management Agency (FEMA) – project funding, plan review, and approval.

Natural Hazards Mitigation Planning Work Group (Planning Work Group): A Planning Work Group comprised of representatives from the OEM staff, the Department of Planning and Zoning, and the two

subject matter experts, worked diligently throughout the plan update process, drafted the NHMP update and facilitated meetings between all parties involved.

- Dan Cornwell - Office of Emergency Management
- Angelique So - Office of Emergency Management
- Colleen Clary - Office of Emergency Management
- Gregory Vernon - Department of Planning and Zoning
- Steve Pardue - Vissering Pardue and Associates
- Deepa Srinivasan - Vision Planning and Consulting

Natural Hazards Mitigation Plan Steering Committee (NHMPSC): The NHMPSC convened four times during the NHMP update process to review documents produced by the Planning Work Group, and provided comments and feedback. The NHMPSC comprised of representatives from the following County departments:

- Office of Emergency Management - Dan Cornwell
- Department of Fire and Rescue Services - BC Ed Shilling
- Howard County Police Department - Lt. Mike Price
- Department of Public Works - Kris Singleton
- Howard County Health Department - Sheila Palmiotto
- Department of Technology and Communication Services - Rob Slivinsky
- Department of Inspection, Licensing and Permits - Don Mock
- Department of Planning and Zoning - Brad Killian
- Department of Public Information Officer - Kevin Enright
- Department of Recreation and Parks - John Marshall and Dan McNamara
- Howard County Office of Risk Management - Nancy Gray

Four Natural Hazards Mitigation Plan Steering Committee meetings were held during the plan update process. The first meeting was held on November 8, 2010 at the Columbia Gateway Building. At this meeting, the various steps in the plan update process were discussed and the timeline for completion of the plan update was laid out. The meeting ended with a discussion on grant funds availability identified and the roles of the two local Subject Matter Experts in the plan update process.

Figure 5.4.1-1
Natural Hazards Mitigation Plan Steering Committee Meeting

The second Steering Committee meeting was held at the George Howard Building on March 8, 2011. At this meeting, the roles and responsibilities of the Committee members and Work Group participants were identified, hazards from the 2004 plan were examined and new hazard events that occurred since 2004 were documented. The 2004 plan was a topic of discussion in terms of its format and structure and elements that should be included or removed in the plan update were identified. A number of County departments attended this meeting.

Since the County's Department of Public Works comprises a number of Bureaus: Engineering, Environmental Services, Highways, Facilities and Utilities that are directly involved in mitigation activities, a separate Steering Committee meeting was held on May 26, 2010 to discuss mitigation actions and their role in the plan update process.

The third Steering Committee meeting was held on June 14, 2011 at the Columbia Gateway Building. At this meeting the Hazard Identification and Vulnerability Assessment sections were reviewed and the 2004 mitigation actions were examined. New actions were identified and prioritized and the plan integration strategy was discussed.

In August 2011, Howard County experienced an unprecedented number of different hazard events including an earthquake, flooding, and Tropical Storm Lee. These events gave rise to some additional issues so an additional and final Steering Committee was held on October 4, 2011 at the Ligon Building to review the mitigation actions in light of these hazard events. A number of mitigation actions were added as a result of these events. A final and follow up meeting was also held with the Public Works Department at the George Howard Building on December 22, 2011 to discuss the impact of the hazard events on the Department's proposed mitigation actions.

Copies of the agendas, sign-in sheets, and meeting minutes of all meetings are included in the Appendix.

Stakeholders: During the NHMP's development, stakeholders representing agencies that could be directly affected by the plan were invited to NHMPSC meetings and the Public Meeting. Their unique insight provided a better perspective on how to improve the NHMP plan update. The Stakeholders who were invited to participate in the planning process, as well as the organizations they represent, are listed below:

Organization	Representative and Contact information
All Department representatives on the Emergency Management Advisory Group (EMAG):	
• Chief Administrative Officer	Lonnie Robbins (lrobbins@howardcountymd.gov)
• Department of Fire and Rescue Services	Chief and OEM Director William Goddard (wgoddard@howardcountymd.gov)
• Howard County Police Department	Chief William McMahon (wmcmahon@howardcountymd.gov)
• Department of Public Works	Director Jim Irvin

• Howard County Health Department • Department of Recreation and Parks • Public Information Office • County Administration • Sheriff's Office • Department of Inspections, Licenses and Permits • Department of Technology and Communication Services • Department of Planning and Zoning • Department of Citizen Services	(jirvin@howardcountymd.gov) Health Officer Dr. Peter Beilenson (pbeilenson@howardcountymd.gov) Director John Byrd (jbyrd@howardcountymd.gov) Kevin Enright (kenright@howardcountymd.gov) Jessica Feldmark (jfeldmark@howardcountymd.gov) Sheriff James Fitzgerald (JFitzgerald@howardcountymd.gov) Director Bob Frances (bfrances@howardcountymd.gov) Director Ira Levy (ILevy@howardcountymd.gov) Director Marsha McLaughlin (mmclaughlin@howardcountymd.gov) Director Lois Mikkila (lmikkila@howardcountymd.gov)
All members of the Community Emergency Response Network (CERN)	Mary Lasky (Mary.Lasky@jhuapl.edu)
Academic/Educational and Research Institutions: • Howard County Public School System • Howard County Community College • University of Phoenix Maryland Campus • Johns Hopkins Applied Physics Laboratory	Ron Miller (Ronald_Miller@hcpss.org) Shelly Bilellow (mbilello@howardcc.edu) Alethea Watkins (alethea.watkins@phoenix.edu) Mary Lasky (Mary.Lasky@jhuapl.edu)
Howard County General Hospital	Ken Shaw (KShaw@hcgh.org)
Economic Development Authority	Laura Neuman (lneuman@howardcountymd.gov)
Office of Law	Cythnia Peltzman (CPeltzman@HowardCountyMD.gov)
Columbia Association	Sean Harbaugh (Sean.Harbaugh@ColumbiaAssociation.com)
Surrounding jurisdictions County Office's of	

Emergency Management	
• Baltimore	Director Mark Hubbard (Deputy Chief) Emergencymanagement@baltimorecountymd.gov
• Carroll	Director James Weed Jweed@ccg.carr.org
• Frederick	Director John E. (Jack) Markey Emergencymanagement@frederickcountymd.gov
• Anne Arundel	Director Eric Hodge (Captain) EmergencyManagement@aacounty.org
• Prince George's	Deputy Director Ron Gill regill@co.pg.md.us
• Montgomery	Director Chris Voss mchomelandsecurity@montgomerycountymd.gov

Appendix G contains the emails soliciting stakeholders' input. These emails informed the stakeholders of the NHMP process, and list the website address which outlined a draft copy of the NHMP (http://www.howardcountymd.gov/displayprimary.aspx?id=6442459634). The emails kindly request feedback and input from the stakeholders. Appendix G also contains an email response from CERN, indicating that the email has been disseminated to its members.

Public: A Public Meeting was held on June 28, 2011 at the Howard County Government Gateway Building in Columbia. The Planning Work Group provided the public with a broad overview of the planning process, as well as some highlights from the hazard identification and risk assessment sections. The public was also encouraged to provide input and feedback on the 2011 mitigation goals and objectives, as well as on new mitigation actions. The meeting was advertised in local newspapers to notify residents of the meeting. In addition to soliciting additional public and stakeholder input, the county posted information on the hazard mitigation process on its external website. The website included background information on the planning process, meeting details, and NHMP status updates. Citizens were also invited to provide feedback on the NHMP update via email. A copy of the agenda, sign-in sheet and PowerPoint slides are included in the Appendix.

Figure 5.4.1-2
Public Meeting Press Release

Howard County Hazard Mitigation Plan Update Public Meeting Press Release - June 17, 2011

Howard County Office of Emergency Management requests public participation in developing the County's Updated Natural Hazards Mitigation Plan

The Howard County Office of Emergency Management is in the process of updating the County's Natural Hazards Mitigation Plan, a long-term strategic plan designed to reduce or eliminate the loss of life and property due to natural disasters. Howard County and all local governments are required to periodically update their plans to be eligible for certain types of non-emergency disaster assistance from the Federal Emergency Management Agency (FEMA).

The Office of Emergency Management will be conducting a public meeting on Tuesday, June 28 at 6:00 PM, to brief the general public on the plan update, including the process, timeline, and the research conducted thus far. In addition, this meeting will also provide an opportunity for public commit on the plan. The location of the meeting will be at the Department of Fire & Rescue Services Headquarters, 6751 Columbia Gateway Drive, Room 401, in Columbia, MD.

If you plan on attending, please RSVP so that we can ensure we have enough handouts, seating and refreshments at oem@howardcountymd.gov or by contacting 410-313-5911. Comments may also be submitted by e-mail to oem@howardcountymd.gov. The Natural Hazard Mitigation Plan Update is expected to be complete by December 2011.

Point of Contact:
Dan Cornwell, Emergency Management Specialist II
Howard County Office of Emergency Management
410-313-5911 (work) dcornwell@howardcountymd.gov

Figure 5.4.1-3

Public Meeting Flyer

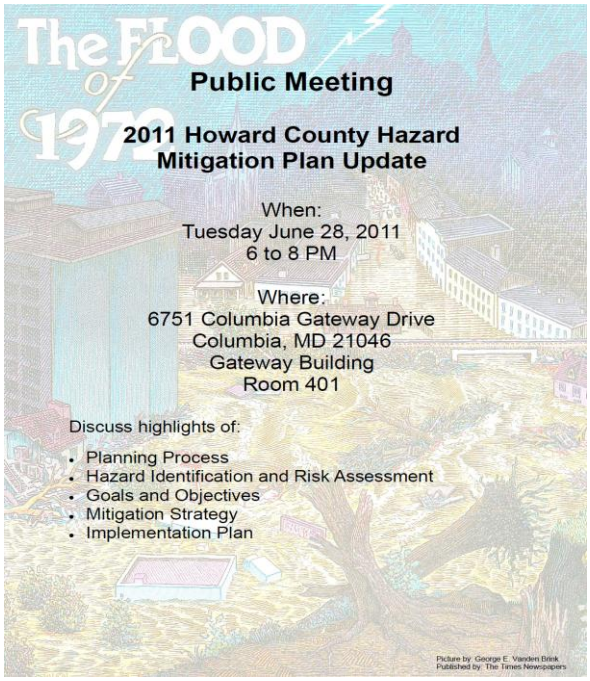


Figure 5.4.3-4
Public Meeting

5.4.2 Assess Risks

For this step, data on hazard events from the past six years was gathered and reviewed. This formed the basis for Section 6 (*Hazard Identification, Profiling and Ranking*) and Section 7 (*Risk Assessment*) of the 2011 NHMP. The hazard identification section summarized past occurrences and the probability of future events. The vulnerability analysis section included estimates of potential losses, types, and numbers of existing and future at-risk buildings, infrastructure, and critical facilities located in the identified hazard areas.

The NHMP update described also provided a general description of land uses and development trends in the County, so that mitigation options can be considered in future land use decisions. Section 9 (*Plan Integration*) included a thorough review and analysis of the current county plans and ordinances in light of hazard mitigation principles. This interdisciplinary approach will enable Howard County to incorporate hazard mitigation principles into various Howard County planning documents.

5.4.3 Develop a Mitigation Plan

The development of this mitigation plan is a collaborative effort by the NHM Planning Work Group and the NHMPSC. Prior to the development of the 2011 NHMP, the 2004 plan was examined and reviewed extensively. While certain parts of the 2004 plan were incorporated into the new NHMP, many new sections were added to conform to the new IFR guidance.[1]

Several actions were undertaken to protect the County from long-term vulnerability from identified hazards and to ensure community resiliency in the future. The NHM Planning Work Group reviewed the 2004 NHMP mitigation goals and departments were contacted in order to ascertain the status of these 92 mitigation actions. With the help from subject matter experts, departments were able to formulate new mitigation actions and projects to reduce the effects of hazards affecting the County.

The NHMP explored actions in the following six categories:

- Preventative – e.g., zoning, floodplain, stormwater, and other ordinances;
- Structural projects – e.g., levees, dams, reservoirs and channel improvements;
- Property protection – e.g., relocation, floodproofing, and insurance;
- Emergency services – e.g., warning systems, sandbagging, evacuation routes;
- Natural resource protection – e.g., wetlands protection, sediment erosion control, and other best management practices; and
- Public information – e.g., outreach projects, environmental education and technical assistance.

5.4.4 Implement Plan and Monitor Progress

Plan implementation is discussed in-depth in Section 10, *Plan Monitoring and Maintenance*. Section 8.5.1-1 describes how the identified mitigation actions would be prioritized, implemented, funded, and administered by the County. This step also included a description of the method and schedule for monitoring, evaluating, and developing the next plan update.

[1] See e.g. Section 9, *Plan Integration*.

MEMA and FEMA. Upon completion, the plan will be submitted to MEMA and FEMA for review and approval in January 2013. Once the NHMP received final approval from both agencies, the NHMP update will be formally adopted by the County Council in February 2013.

Section 6
Hazard Identification and Profiling

Contents of this Section

6.1 IFR Requirement for Hazard Identification and Profiling

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

6.2 Hazard Identification

As part of its efforts to support hazard mitigation initiatives, and in accordance with IFR requirements, the Natural Hazards Mitigation Planning Work Group (Planning Work Group) prepared this assessment of natural hazards that may potentially impact the County.

The 2011 Howard County Natural Hazards Mitigation Plan (NHMP) preserved sections of the original plan, while other sections were deleted or heavily edited. While much of the historical information on each hazard has been retained from the 2004 plan, several sections have been enhanced to accurately depict the conditions that have affected Howard County since the original plan's adoption in 2004. As a result, the list of hazards that were profiled in the 2004 plan has been slightly modified to reflect current conditions. Please refer to Section 6.4 for a detailed discussion on the development of the list of hazards for the 2011 NHMP.

The 2004 plan addressed the following seven hazards:

- Floods
- Hurricanes
- Earthquakes
- Heat & Drought
- Severe Winter Weather (Ice and Snow)
- Wildfires & Lightning
- Wind Events & Tornadoes

In this 2012 update, the NHMP now contains the following eight hazards:

- Floods
- Severe Winter Storms
- Wildfires
- Hurricanes & Tropical Cyclones
- Tornados & Wind Storms
- Lightning
- Earthquakes
- Drought & Extreme Heat

Each of the eight hazards identified has been broken into four sub-sections (as mandated by FEMA's Interim Final Rule):

- Description of the Hazard;
- Location of the Hazard;
- Severity and Extent of the Hazard; and,
- Impact of the Hazard on Life and Property.

This chapter provides an overview of past natural hazard events that occurred in Howard County and brief descriptions of the potential for future losses based upon these past experiences. Section 7, Vulnerability Assessment and Loss Mitigation, provides a more detailed analysis of past and potential future risks and subsequent expected losses based on the most significant hazards impacting Howard County.[1]

The term "planning area" is used frequently in this section. This term refers to the geographic limits of the County.

6.2.1 Overview of Howard County's Natural Hazards History

The NHMP uses best available data to describe, identify, and explain the potential severity and extent of impact by each hazard. While numerous government agencies maintain records regarding natural hazards losses[2], no single source provides a definitive account of losses due to natural hazards.[3] Even though the

[1] The methodology used to determine which hazards are subject to additional analysis in Section 7 can be found in Section 6.5, *Methodology for Identifying Natural Hazards for Additional Analysis*.

[2] Losses, in this context, could denote property losses, crop losses, injuries, and/or fatalities.

information may not all align, the NHMP relies heavily on data from the National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), the Federal Emergency Management Agency (FEMA), and the SHELDUS program[4,5], to formulate a comprehensive examination of natural hazards. Analyzing this data paints a comprehensive picture of the extent, severity, and impact a natural hazard event may have on the County.

According to the NOAA NCDC database, Howard County has experienced the following events between January 1969 and December 2011:

Type of Events	**Number of Events**
Severe Thunderstorms/Tropical storms/Lighting	124
Winter storms/Ice storms	99
Droughts/Extensive Heat	44
Floods/Flash Floods	56
Wind Event	32
Hail Storms	30
Extreme Cold/Freeze	16
Tornadoes	4 F0s, 3 F1s, and 2 F2s

The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988[6] (the Act) establishes a systematic way for a presidential declaration by the President to trigger financial and physical assistance for States and local jurisdictions. It is up to the President's discretion to issue either a Major Disaster Declaration[7] or an Emergency Declaration[8] during an emergency. As part of its documentation process, FEMA maintains records of these types of declarations, along with federal expenditure records, on its website.[9]

Since 1971, Howard County has received ten Major Disaster Declarations, which are summarized below in Table 6.2.1-1. Of the ten Major Disaster Declarations between 1971 and 2012, there were four snow events, two flooding/severe storms-related events, two hurricanes, and two tropical storms.

[3] Some other government agencies that provide information regarding hazards loss analysis include the U.S. Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS), which maintain records on hazard losses for on-going projects and studies.

[4] A county-level spatial hazards database for 18 different hazard events, it lists the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities for each hazard event.

[5] For more information, see SHELDUS, http://webra.cas.sc.edu/hvri/products/sheldus.aspx (last accessed February 28, 2012).

[6] See Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (Pub. L. No. 93-288, 88 Stat. 143 (codified as amended at 42 U.S.C. §§ 5232 et seq. (2010))) [*hereinafter* as Stafford Act].

[7] As defined by the Stafford Act, a Major Disaster is "any natural catastrophe …, which in the determination of the president causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby." Stafford Act, 42 U.S.C. § 5122.2.

[8] The Stafford Act defines an Emergency as "any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States." Stafford Act, 42 U.S.C. § 5122.1.

[9] For a comprehensive list of Maryland's disaster history, please see http://www.fema.gov/news/disasters_state.fema?id=24 (last accessed February 28, 2012).

Table 6.2.1-2 provides a summary of the Major Disaster Declarations for the County. These figures and events are discussed in more details in the hazard-specific subsections that follow.

Table 6.2.1-1
Major Presidential Disaster Declarations in Howard County (1971 to 2012)
(Sources: FEMA, NCDC database)

Date	Event Type	Event Description
FEMA DR-309 8/17/1971	Severe storms/flooding	On August 17, 1971, storms caused flooding to the Baltimore and Washington, DC metropolitan regions. Declarations was made for local jurisdictions from Harford County to Prince George's County for FEMA Public Assistance (Category B – Emergency Protective Measures).
FEMA DR-341 6/23/1972	Tropical Storm Agnes	Hurricane Agnes made landfall on the Florida Panhandle and traveled northwestward, bringing with it strong winds and heavy rains. The Patuxent, Little Patuxent and Patapsco Rivers all exceeded their 100-year flood levels. Eight people were killed and 700 families were left homeless.
FEMA DR-489 10/4/1975	Heavy rains/flooding	On October 4, 1975, heavy rains caused flooding. Fourteen counties were declared for FEMA Public Assistance (Category B - Emergency Protective Measures).
FEMA DR-1081 1/11/1996	Blizzard	A winter storm known as the "Blizzard of '96" crippled most of Maryland during the first weekend of January 1996. In general, snow totals were as follows: 20 inches in lower Southern Maryland, 20 to 26 inches in Central Maryland to include Howard County, and 26 to 36 inches over the northern tier.
FEMA DR-1324 4/10/2000	Winter storm	A low pressure system off of Cape Hatteras rapidly intensified on January 24, 2000. The storm soon developed into a nor'easter and began to track northward along the Eastern shoreline. On January 25th, the storm brought snowfall totals ranging from 1 inch to 20 inches across the state. The higher amounts of snow occurred around the Chesapeake Bay. A total of 11.5 inches of snow fell in Columbia, Maryland.

Date	Event Type	Event Description
FEMA DR-1492 9/19/2003	Hurricane Isabel	On September 18, 2003, Hurricane Isabel made landfall on the North Carolina coast. Isabel raced inland, bringing rain and wind. There was no major flooding caused by the storm. However, many trees were toppled from the wind combined with the saturated ground. At one point, over 50% of the County was without power. Five homes suffered major damage and another eight suffered minor damage.
FEMA DR-1875 2/19/2010	Winter storm	This was the first of two major blizzards that occurred during the 2009-2010 winter. On December 18, 2009, two low pressure systems merged to form a strong low pressure system over the Mid-Atlantic. The new low was able to gather moisture from the Gulf of Mexico and the Atlantic Ocean, while the high pressure system to the north kept the cold air in place. From December 18th to December 20, 2009, between 14 and 17 inches of snow fell across the County.
FEMA DR-1910 5/6/2010	Winter storms	DR-1910 was issued in response to the February 5th to February 11, 2010 blizzards. The first blizzard caused snow accumulations between 12 to 38.3 inches. The second blizzard added an average of 12 to 21.5 inches across the County. As the low pressure intensified, strong winds caused blowing and drifting snow that led to whiteout conditions. All Maryland counties, with the exception of Somerset and Worcester Counties, were declared for FEMA Public Assistance (Category B – Emergency Protective Measures).
FEMA DR – 4034 9/16/2011	Hurricane Irene	In Maryland, the hurricane left more than 700,000 people without power. Damages were estimated at approximately $16 million, with the most severe damages occurring in the Eastern and Southern portion of the state. A Presidential Disaster Declaration (FEMA-DR-4034) was declared for 13 of the 24 counties in Southern and Eastern Maryland. Also, all Maryland jurisdictions were eligible for Hazard Mitigation Grant Program.

Date	Event Type	Event Description
FEMA DR – 4038 10/05/2011	Remnants of Tropical Storm Lee	Following TS Lee, assessments show Howard County suffered approximately 2 million dollars' worth of damage. Main Street in Historic Ellicott City was severely flooded, where sixteen homes in the area sustained flood damage of various degrees. The Presidential Disaster Declaration (FEMA-DR-4038) was declared for the following counties: Anne Arundel, Baltimore County, Cecil County, Charles County, Harford County, Howard County, and Prince George's County.

Table 6.2.1-2
Emergency Declarations in Howard County (1993 to 2012)
(Sources: Public Entity Risk Institute (PERI) website, FEMA, NCDC database)

Date	Event Type	Event Description
FEMA EM-3100 3/16/1993	Winter storm	From March 13th to March 17, 1993, a snow storm hit the State of Maryland. All counties in Maryland were declared for FEMA Public Assistance (Category B – Emergency Protective Measures).
FEMA EM-3179 3/14/2003	Winter storm	From February 14th to February 18, 2003, a storm bought three waves of wintery precipitation. Snowfall totals ranged from 20 to 32 inches across Northern and Central Maryland and the Baltimore Metropolitan area. This was the heaviest snowfall event in the Baltimore region since records began in 1870 (the record will not be broken until the 2010 snowstorms).
FEMA EM-3251 9/13/2005	Hurricane Katrina Evacuation	Between August 29, 2005 and October 1, 2005, an Emergency was declared for the State of Maryland. This Emergency declaration provided federal aid to State and local response efforts to assist evacuees after Hurricane Katrina.
FEMA DR-3335 8/27/2011	Hurricane Irene	DR-3335 was issued as a response to Hurricane Irene making landfall on the East Coast, which brought tropical storm force winds and torrential rains to the region. While no individual assistance is available, almost all Maryland counties except Garrett County, were declared eligible for FEMA Public Assistance (Category B – Emergency Protective Measures).

6.2.2 Natural Hazard Related Deaths, Injuries and Property Damage

According to the NCDC database, Howard County has experienced 99 deaths and 617 injuries from natural hazards from 1950 to 2012. Property damage from these natural hazards is estimated at slightly more than $20.71 million. Crop damage during the same period is estimated to be roughly $95.74 million.[10]

6.3 Losses Due to Major Disasters

As discussed above, there is no definitive record that exists for all losses due to natural disasters in Howard County. In the United States, estimates for public and private costs of natural hazards range from $2 billion to over $6 billion per year. In most declared disasters, the federal government reimburses 75% of the cleanup and recovery costs, while the remaining 25% is covered by the state and affected local jurisdictions.[11]

As of 2012, Howard County had been part of twelve Presidential Disaster Declarations. The estimated damages for these disasters are summarized below in Table 6.3-1.

Table 6.3-1
Estimated Damages for Federally Declared Disasters
In Howard County, Maryland (1965 to 2010)
(Sources: PERI website, FEMA)[12]

FEMA Disaster	Event Date	Event Type	Total Damages
FEMA DR-127	3/12/1962	Severe storms/flooding	No information available
FEMA DR-309	8/17/1971	Severe storms/flooding	$14,925,339
FEMA DR-341	6/23/1972	Tropical Storm Agnes	$117,161,571
FEMA DR-489	10/4/1975	Heavy rains/flooding	$6,112,771
FEMA DR-1081	1/11/1996	Blizzard	No information available
FEMA DR-1324	4/10/2000	Winter storm	$16,744,243
FEMA DR-1492	9/19/2003	Hurricane Isabel	No information available

[10] These statistics are derived from the National Oceanic and Atmospheric Administration National Climatic Data Center – Storm Events [*hereinafter* as NOAA NCDC]. See NCDC Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).
[11] Stafford Act, 42 U.S.C. § 5170 (Cost sharing requirements for Major Disaster Assistance Programs) and § 5192 (Cost sharing requirements for Federal Emergency Assistance Programs).
[12] Although the database is still available, the PERI Presidential Disaster Declaration site (http://www.peripresdecusa.org/mainframe.htm) is no longer updated regularly. Data remains current until 2009 and all reported damages are in 2009 dollars. The rest of the information is derived from FEMA reports available in its database, http://www.fema.gov/news/disaster_totals_annual.fema.

FEMA Disaster	Event Date	Event Type	Total Damages
FEMA DR-1875	2/19/2005	Winter storm	No information available
FEMA DR-1910	2/5/2010 to 2/11/2010	Winter storms	$38,565,855[13]
FEMA DR-4034	9/16/2011	Hurricane Irene	$18,290,538[14]
FEMA DR-4038	10/05/2011	Remnants of Hurricane Irene	$25,302,710[15]

6.4 Overview of the Type and Location of Natural Hazards

The 2004 NHMP addressed the following seven hazards:

- Floods
- Hurricanes
- Earthquakes
- Heat and Drought
- Severe Winter Weather (Ice and Snow)
- Wildfires and Lightning
- Wind Events and Tornadoes

During the revision process, the Subject Matter Expert (SME) reviewed the 2004 list of hazards during a Planning Work Group meeting. The SME suggested separating "Lightning & Wildfires" into two different hazards since lightning and wildfires are two separate, distinct events. He also suggested several other potential hazards. Once the list was finalized, it was then approved by the Natural Hazard Mitigation Plan Steering Committee (NHMPSC) (see Appendix D for the Minutes). After several natural hazard events that occurred last summer (namely an earthquake in Mineral, Virginia in July, and Hurricane Irene and Tropical Storm Lee in August/September), a Fourth Steering Committee Meeting was convened to address and approve the hazards to be discussed in the 2011 NHMP prior to its adoption.

Based on these discussions, the natural hazards selected to be profiled as part of the 2012 Howard County NHMP update included the following:

- Floods
- Severe Winter Storms
- Wildfires
- Hurricanes and Tropical Cyclones/Storms
- Tornados and Wind Storms

[13] Figure only includes Public Assistance. See http://www.fema.gov/pdf/news/pda/1910.pdf.
[14] Includes both Individual Assistance and Public Assistance. See http://www.fema.gov/pdf/news/pda/4034.pdf.
[15] Includes both Individual Assistance and Public Assistance. See http://www.fema.gov/pdf/news/pda/4038.pdf.

- Lightning
- Earthquakes
- Drought and Extreme Heat

Each of the eight hazards identified has been broken into four sub-sections (as mandated by FEMA's Interim Final Rule):

- Description of the Hazard;
- Location of the Hazard;
- Severity and Extent of the Hazard; and,
- Impact of the Hazard on Life and Property.

Again, these sub-sections provide an overview of past natural hazard events that occurred in Howard County and brief descriptions of the potential for future losses based upon these past experiences. Section 7, Vulnerability Assessment and Loss Mitigation, will provide a more detailed analysis of past and potential future risks, as well as subsequent expected losses based on the most significant natural hazards that could impact the County.

In analyzing many of the following natural hazards, the future probability of its occurrence is broken down into high, medium or low probability. In Table 6.4-1, the chart breaks down the definition of high, medium, and low probability in terms of future probability of occurrence.

Table 6.4-1
Definition of High, Medium, and Low Probability of Occurrence

High	Event is likely to occur more than once every 5 years.
Medium	Event is likely to occur less than once every 5 years, but more often than once every 30 years.
Low	Event is likely occur less than once every 30 years.

6.4.1 Floods

Description of the Flood Hazard

In the United States, hundreds of floods occur each year, making them one of the most common and costly natural hazards.[16] FEMA defines floods as "a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property) from: overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source or mudflow."[17] It could also mean the "collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined

[16] Federal Interagency Floodplain Management Task Force, *Floodplain Management in the United States: An Assessment Report*, Volume 1, at 69 (1992).
[17] *FEMA: Definitions*, http://www.fema.gov/business/nfip/19def2.shtm#F (last accessed February 29, 2012).

above."[18] Flooding typically results from large-scale weather systems that generate prolonged rainfall. Other conditions such as winter snow thaws, over-saturated soil, ice jams that break apart, and urbanization can cause flooding. In Howard County, flooding can follow weather events, including, but not limited to: tropical cyclones (either hurricanes or tropical storms), thunderstorms (convectional and frontal), heavy rain events, winter storms, spring thaws or a combination of these events.

Flooding is a natural event for rivers and streams. Howard County can be impacted by several different types of floods:

- Riverine flooding
- Flash flooding
- Urban flooding

Past flood events in Howard County have shown that many of the streams in the County carry both riverine and flash flood threats. Riverine flooding occurs when rivers, creeks, streams, reservoirs or channels receive too much water, which leads to the excess flow of water over its banks and onto the adjacent floodplain.[19] This type of flooding is often referred to as "overbank" flooding.

Riverine flooding generally occurs over a period of days or weeks. The common nomenclature associated with riverine flooding and floodplains include terms such as the 100-year flood.[20]
Flash floods fall under the riverine flooding category and involve a rapid rise in water level, high water velocity, and large amounts of debris. These types of floods can cause significant damage, including the tearing out of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the amount and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding.

Urban flooding is caused by a combination of excessive rainfall or snow melt events that over saturate soils and clog drainage areas. The result of urban flooding is ponding or overland flooding. In ponding events, water temporarily accumulates in an area until normal drainage allows it to flow away. Overland floods, which are also known as sheet flooding, occur when intense rainfall simply runs across the ground. In extreme cases, overland floods can rise to depths of more than a foot at relatively high velocities.[21]

Location of the Flood Hazard

Howard County's two major rivers (and their tributaries) are often the origin of riverine flooding in the County. These rivers are the Patuxent, which borders Prince George's and Montgomery Counties to the southwest, and the Patapsco, which borders Carroll and Baltimore Counties to the north and northeast. Both rivers are tributaries to the Chesapeake Bay. In Howard County, the Patuxent River watershed includes the main Patuxent River and two branches, the Middle Patuxent and Little Patuxent.

[18] Id.
[19] A floodplain is a "land areas adjacent to rivers and streams that are subject to recurring inundation." See *Floodplain Definition and Flood Hazard Assessment*, http://www.srh.noaa.gov/mrx/hydro/flooddef.php (last accessed March 4, 2012).
[20] The 100-year flood is a flood which has a one percent chance of being equaled or exceeded in any given year.
[21] For additional information about floods, visit *NOAA's Flood Monitor,* http://www.noaawatch.gov/floods.php (last accessed February 29, 2012).

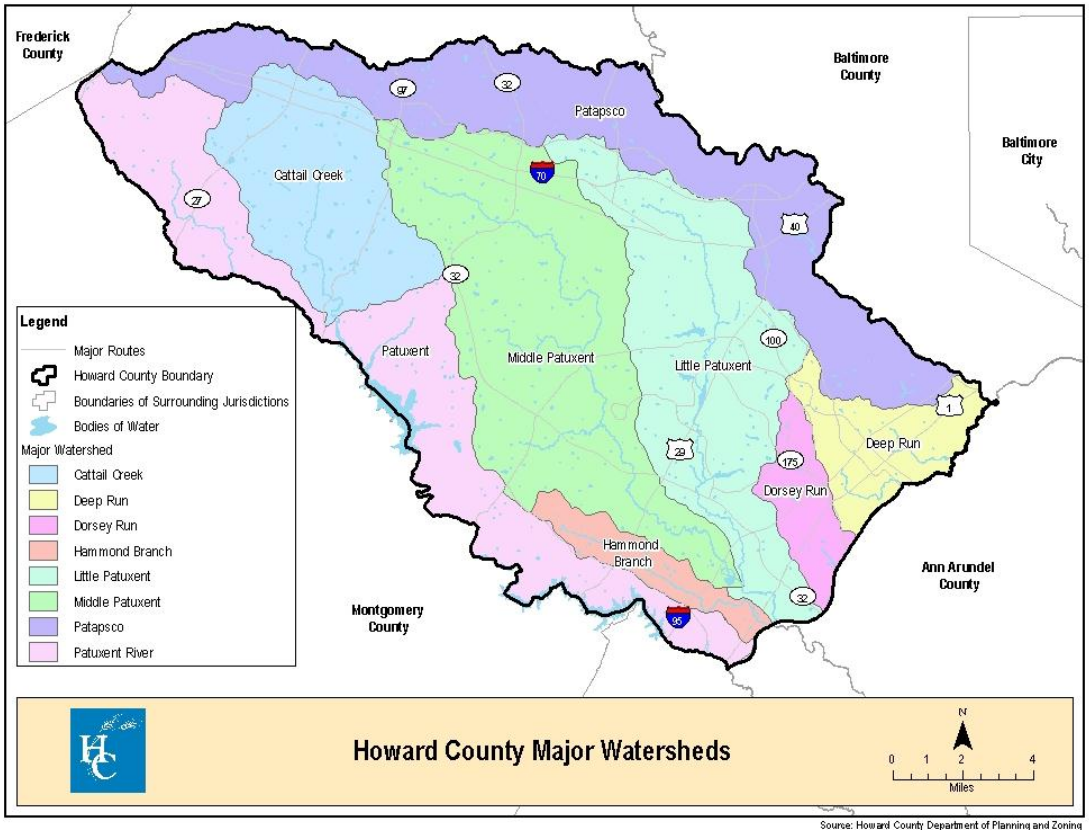
Approximately three-quarters of Howard County's land area lies within the Patuxent watershed. The main Patuxent River branch begins at the most western point of Howard County. This river acts as a political boundary between Howard and Montgomery Counties and a source of drinking water for the National Capital Region. The river feeds into two reservoirs, the Rocky Gorge and the Triadelphia Reservoir. The Brighton and Howard Duckett Dams preserve these reservoirs. The Middle Patuxent and the Little Patuxent are two of the three major tributaries of the Patuxent River. The Middle Patuxent starts just south of Interstate 70 and runs through the middle of the County. The Little Patuxent runs southeast through Columbia and meets up with the Middle Patuxent in Savage.

The Patapsco River watershed makes up the remaining quarter of the County's land area. The watershed is located to the extreme north and northwest of the County. The main portion of the Patapsco River acts as a political boundary for the northeast part of Howard County. The river splits into two branches, which serve as the borders for Carroll, Baltimore and Howard Counties.

The Patuxent, Middle Patuxent, Little Patuxent and Patapsco River watersheds can be divided even further to include Cattail Creek, Deep Run, Dorsey Run, and Hammond Branch watersheds. In addition, the County has several other smaller tributaries. These include: Bonnie Branch, Clyde's Branch, Guilford Branch, Plumtree Branch and the Tiber-Hudson Branch. All of these tributaries are susceptible to riverine flooding.

These major watersheds of Howard County are visually represented in Figure 6.4.1-1.

Figure 6.4.1-1
Howard County, Major Watersheds
(Source: Howard County, Planning and Zoning Department)



FEMA prepares and distributes Flood Insurance Rate Maps (FIRMs) to the public, which provide an overview of flood risk and identifies County land that is vulnerable to flooding. FIRMs are used to regulate new development and control the substantial improvement or repair of substantially damaged buildings. Flood Insurance Studies (FIS), often developed in conjunction with FIRMs, contain a narrative of the flood history of a community and discuss the engineering methods used to develop the FIRMs. The study also contains flood profiles for studied flooding sources and can be used to determine Base Flood Elevations (BFE) for some areas.[22]

The most recent Howard County FIS is dated December 4, 1986, and compiles previous flood information and data on numerous waterways. On November 30, 2009, FEMA released a preliminary FIS update for Howard County.

The Flood Mitigation Plan (FMP)[23] indicates that Preliminary Digital Flood Insurance Rate Maps (DFIRMs) were also released for Howard County in 2009 and are under the relevant departments' review.[24] These DFIRMs are made in response to the changing conditions affecting the County, including changes in land use, weather events, and improved techniques for assessing floodplains. These proposed DFIRMs will replace the FIRMs in full. As of the writing of the NHMP, the Department of Public Works is hosting public meetings to discuss and address any question raised by these proposed changes.[25]

The preliminary DFIRM includes new flood zone designations. Table 6.4.1-2 compares the effective flood zones with the new proposed flood zones. The most significant change is that the new maps replace Zone A with Zone AE, which includes detailed engineering methods to establish Base Flood Elevations (BFE).

Table 6.4.1-2
Comparison of Flood Hazard Zones (Effective FIRM vs. Preliminary DFIRM)
(Source: Preliminary Flood Insurance Study – Howard County, November, 2009)

Effective Flood Zones	New Flood Zones
A1 – A30	AE
B	X
C	X

[22] The BFE is defined as the computed elevation to which floodwater is anticipated to rise during the base flood. It serves as the regulatory requirement for the elevation or flood-proofing of structures, which determines the flood insurance premium. See FEMA: Base Flood Elevations, http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood_elevation.shtm (last accessed March 2, 2012).

[23] Deepa Srinivasan and Dr. Michael Scott, *Flood Mitigation Plan; Howard County, Maryland*, 39 (September 6, 2010) (draft manuscript on file with the Howard County Department of Public Works, Bureau of Environmental Services) [hereinafter as *Flood Mitigation Plan*].

[24] The new DFIRMS now include cross sections (with elevations), as well as the 100-year flood. Id.

[25] Please see http://www.howardcountymd.gov/dfirm.htm for more information regarding the DFIRM update process.

The preliminary Howard County DFIRM shows the following flood zones:

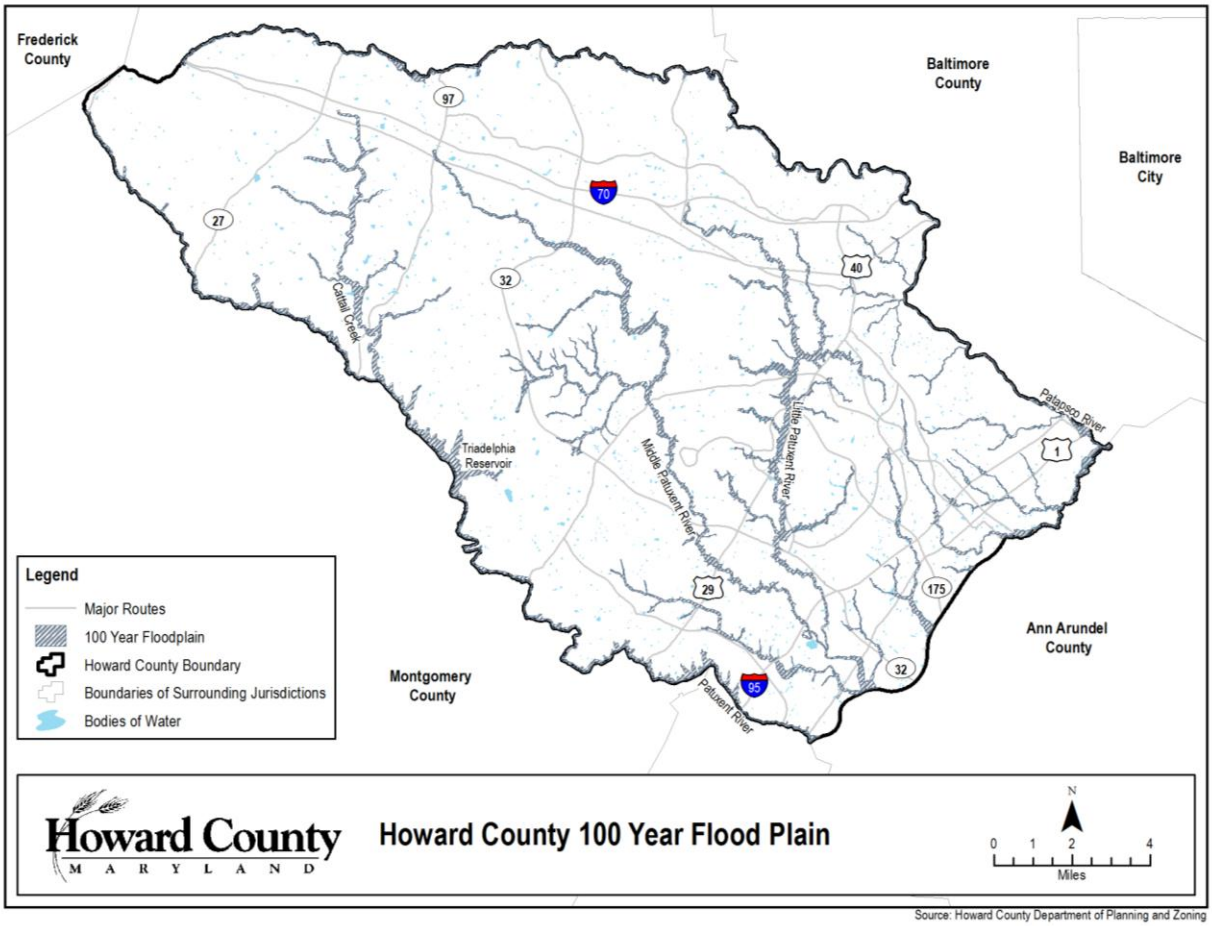
AE Zones along rivers and streams for which detailed engineering methods were used to determine BFEs.

Zone X (shaded). Moderate flood hazard areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.

Zone X (un-shaded). The areas of minimal flood hazard, which are the areas outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance flood.

Figure 6.4.1-3 identifies the most current version of the 100-year floodplain for Howard County based on the DFIRM. As Figure 6.4.1-3 illustrates, the majority of the flood-prone areas are located in the eastern, and more urbanized, portion of the County. The Howard County FMP states that 6.4% of the County's land area is located within the 100-year floodplain and are susceptible to riverine, flash, and urban flooding.[26]

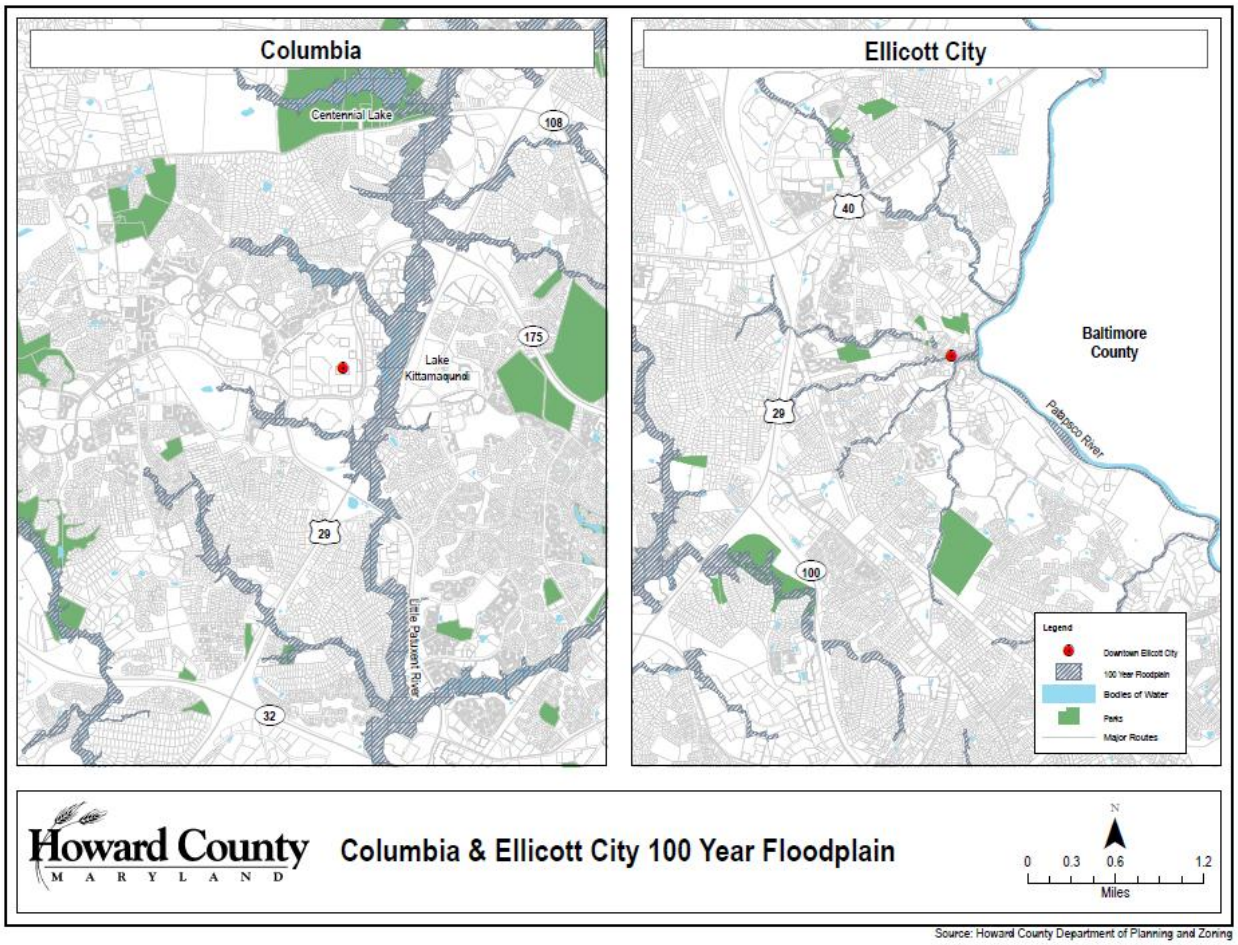
Figure 6.4.1-3
Howard County, 100-year Floodplain (preliminary DFIRM, May 15, 2012)[27]
(Sources: Howard County Department of Planning and Zoning)



[26] Id. at 18.
[27] As the floodplains are still being revised as of the date of this publication, both Figures 6.4.1-3 & 6.4.1-4 should not be viewed as definitive.

Ellicott City and Columbia are two areas in the region that are highly susceptible to flood damage due to urbanization.[28] Two DFIRM maps (one of Columbia, and another of Ellicott City) are included here below.

Figure 6.4.1-4
Columbia and Ellicott City, Maryland: 100-year Floodplain (preliminary DFIRM, May 22, 2012)
(Sources: Howard County Department of Planning and Zoning)



Severity (or Extent) of the Flood Hazard

Flood severity is measured in various ways, including frequency, depth, velocity, duration, contamination, and other factors. In Howard County, the severity of the flood hazard depends on the part of the County considered, but severity issues are generally correlated with frequency of occurrence.

Flooding along the three major rivers of the County[29] usually occurs during the summer and early fall, mainly as a result of tropical cyclones. Tropical cyclones, thunderstorms, heavy rains, and frontal storms may also force smaller tributaries of the County[30] to overflow and flood. The flooding that resulted from

[28] Federal Emergency Management Agency, *Flood Insurance Study: Howard County, Maryland and Incorporated Areas*, 8 (Preliminary report, November 30, 2009), available at https://www.rampp-team.com/county_maps/maryland/howard/howard_revised_prelim/Howard_MD_RP_fis_tables_1.pdf [*hereinafter* Flood Insurance Study]

[29] The three main rivers of the County consist of the Patuxent, the Little Patuxent, and the Patapsco River.

[30] Smaller tributaries include Bonnie Branch, Clyde's Branch, Guilford Branch, Plumtree Branch, and the Tiber-Hudson Branch.

Tropical Storm Agnes on June 22, 1972 is the largest flood recorded and caused the greatest amount of damage in Howard County.[31] Other significant flood events occurred in 1868, 1894, 1923, 1952, 1971, 1975, 2003 and 2011. Although the majority of these flood events were a result of tropical cyclonic-related events, intense local thunderstorms in the spring and summer have been known to cause flooding, particularly flash and urban flooding.

Impact on Life and Property

Much of the potential impact on life and property by flooding has been dramatically reduced by the implementation of strong mitigation practices by the County. After Tropical Storm Agnes in 1972, the County did not rebuild infrastructure or issue building permits in flooded areas.

According to the NCDC database, there have been 42 flooding events from 1950 to 2012. The database provides no indication as to why there were no events listed prior to 1996. These events have caused an estimated $1.24 million in property damage and injured two people, but fortunately resulted in no fatalities. The SHEDLUS database examines 26 flooding events from 1965 to 2006. The database estimates there were five fatalities, three people were injured, and the County suffered about $24.9 million in property damages.

The 2010 Howard County FMP indicates that 198 structures are located within the 100-year floodplain.[32] Of these 198 structures, 121 are residential structures.[33] The second largest category of buildings within the 100-year floodplain is commercial buildings.[34] Table 6.4.1-5 shows the number and type of structures located within the 100-year floodplain.

Table 6.4.1-5
Structures Located in the 100-year Floodplain
by General Occupancy Type
(Source: 2010 Howard County Flood Mitigation Plan, Page 25)

Structure Category	# Structures in the Floodplain	% of Total
Residential	121	61.1%
Commercial	73	36.8%
Educational	1	0.5%
Government	2	1.0%
Industry	1	0.5%
Total	198	100%

The FMP uses FEMA's lost estimation software HAZUS – Multi Hazard[35] to assess the County's vulnerability to flooding. The results of the analysis indicated that 26 buildings (or 13%) faced the

[31] *Flood Insurance Study*, supra note 22 at 8.
[32] *Flood Mitigation Plan*, supra note 19 at 23.
[33] Id.
[34] Id.at 24.
[35] The Flood Mitigation Plan utilized Version MH MR4 of HAZU Multi-Hazard. *Flood Mitigation Plan*, supra note 19 at 23.

possibility of sustaining severe[36] damage of greater than 50% in the event of a 100-year flood.[37] Section 7, Vulnerability Assessment and Loss Mitigation, includes a detailed discussion of the potential flood impacts on the County.[38]

Occurrences of the Flood Hazard

As noted above, the NCDC indicates there have been 55 flooding events in Howard County from 1996 to 2011. The majority of these events were labeled as flash floods, and caused no property damage, injuries or fatalities. Only 9 of the 55 flood events resulted in reported property damage. These nine flood events are listed below in Table 6.4.1-6.

Table 6.4.1-6
Howard County: Flood Events from 1996 to December 2011
Resulting in Property Damage
(Source: NOAA/NCDC)

9 FLOOD event(s) were reported in **Howard County, Maryland** between **01/01/1950** and **02/28/2011** with **at least $1 in Property Damage**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Maryland

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 All	01/19/1996	09:00 AM	Flash Flood	N/A	0	0	5K	0
2 Nw Portion	06/19/1996	06:00 AM	Flash Flood	N/A	0	0	20K	0
3 Nw Portion	06/19/1996	10:45 PM	Flash Flood	N/A	0	0	30K	0
4 Ne Portion	06/19/1996	11:15 AM	Flash Flood	N/A	0	0	10K	0
5 Elkridge	07/30/1996	10:00 PM	Flash Flood	N/A	0	0	10K	0
6 Countywide	09/06/1996	01:00 PM	Flash Flood	N/A	0	0	25K	0
7 W Portion	12/13/1996	11:15 AM	Flash Flood	N/A	0	0	10K	0
8 MDZ006>007 - 009>011 - 013>014	10/08/2005	05:30 AM	Flood	N/A	0	2	200K	0
9 Countywide	06/25/2006	06:30 PM	Flash Flood	N/A	0	0	150K	0
				TOTALS:	0	2	460K	0

Howard County has had numerous flooding incidents, including major events such as Tropical Storm Agnes in 1972, Hurricane Eloise in 1975, Hurricane Floyd in 1999, and most recently, Tropical Storm Lee in 2011. Most incidents are the result of tropical systems, nor'easters or flash flooding from sudden, short-lived rainstorms. To develop the following flood history narratives, information was culled from FIS for Howard County and the NCDC database.

[36] "Severe" damage can be categorized as "removal of cladding from "wash through" of surge without wall structural damage." See Carol Friedland et al., *Loss-Consistent Categorization of Hurricane Wind and Storm Surge Damage for Residential Structures*, 4, available at http://www.iawe.org/Proceedings/11ACWE/11ACWE-Friedland.pdf.
[37] Id. at 23.
[38] In particular, the history of NFIP claims and the number of FEMA "repetitive loss" properties will be discussed in-depth in Section 7.3.1.

As mentioned previously, the most notorious and destructive flooding event in Howard County was caused by Tropical Storm Agnes on June 21 – 23, 1972. The Howard County FIS estimates the total property damage from the storm to be as high as $41.2 million.[39] The majority of the damage occurred along the Patapsco River in Ellicott City and Elkridge areas. The total damage along the Patapsco River was estimated to be approximately $36 million.[40] Property damages along the Little Patuxent River totaled about $2.4 million[41] and damages along the Patuxent and Middle Patuxent totaled roughly $512,000.[42] An estimated $1.1 million[43] worth of damages occurred to roads and bridges throughout the County. Meanwhile, the SHEDLUS database estimates the total property damage from Tropical Storm Agnes to be roughly $11.17 million.[44] This massive flood caused at least 3 fatalities. Figure 6.4.1-7 is a photograph showing the flooding that occurred along Main Street in downtown Ellicott City.

Figure 6.4.1-7
Hurricane Agnes, 1972: Flooding along Main Street in Downtown Ellicott City

(Source: The Times Newspaper, 1972)

Other significant flooding events that have impacted Howard County are summarized below. Section 6.4.4 below discusses Tropical Storm Lee and the subsequent flooding of Historic Ellicott City.

- **July 24, 1868:** 18 inches of rain fell on Howard County, causing the Patapsco River to overflow. Witnesses noted that the river rose approximately 30 feet in 30 minutes. The flood resulted in 37 fatalities and caused an estimated $4 million[45] in damage.
- **May 1894:** The Patapsco River flooded, causing extensive property damage. The flood resulted in approximately $149,228[46] in damage.

[39] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.
[40] Id.
[41] Id.
[42] Id.
[43] Id.
[44] Id.
[45] Id.

- **September 1952:** On Labor Day weekend, Hurricane Able's heavy rains swept through Howard County. A destructive flash flood caused a log jam in the mouth of the Tiber River and resulted in approximately $4.06[47] million dollars' worth of damage.
- **August 1 – 4, 1971:** Heavy rain flooding caused numerous road closures and damaged several homes. The Patuxent River rose 25 feet in 30 minutes and mud slides damaged roads and bridges. Roads that were flooded and/or damaged included: Owen Brown Road, Morgan Road, Carroll's Mill Road, River Road, Mullinix Mill Road, Howard Chapel Road, Furnace Avenue, Mink Hollow Road, Route 108, Route 32, Centennial Lane, Bethany Lane, and Old Annapolis Road. An estimated $585,400[48] in County property damage was reported.
- **September 22 – 26, 1975:** The remnants of Hurricane Eloise, coupled with snow from a previous storm, resulted in over 12 inches of rain in four days and caused both the Patuxent and Patapsco Rivers to overflow up to 24 feet above normal. Much of Ellicott City and Elkridge were again flooded, as some businesses had just reopened after recovering from the extensive damage caused by Hurricane Agnes. Mud and debris covered the landscape, and homes and businesses were declared unsafe.
- **June 19, 1996:** Storms poured 5.5 inches of rain into Howard County and flooded roads, bridges, and properties. Seneca Creek and Bennett Creek overflowed their banks, causing several roads to be temporarily closed. Two fatalities occurred when a couple rafting in the Patapsco River was swept over a dam in the raging current. $82,500[49] in property damage was reported.
- **September 6, 1996:** The remnants of Hurricane Fran left up to 5 inches of rain in parts of the County and caused physical damage to the County with 40 mph sustained winds. Minor flooding occurred, 36,300 residents of Howard County lost power, and $34,300[50] of property damage was recorded.
- **September 9, 1999:** Thunderstorms moved through the County, producing damaging winds and heavy rainfall across the area. Flooding occurred in Ellicott City, Dorsey, Columbia, and Elkridge. Portions of Route 1 were flooded and cars were trapped by the surrounding water. Water infiltrated homes near Columbia and Dorsey. Precipitation measurements showed 7.39 inches of rain near Columbia and 5.98 inches near Elkridge.
- **September 16, 1999:** The remnants of Hurricane Floyd produced high winds and heavy rains that closed 200 roads and streets countywide. Businesses were threatened by the raging waters of the Patapsco River as its banks overflowed in Ellicott City. Rainfall measurements of 2 to 5 inches were reported throughout the day. County officials reported 17 homes were damaged, 350 basements were flooded, 2 people were rescued, and the Howard Country Fair was shut down for the first time in its 47 year history.
- **Floods of 2003:** Howard County experienced several floods in 2003. First, on February 22nd, widespread flooding was caused by both melting snow from the snowstorm of February 14 – 18th combined with 1.5 to 3 inches of rain. Several roads were closed, including Route 108, Race Road, Furnace Avenue, Triadelphia Mill Road, and Toll House Road. 30 basements were flooded. A few months later, on June 7th – 20th, precipitation systems moved across the region, causing roads and waterways to flood off and on for nearly two weeks. River and stream levels remained

[46] Id.
[47] Id.
[48] Id.
[49] Id.
[50] Id.

high throughout this period, fed by up to 5 inches of rain a day. Several roads were closed multiple times including Furnace Avenue, South Entrance Road, Carris Mill Road, Warfield Road, Route 108, and Lime Kiln Road. On September 23rd, a few days after Hurricane Isabel brought rain to the region, a heavy rain storm brought 2.5 inches of rain in one day and flooded parts of the County. On November 19th, a strong line of thunderstorms brought 2 to 4 inches of rainfall, which resulted in the closure of several roads. Finally, on December 11th, a heavy overnight rainfall averaging 2 to 3 inches fell on snow-covered grounds, melting the snow. This led to the heightening of rivers and streams as well as the closure of several roads due to rising water.

- **October 8, 2005:** Remnants of Tropical Strom Tammy caused prolonged heavy rainfall that measured 7 inches in 2 days. 10 roads in the County were flooded, 2 homes were damaged by the influx of mud, and a water rescue was conducted in Ellicott City.
- **June 23 – 26, 2006:** A storm system from the south caused torrential rain that continued for 4 days. The ground was saturated and low lying areas flooded as the area accumulated more than 10 inches of rain. A 2 to 3 feet storm surge, coupled with flood water, washed away part of Vollmerhausen Road Bridge and forced the closing of minor roads. Main Street in Ellicott City flooded, which broke a sewer line.
- **July 23, 2008:** A slow moving cold front produced waves of heavy showers in the afternoon and evening. Flash flooding occurred, closing several roads including I-95, the nation's main thoroughfare on the East Coast, near Elkridge.

Future Flood Probability for Howard County

With a total of 42 flooding events between 1996 and 2012, Howard County experiences, on average, slightly less than 3 flooding events per year. As with most areas of its size, there is virtually 100% annual probability that a flood of some magnitude will occur within the County in the future. With significant flood events occurring in 2003, 2005, 2006, 2008 and 2011, this pattern also emphasizes a high probability of future floods occurring in Howard County.

Section 7, Vulnerability Assessment and Loss Mitigation, of this plan includes detailed probability-based estimates of potential future flood losses for the County and several municipalities.

6.4.2 Severe Winter Storm

Description of the Winter Storm Hazard

A winter storm is a weather event that produces forms of precipitation caused by cold temperatures, such as snow, sleet, ice, and freezing rain, while ground temperatures are cold enough to cause precipitation to freeze. Windy conditions may also be present during a winter storm. The accumulation of these forms of precipitation can immobilize an entire region, leaving roads impassable, triggering utility outages, causing flooding and storm surge, and may lead to the loss of lives. These impacts may be enhanced with the presence of windy conditions, which can lead to blizzard, whiteout conditions, and drifting of snow.[51]

[51] For additional information about winter storms, see NOAA's *Hydrometeorological Prediction Center*, http://www.hpc.ncep.noaa.gov/wwd/winter_wx.shtml (last accessed November 23, 2011). See also *Winter Weather Basics*, http://www.nssl.noaa.gov/primer/winter/ww_basics.html (last accessed February 21, 2012).

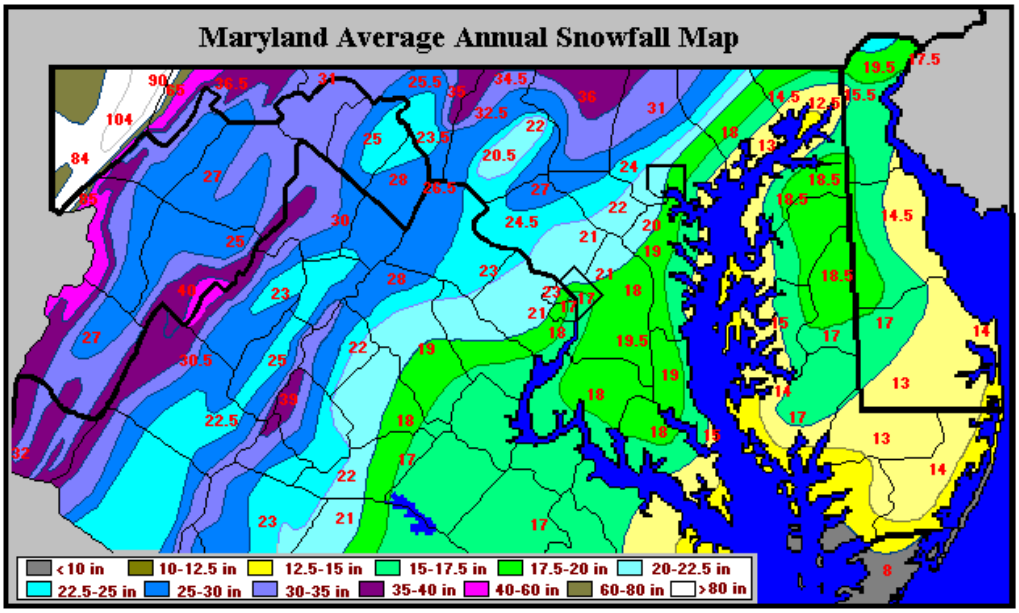
Location of the Winter Storm Hazard

Severe winter weather, including snow storms, ice storms, and extreme cold, may affect any part of Howard County during winter. The annual snowfall for the County is 20.7 inches, which is relatively moderate. Western Maryland counties experience significantly more annual snowfall, while counties closer to the Atlantic Ocean generally have a smaller annual snowfall total.

Generally, the winter storm season for the eastern portion of Maryland runs from November to mid-March, while the western counties experience longer winters. Severe winter weather has occurred as early as October and as late as May in eastern portions of the State. Within Howard County, the risk to people and property from winter weather cannot be distinguished by area, as the hazard may have uniform probability of occurrence across the County. Although different parts of the County may be impacted in different ways when a severe winter weather event strikes, generally all people and assets are considered to have the same degree of exposure.

Figure 6.4.2-1 shows the average annual snowfall totals for Maryland, Delaware, Washington, DC, Northeast and West Virginia, and Northern Virginia. The map shows the western counties average significantly more snow, upwards of 104 inches a year. Meanwhile, parts of the Eastern Shoreline average between 12-15 inches of snow a year. Howard County averages between 20 and 27 inches of snow per year.

Map 6.4.2-1
Maryland Average Annual Snowfall
(Source: NOAA)



Severity (and extent) of the Winter Storm Hazard

Typically, Howard County remains cool during the winter months. Heavy snow events can be common during certain years, with snow fall totals surpassing a foot to a foot and a half. During other years, snowfall events could be considerably less. Generally, January is the coldest month, with an average

temperature slightly above freezing at 33.3 degrees Fahrenheit. February commonly has the highest snow fall, with 9.61 inches of average snow fall.

It is possible for an occasional ice storm, freezing rain event, or sleet to impact the County. Winter storms along the Atlantic Coast can bring a wintery mix of precipitation - where the event may start out as rain and switch over to snow (or vice versa). A wintery mix event may cause more sustained damage than a single-precipitation winter event. For example, if a wintery mix started as snow and then switches over to rain, the weight of the fallen snow may bring down trees and electrical lines. Another possible characteristic of severe winter storms is extreme cold temperatures, where single digits and wind chills below zero are possible.

Snow events such as winter storms, heavy snow fall, ice, wind, and cold temperatures have the potential to create hazardous situations. Over the years, Howard County has sustained varying degrees of damages from winter storm events. These storms have affected the entire County by restricting travel, downing trees, interrupting electrical power, and causing water main breakage. The 2009-2010 winter season had the highest recorded snowfall on record, with 77 inches of snow falling across the area. Several other snow events brought over 12 inches of snow to the County during that period. These smaller snow events, along with sleet, freezing rain, and cold temperatures, caused physical damage to the environment.

Impact on Life and Property

Winter storms are prevalent on a yearly basis for the County, but significant improvements to building codes, maintenance to structures, and weather forecasting has dramatically decreased the threat to people and property. Even with these improvements, a risk of injury or death to individuals during a winter event may still exist, particularly with elderly persons, small children, infants and/or the chronically ill. These groups may be more susceptible and vulnerable to injury or death if they are exposed to the winter event or if they do not have adequate heating in their homes. Also, heavy snow loads may cause possible structural failure or structural damage to buildings and infrastructure.

Severe winter storms could also result in increased traffic accidents, impassable roads, and loss of income. On the roadways, snow and ice can reduce visibility and affect automobile traction as bridges may freeze prior to the majority of the roadways. Disruption of the roadways and other transportation methods is a threat to the County's economic well-being, for individuals will not be able to travel to work and the shipment of goods could come to a standstill.

County residents may also be affected physically by severe winter storms. People may injure themselves while walking on ice and snow, or suffer heart attacks as a result from overexertion from shoveling snow. Although rare, carbon monoxide poisoning may occur during winter events when heaters, automobile mufflers or generators are not vented properly.[52] Frostbite and hypothermia may also lead to death or injury.

[52] In Ellicott City, one died and two were seriously injured from carbon monoxide poisoning when a family used a generator indoors during Hurricane Irene's wake. See *Two Improving in Ellicott City Carbon Monoxide Poisoning that Left One Dead*, http://www.baltimoresun.com/explore/howard/news/ph-ho-cf-co-poisoning-0901-20110830,0,3266348.story (last accessed April 3, 2012).

In Howard County, the NCDC reports eight deaths and 166 injuries due to serve winter weather since 1969.[53] During that same period, the NCDC reports approximately $8.805 million in property damages.[54] The SHEDLUS database reports five deaths and 71 injuries from 1960 to 2007.[55] From 1960 to 2007, SHEDLUS reports that Howard County suffered approximately $8.842 million in property damages.[56] The winter storm hazard affects all residential and commercial building types equally within the planning area.

Occurrences of the Winter Storm Hazard

The NCDC database reports Howard County has experienced 93 severe winter storm events between 1969 and 2011.[57] Although the query results start in 1969, the first reported severe winter event was in 1993. Of the 93 severe winter events, only seven resulted in property damage.[58] Table 6.4.2-2 lists the seven winter storms that resulted in property damage for Howard County between 1995 and 2011. Although not indicated in the NCDC database, the severe winter storms in December 2009 and February 2010 also resulted in property damage. These two events are described following Table 6.4.2-2

Table 6.4.2-2
Howard County: Winter Storm Events Resulting in Property Damage, 1995 – February of 2010
(Source: NOAA/NCDC)

8 SNOW & ICE event(s) were reported in Howard County, Maryland between 01/01/1950 and 12/31/2011

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

	Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1	MDZ003>007 – 010>011	12/19/1995	1500	Ice Storm	N/A	0	0	100K	0
2	MDZ002>007 – 009>011 – 013>014 – 016>018	01/12/1996	07:00 AM	Heavy Snow	N/A	0	0	100K	0
3	MDZ002>007 – 009>011 – 013>014 – 016>018	02/08/1997	01:00 PM	Heavy Snow	N/A	0	0	10K	0
4	MDZ005>006 – 009>010	01/15/1998	08:00 AM	Winter Weather	N/A	0	0	5K	0

[53] Supra note 46.
[54] Id.
[55] Id.
[56] Id.
[57] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).
[58] Id.

5	MDZ002>007 – 009>011 – 013>014 – 016>018	01/14/1999	01:00 AM	Ice Storm	N/A	0	0	3.2M	0
6	MDZ002>007 – 009>011 – 013>014 – 016>018	02/14/2003	08:00 AM	Winter Storm	N/A	1	10	5.2M	0
7	MDZ002>007 – 009>011 – 013>014 – 016>018	02/11/2006	08:45	Heavy Snow	N/A	0	0	230K	0
8	Howard	10/30/2011	500	Winter Weather	N/A	0	0	514K	0
						1	10	9.352K	0

The NCDC database indicates that one of the most severe winter storms resulting in property damage and loss of life occurred on February 14, 2003 and lasted until February 18, 2003. The system brought three waves of wintery precipitation to the region. The first line of precipitation started to fall on the evening of the 14th as a mix of light to moderate snow or rain. The next round, on the 16th and 17th, took the form of heavy wet snow and sleet. The event ended with snow showers tapering off on the 18th. When the winter storm ended, snowfall totals ranged from 20 to 32 inches across the Baltimore Metropolitan area. Estimated regional property damages from the storm were $6.1 million.[59] In Howard County, a stable, a warehouse, a store awning, a tennis bubble dome, a greenhouse, and a shed collapsed under the weight of the snow.[60]

More recently, the 2009-2010 winter season brought the highest snowfall on record in the region. Several waves of severe snow events dropped over a foot each of snow in the County. The first low pressure system arrived on the night of December 18, 2009. The system strengthened on the 19th, as moisture from the South pushed northward while the cold air remained in place. Snowfall totals ranged from 14 to 17 inches across the County. As a result of this event, a Presidential Disaster Declaration (DR-1875) was issued for the State of Maryland on February 19, 2010 for the December storms. Before the Presidential Disaster Declaration was even issued for the December storms, the State was hammered yet again by a line of severe winter storms from February 5th to February 11th, 2010 and produced a snowfall of 10 to 20 inches across the County. Certain parts of the County had even higher localized amounts. As a result of this event, another statewide Presidential Disaster Declaration (FEMA DR-1910) was declared on May 6, 2010 for the February storms.

[59] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.
[60] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).

Figure 6.4.2-3
February, 2010: Snow Covered Streets in Ellicott City, Maryland

Other significant winter storm events that have impacted Howard County are summarized below.

- **February 1899:** Also known as the "Great Eastern Blizzard of 1899," this February 1899 storm is one of the earliest documented severe winter storm events in the area. The storm produced approximately 20 inches of snow across the region.
- **January 5, 1912 – February 12, 1912:** Known as the "Great Cold Wave" of January 1912, extreme cold was recorded across the region. In Howard County, reports showed that temperatures fell close to 20 degrees below zero.
- **January 27, 1922 – January 28, 1922:** Known as the "Knickerbocker Storm," the nor'easter brought 30 to 32 inches of snow across the County. The high winds also brought blizzard and whiteout conditions across the region.
- **March 29, 1942 – March 30, 1942:** The "Palm Sunday Snowstorm" was the heaviest March snowstorm on record in Maryland. The storm dropped over 20 inches of heavy, wet snow in Howard County.
- **February 18, 1979**: The "Presidents' Day Storm" brought the second greatest amount of snow fall in the Howard County region, bringing snow of up to 20 inches over the Northern Virginia and Maryland region. At times, snow was falling 2 to 3 inches an hour, and temperatures fell to the single digits.
- **February 11, 1983 – February 12, 1983:** The "Blizzard of 1983" was the second greatest snow fall in the region. Over two feet of snow covered the County. During certain periods, snow fell at a rate of 3.5 inches per hour.

- **January 7, 1996 – January 13, 1996:** The "Blizzard of '96'" brought between 18 and 30 inches of snow to Howard County on January 8th. On the 9th, an "Alberta Clipper" left an additional 3 to 5 inches of snow throughout the region. A third storm brought another 4 to 6 inches of snow. The County had 2 to 3 feet of snow by the end of the week.
- **January 14, 1999:** An arctic cold front moved over Central Maryland and brought snow to the region. The snow turned to rain while the ground remained below freezing, which in turn created a hazardous condition. Ice accumulations ranged from ¼ to ½ inch. With wind gusting over 40 mph, fallen trees and power outages occurred across the County. At one point, as many as 39,000 households were without power. The Governor of Maryland declared a State of Emergency for Howard County and the surrounding counties.
- **December 11, 2002:** A low pressure system produced between 1 and 2 inches of rain. However, the rain turned to ice as temperatures dropped below freezing. In some locations, ice accumulated to ¼ of an inch thick. In Howard County, 22 people were treated for slip and fall injures related to the ice accumulation.
- **February 14-19, 2003:** A high pressure system held a low, definite Nor'easter in place during Presidents' Day weekend of 2003, resulting in one of the most severe snowstorm to affect the East Coast in recorded history. The Baltimore region received 28.2 inches of snow. As a result of this storm, all three airports in the region were closed, and schools were closed for a week.
- **February 11, 2006 – February 12, 2006:** Storm totals ranged from 14 to 22.5 inches fell across the Washington, DC and Baltimore Metropolitan regions, with Howard County suffering a direct hit from the storm. The highest snowfall total occurred in Columbia Hills, which is located in the north-east part of the County. In that region, snowfall of up to 22.5 inches was recorded. There were numerous reports of downed trees and power outages in the County. NCDC database estimated property damage to be $248,000[61] for the entire storm.
- **February 12, 2008:** A wintery mix of snow and ice produced roughly an inch of snow and between $^{1}/_{10}$ to $^{3}/_{10}$ of an inch of ice. The central and eastern portions of Maryland saw a quick change from snow to ice, which froze just before the evening commute. As road conditions deteriorated, a number of accidents were reported across the region.
- **January 26, 2011 – January 27, 2011:** A snowfall event produced between 8 to 13 inches of snow across the County. The heavy, wet snow brought trees and power lines down and left thousands without power. Unfortunately, the storm coincided with the evening commute and led to numerous car accidents and roadway shutdowns. There were also several reports of tractor trailers jackknifing due the slick road conditions.

With a total of 93 winter storm events between 1993 and 2011, Howard County experiences on average 5.5 winter storm events a year. With 5.5 winter storms occurring per year, there is a 100% annual probability of a winter storm event occurring in Howard County in the future.

6.4.3 Wildfire

As part of the 2011 NHMP update, the hazard of lightning/wildfire has been divided into two separate hazards. Upon conferring with the NHMPSC, it was agreed that the two sections should be separated since they can affect the County in distinct ways. This section focuses on wildfires, while Section 6.4.9 below discusses lightning's impact on Howard County.

[61] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.

Description of the Wildfire Hazard

Wildfires are uncontrolled forest fires, grassland fires, rangeland, or urban-interface fires which consume natural fuels and spread in response to its environment.[62] Wildfires can be either a natural phenomenon or human-caused. Wildfires can play a positive or destructive role in the evolution of an ecosystem.

Forest and grassland fires can occur throughout the year. In Maryland, the greatest threat of wildfires occurs during the spring season, in the months of March and April. The length and severity of the burning season largely depends on weather conditions. During the spring, the region experiences low humidity, high winds, below-normal precipitation, and high temperatures, which all contribute to high fire danger. Wildfires can also occur in late fall. Depending on weather conditions, the month of November also generally has a high rate of wildfires.[63]

Location of the Wildfire Hazard

Urban interface fires[64] are becoming increasingly problematic in Maryland. As people continue to live and work near wildland areas, the threat to private property from wildfires increases. This phenomenon is growing in Howard County as suburbanization and population growth continues in the County. Although urban interface fires have the greatest possibility to cause property damage, the potential for wildfires exists throughout the entire planning area. The greatest risk for significant wildfires to occur would be in large, forested areas such as the Patapsco State Park and the Hugh Thomas Wildlife Management Area to the north. The Patapsco River Valley, where Patapsco State Park is located, is characterized by steep slopes exceeding 20% grade. In addition, dense vegetation and hardwoods provide ample fuel for fire. In the southern portion of the County, the Rock Gorge Reservoir Park and the Patuxent Wildland Area are also areas at risk for potential wildfires. The Patuxent Wildland Area is a State-designated wildland, which restricts the ability to reduce fuels or create ingress routes. In addition, the characteristics of the Patuxent Wildland Area are similar to the Patapsco State Park, where dense vegetation and hardwoods provide high fuel loads.

Severity of the Wildfire Hazard

The frequency and severity of wildfires depends on both weather and human activity. The severity in Howard County has been historically very low, and the duration of wildfires has ranged from a matter of hours to several days.

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[62] See also *NWCG Glossary of Wildland Fire Terminology*, http://www.nwcg.gov/pms/pubs/glossary/w.htm#Wildfire (last accessed April 1, 2012).

[63] For additional information on wildfires, see generally *Maryland's Department of Natural Resources' Wildland Fire Management Page*, http://www.dnr.state.md.us/forests/wfm.asp (last accessed March 12, 2012).

[64] The urban interface is defined as the area where structures and other human development blend with undeveloped wildland. See *Technical Guide to Map and to Characterize Wildland-Urban Interface (WUI)*, http://www.fireparadox.org/technical_guide_wildland_urban_interfaces_print.php (last accessed March 12, 2012).

Impact on Life and Property

As previously mentioned, the populated areas considered most at-risk from wildfires are located in the large forested areas, such as Patapsco State Park and the Hugh Thomas Wildlife Management Area in the north. There have been no reported deaths or injuries from wildfires in the planning area.

Occurrences of the Wildfire Hazard

Wildfires incident data shows fires in Maryland occur relatively frequently.

According to the Maryland Department of Natural Resources, Maryland averaged 6,919 natural cover fires per year from 1995-2001.[65] Table 6.4.3-1 summaries the total number of fires and acres for the State of Maryland between 2004 and 2011.

Table 6.4.3-1
Fires and Acres Burned in Maryland from 2004 - 2009
(Source: Maryland Department of Natural Resources)

Year	Total Number of Fires	Total Acres Burned
2004	253	3,149
2005	441	4,344
2006	753	6,074
2007	622	5,102
2008	583	2,339
2009	408	4,853
2010	170	1,503
2011	825	8310

The NCDC[66] indicated there were no wildfire incidents between 1950 and 2011 within Howard County. According to the SHELDUS database[67], two wildfires caused several thousand dollars' worth of damage in 1963. Periodical sources were also consulted to identify past wildfire events for Howard County.

Based on this research, some recent wildfire events are described below.

- **March 30, 1999:** A 10-acre brushfire raged for four hours in the Patapsco Valley State Park. Firefighters were then called to a 5-acre brushfire within an hour after extinguishing the park fire. Firefighters responded to four other fires within eight miles of one another. The high number of fires was due to drought-like conditions.
- **March 23, 2004:** A brushfire on County land near Oakland Mills High School in Columbia burned 10 acres of land. Fueled by dead corn stalks and trees, the fire raced across an open field before firefighters contained it an hour later.[68]

[65] See Wildland Fire Management Fire Statistics for Maryland, http://dnr.maryland.gov/forests/fire/ (last accessed March 3, 2012).
[66] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).
[67] See *SHELDUS*, http://webra.cas.sc.edu/hvri/products/sheldus.aspx (last accessed February 28, 2012).
[68] Sententes, Gus, *Brush Fire Scorches About 10 Acres*, Baltimore Sun, March 24, 2004, available at http://articles.baltimoresun.com/2004-03-24/news/0403240194_1_firefighters-oakland-mills-corn-stalks.

- **February 19, 2011.** High winds with gusts up to 45 mph, high temperatures, and low humidity contributed to the start of eight brushfires, which eventually burned down 20 acres. One of the largest fires occurred near the 3800 block of Manor Lane in Ellicott City. A wildfire was also located on Interstate 95 in the Laurel area between MD 198 and the Capital Beltway closing down both northbound and southbound lanes until the fire was brought under control.

Although wildfire incidents are expected to occur more frequently due to increased human activity in forested areas, no acceptable mechanism exists to assign probability to fire occurrences. As noted, wildfire incidents are directly related to weather patterns and antecedent conditions, and thus its probability of occurrences are dynamic.

6.4.4 Hurricane/Tropical Cyclones

Description of the Hurricane/Tropical Cyclones Hazard

Hurricanes, tropical storms, and typhoons are collectively known as tropical cyclones. NOAA defines a tropical cyclone as a "warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere."[69] Tropical cyclones are among the most devastating naturally occurring hazards in the United States. Hurricanes, the strongest type of the tropical cyclones, generate hazards that can cause extensive damage such as high winds, heavy rainfall, tornadoes, and storm surge. While there is potential for hurricane force winds to occur in Howard County, its inland location removes it from the Atlantic coastline and places it north of the warm Carolina waters. Instead, its location makes the County more vulnerable to tropical storms and tropical depressions.

As a tropical cyclone strengthens, it can be become a tropical depression with wind speeds below 38 mph. As a storm intensifies, it becomes a tropical storm with maximum sustained wind speeds ranging from 39 to 73 mph. A storm of that magnitude is given a name once it reaches tropical storm intensity. Further development can produce a hurricane, which can be described as a well-defined low pressure system with circulation around the "eye" or center of the storm.[70]

[69] *Glossary of National Hurricane Center Terms*, http://www.nhc.noaa.gov/aboutgloss.shtml#TROPCYC (last accessed March 2, 2012).
[70] See generally *NOAA FAQ*, http://www.aoc.noaa.gov/faq.htm#whatisahurricane (last accessed March 2, 2012).

Table 6.4.4-1 provides a concise explanation of each of the degrees of tropical cyclones.[71]

Table 6.4.4-1
Tropical Cyclone - Wind Speeds Categories
(Source: NOAA)

Category	Wind Speed	Definition
Tropical Depression	< 38 mph	An organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds of 38 mph or less.
Tropical Storm	39 -73 mph	An organized system of strong thunderstorms with a defined surface circulation and a wind speed range from 39 to 73 mph.
Hurricane	74+ mph	An intense tropical low pressure system of strong thunderstorms with a well-defined surface circulation and a sustained wind speed of 74 mph or more. The term hurricane is used for Northern Hemisphere tropical cyclones east of the International Dateline to the Greenwich Meridian.

Location of the Hurricane/Tropical Cyclones Hazard

Tropical cyclone risk in the United States extends along the entire East Coast (from Florida to Maine), the Gulf Coast, and Hawaii. Based on historical storm tracks, it shows that Southeastern United States and the Gulf Coast are at the greatest risk. As one moves further inland and north along the Atlantic Coast where colder ocean waters persist, the threat of powerful hurricanes diminishes. However, the threat of tropical storms and remnants of hurricanes is still prevalent. The greatest threat for the occurrence of a tropical cyclone is during the Atlantic Ocean/Gulf Hurricane season, which runs from June 1 to November 30 each year. The hurricane/tropical cyclone hazard affects the entire planning area.

Severity and Extent of the Hurricane/Tropical Cyclones Hazard

The severity of hurricanes and tropical storms is measured primarily by wind velocity, surface pressure, and storm surge. Hurricane severity is measured by the Saffir/Simpson Scale, which classifies hurricanes on a numbered scale of 1 through 5 based on factors such as wind speed, storm surge height, and potential damage.

[71] For additional information about hurricanes and tropical storms, see *NOAA's National Hurricane Center*, http://www.nhc.noaa.gov/ (last accessed April 2, 2012).

Table 6.4.4-2 depicts the Saffir/Simpson Scale and the potential effects of wind damage during a hurricane event.

Table 6.4.4-2
Saffir/Simpson Scale
(Source: NOAA)

Category	Wind Speed (mph)	Surface Pressure (mb)	Storm Surge (ft)	Level of Damage	Description Potential of Damage for Howard County
1	74-95	>980	3-5	Minimal	Potential for flying debris which can cause death or injury. Older mobile homes could be destroyed if they are not anchored correctly. Large tree branches will snap and shallow rooted trees can be toppled. Extensive damage to power lines and poles will likely result in power outages that could last several days.
2	96-110	965-979	6-8	Moderate	There is substantial risk of death or injury caused by flying debris. Older and newer mobile homes can be destroyed. Many shallowly rooted trees will be snapped or uprooted, causing the blockage of roads. Near-total power loss is expected with outages, which could last from several days to weeks.
3	111-130	944-964	9-12	Extensive	There is a high risk of injury or death due to flying debris. Most mobile homes will sustain severe damage. Many trees will be snapped or uprooted. Electricity will be unavailable for several days to a few weeks after the storm passes.
4	131-155	920-943	13-18	Extreme	There is a very high risk of injury or death due to flying debris. Nearly all mobile homes will be destroyed. Extensive damage to roofing materials, windows, and doors. Trees will be uprooted and power lines will be brought down, causing widespread power outages.
5	155 +	<920	19 +	Catastrophic	There is a very high risk of injury or death due to flying debris, even indoors. Almost all mobile homes will be destroyed. Certain frame homes will also be destroyed. Extensive damage to roofs, windows, and doors. Nearly all trees will be snapped or destroyed, causing widespread power outages.

Impact on Life and Property

Past tropical storms have had moderate impact on life and property in Howard County. The most recent events are Hurricane Irene and Tropical Storm Lee, which occurred late August and early September 2011. These two events were discussed in detailed in Section 6.4.4 above. Information about Hurricane Irene and Tropical Storm Lee's impact on life and property are not yet readily available through NCDC at the time of this NHMP update.

Prior to these events, Tropical Storm Hanna was the last tropical storm to affect the planning area. On September 6, 2008, Tropical Storm Hanna saturated Howard County before moving up the Eastern Seaboard. According to the NCDC database, Howard County did not suffer any loss of life or property damage from Tropical Storm Hanna.[72] The SHEDLUS database also only reports one tropical cyclone which occurred on [73] September 5, 1979. Tropical Storm David moved across Western Maryland, causing an estimated $18.3 million[74] in damage. It appears that both NCDC and SHEDLUS databases have omitted numerous hurricane/tropical cyclone events that have affected Howard County, which is covered more in-depth in this section.

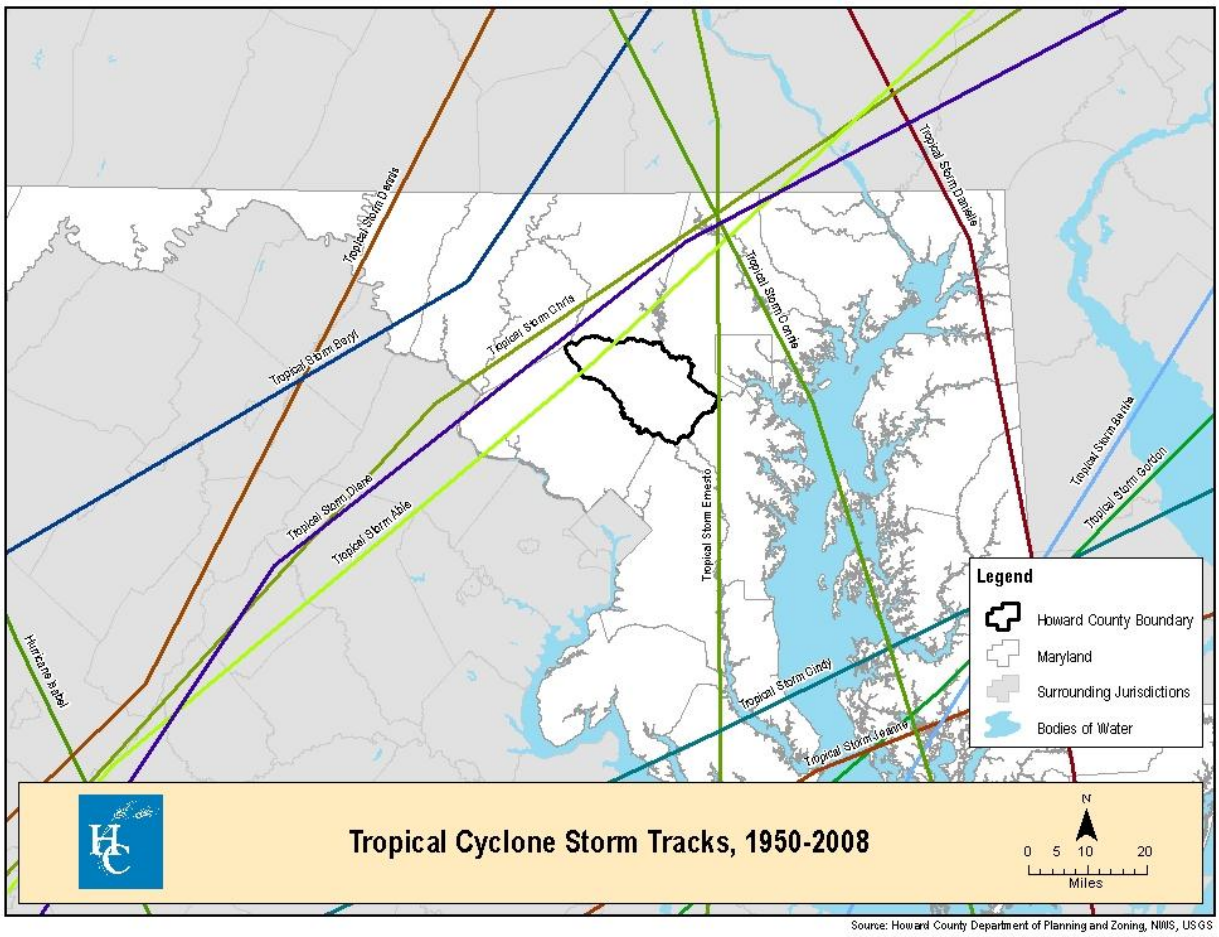
Occurrences of the Tropical Storms and Tropical Cyclones Hazard

Both SHEDLUS and NCDC database indicate that there have been two tropical storms that have impacted Howard County from 1950 to 2011. In addition to these events, other primary sources indicate that several additional hurricane and tropical cyclone events have occurred during that period of time. According to NOAA's GIS database, there have been 13 named tropical cyclones, with only one storm reaching hurricane strength that passed within 65 miles of Howard County between1950 and 2008. All of these storms were downgraded to either tropical storms or tropical depressions by the time they reached the Mid-Atlantic region, which is typical for this region. Although not all of these storms brought significant damage, most brought heavy rain and increased high winds across Howard County.

[72] See NCDC Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).
[73] See SHELDUS, http://webra.cas.sc.edu/hvri/products/sheldus.aspx (last accessed February 28, 2012).
[74] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.

Figure 6.4.4-3 shows the storm track for the 13 tropical cyclones that have passed within 65 miles of Howard County over the last 60 years.

Figure 6.4.4-3
Howard County: Storm Tracks, 1950 –2008
(Source: NOAA, National Weather Service, Howard County Department of Planning and Zoning)



Below is a list of notable tropical cyclonic events since 1950 that have significantly impacted Howard County, excluding the aforementioned Tropical Storms David and Hanna. Also, note that Section 6.4.4-4 includes a discussion of Tropical Storms Irene and Lee.

- **September 1, 1952 – Tropical Storm Able:** On the night of August 30, 1952, Hurricane Able made landfall over Beaufort, South Carolina. As the storm moved northward across South Carolina, North Carolina, and Virginia, Able was downgraded to a tropical storm. On September 1st, the center of Tropical Storm Able had moved over the western portion of Howard County. Able brought winds of 35 to 40 mph and gusts up to 50 mph. The peak wind gust at the Washington National Airport was 60 mph. The rain associated with the storm caused isolated flooding, while the wind brought down trees and branches and caused power outages to the region.[75]

[75] *Monthly Weather Review,* August 1952. Available at http://docs.lib.noaa.gov/rescue/mwr/080/mwr-080-08-0138.pdf.

- **October 15, 1954 – Hurricane Hazel:** Hurricane Hazel was listed as a Category 3 storm when it made landfall 250 miles south of Wilmington, North Carolina. Hazel maintained its hurricane force winds as it rapidly progressed up north. From Southern Virginia to Central Pennsylvania, Hazel produced Category 1 hurricane force winds. The storm passed Washington, DC to the west and then near Hagerstown, Maryland. There were reports of peak gusts in an excess of 130 mph in Howard County.
- **August 15, 1955 – Tropical Storm Connie:** On August 12th, Connie made landfall over the Outer Banks of North Carolina as a Category 1 Hurricane. Hurricane Connie then moved northward across North Carolina. By the time Connie reached Maryland's Eastern Shore on the 13th, it had weakened to a tropical storm. Tropical Storm Connie then moved northwest across the Chesapeake and towards north of Baltimore City; bringing with it 50 mph winds and a substantial amount of rain to the region.
- **August 18, 1955 – Tropical Storm Diane:** Only five days after Connie made landfall, on August 17th, Category 1 Hurricane Diane made landfall near Wilmington, North Carolina. Hurricane Diane was quickly downgraded to a tropical storm as it moved inland. The tropical storm then moved northwest across North Carolina and Virginia before shifting to the northeast over North-Central Virginia. On August 18th, the center of Tropical Storm Diane went through the eastern portion of Frederick County, Maryland, producing winds between 50 and 60 mph. As a result of its proximity, Tropical Storm Diane brought a significant amount of rain and flooding to Howard County.
- **September 7, 1999 – Tropical Storm Dennis:** The remnants of Hurricane Dennis tracked across Western Maryland on September 7th. The hurricane brought heavy rains and flooding throughout the County. Strong winds also caused power outages throughout the region.
- **September 19, 2003 – Hurricane Isabel:** Hurricane Isabel made landfall on September 18th as a Category 2 hurricane. As the storm moved across Southern Virginia, it weakened to tropical storm status. The rain associated with Hurricane Isabel caused isolated flooding, while strong wind brought down power lines and left more than 65,000 homes without power. At one point, 80-90 roads were deemed impassable due to fallen trees. In the end, Hurricane Isabel spared Howard County, but left other Maryland communities suffering substantial damage, particularly areas near the Chesapeake Bay and the Atlantic Ocean.[76]
- **September 3, 2006 – Tropical Storm Ernesto:** Tropical Storm Ernesto made landfall on September 1st in North Carolina. The storm maintained its strength as it tracked northward from North Carolina to Virginia, and then into Southern Maryland. Ernesto's center passed just east of Howard County, bringing upwards of five inches of rain and wind guests over 50 mph. Ernesto's winds caused over 44,000 residents in the region to lose power.[77]

See Section 6.4.1 for information on Tropical Storm Agnes and Hurricane Eloise, to include their impacts on Howard County.

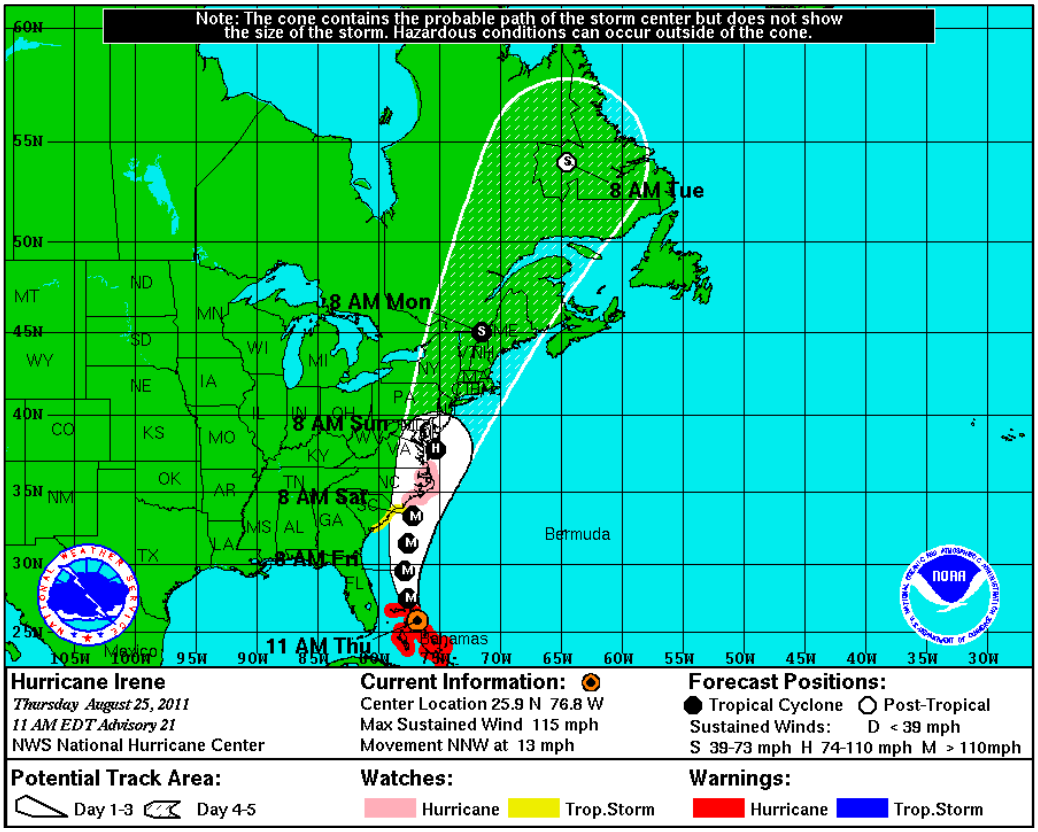
In late August and early September 2011, Howard County was affected by a downgraded Hurricane Irene, which became a tropical storm by the time it reached Central Maryland. Hurricane Irene originally made

[76] *NOAA National Hurricane Center's Tropical Cyclone Report; Hurricane Isabel*. Available at http://www.nhc.noaa.gov/2003isabel.shtml.

[77] Desmon, Stephanie and Gadi Dechte, *Ernesto's Wind Gusts Punched Away at Maryland*, Baltimore Sun, September 3, 2006, available at http://articles.baltimoresun.com/2006-09-03/news/0609030063_1_arundel-county-rain-anne-arundel.

landfall on August 27, 2011 as a Category 1 hurricane near Cape Lookout, North Carolina, with maximum sustained winds of 85 mph. The storm followed the Atlantic coastline as a Category 1 storm, which then made a second landfall as a hurricane near Little Egg Inlet, New Jersey the following morning. The path of the storm is shown in Figure 6.4.4-4.

Figure 6.4.4-4
Hurricane Irene Actual and Projected Storm Path as of 11 a.m. August 25, 2011
(Source: NOAA)



In Maryland, Hurricane Irene caused tropical storm force winds and torrential rains. More than 700,000 people were left without power across the State. Total damage in Maryland was estimated at approximately $16 million, with the most severe damages occurring on the Eastern and Southern portion of the State. A Presidential Disaster Declaration (FEMA-DR-4034) was declared for 13 of the 24 counties in Southern and Eastern Maryland as a result of this storm.

In Howard County, tens of thousands were left without power in the wake of Hurricane Irene. Initial estimates indicated damage of about $1.9 million in Howard County, where the storm severely damaged two homes and caused significant damage to four others in the Ellicott City area. A total of sixteen homes sustained varying degrees of water damage.[78]

[78] *Maryland Officials Tally Hurricane Irene Losses*, September 2, 2011, WBALTV, available at http://www.wbaltv.com/r/29064770/detail.html.

Figures 6.4.4-6 and 6.4.4-7 depict the total rainfall and wind speeds for Hurricane Irene. Figure 6.4.4-6 shows rainfall totals in Howard County were around two inches in the western part of the County, with the rainfall total increasing as one moves eastward. The highest rainfall totals in Howard County were around 4-5 inches along the eastern part of the County. Figure 6.4.4-7 shows that wind speeds across the majority of Howard County averaged 40-45 mph during the storm.

Hurricane Irene also caused widespread power outages throughout the Northeast region. Figure 6.4.4-8 shows a Baltimore Gas & Electric (BGE) report showing the number of power outages on August 30th by ZIP code.

Figure 6.4.4-5
Hurricane Irene: Rainfall Totals for Maryland
(Source: NOAA, National Weather Service)

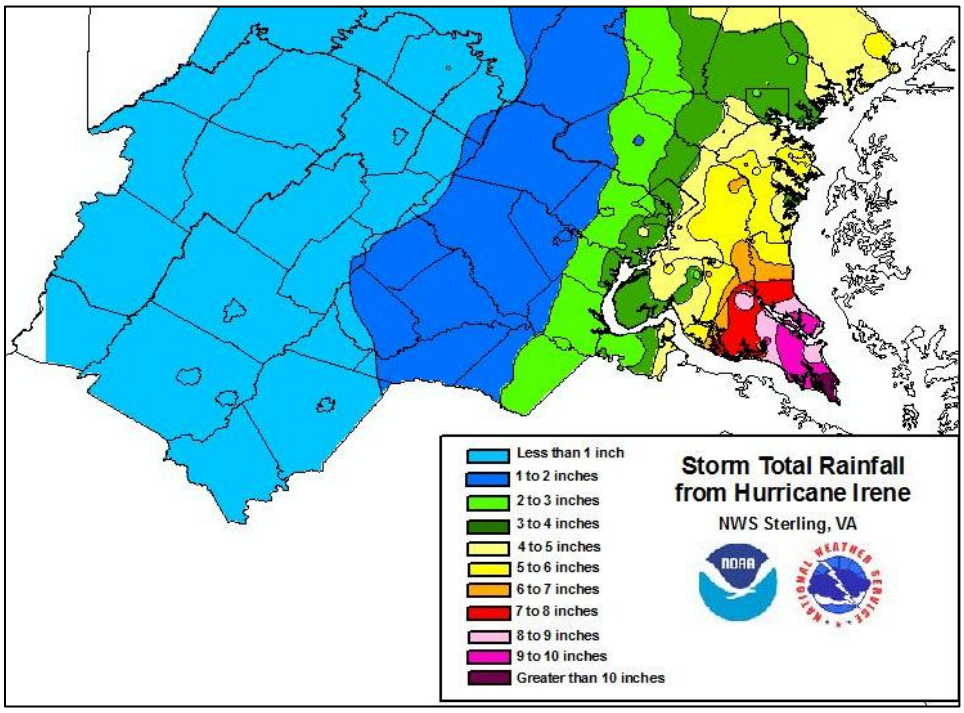


Figure 6.4.4-6
Hurricane Irene: Wind Speeds for Maryland
(Source: NOAA, National Weather Service)

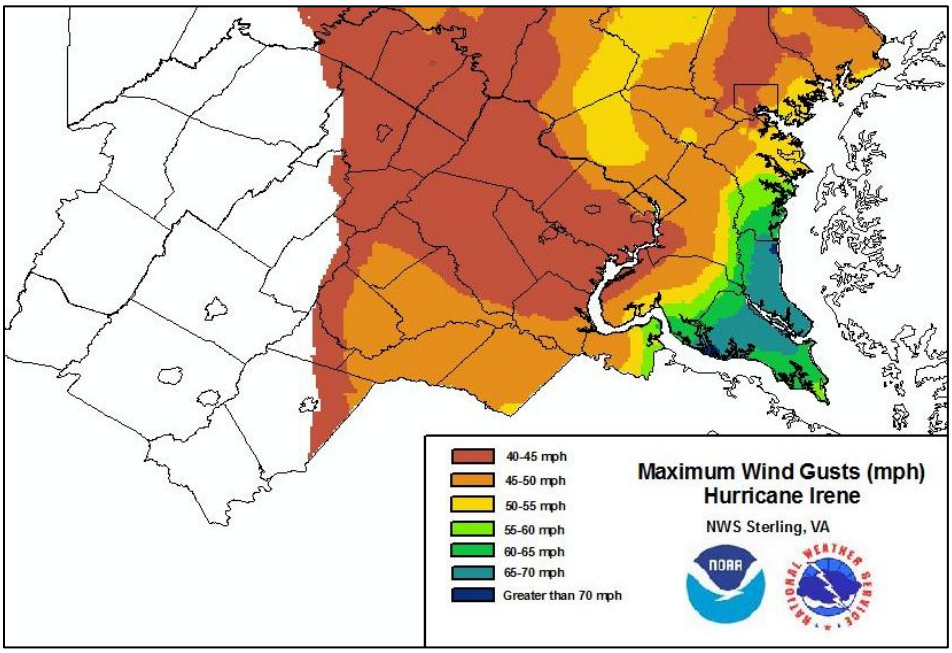
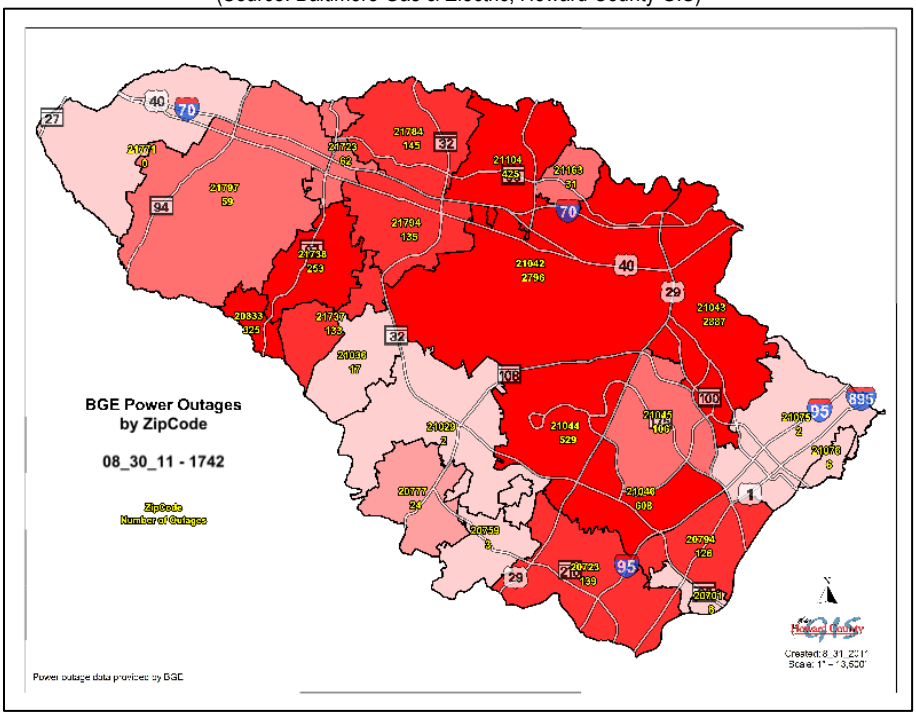


Figure 6.4.4-7
Howard County Power Outages as of August 30, 2011
(Source: Baltimore Gas & Electric, Howard County GIS)



Tropical Storm Lee made landfall on September 4, 2011 along the Gulf Coast near South-Central Louisiana as a slow moving storm with heavy rains and winds of 45 mph. The storm slowly moved inland, bringing torrential rain and flooding to the Gulf Coast region. The storm continued inland, tracking towards the Mid-Atlantic and Northeast.

On September 7, 2011, the remnants of the storm reached the Maryland area. That afternoon, the combination of a warm front moving across the area and the moisture from the remnants of Tropical Storm Lee produced heavy storms and flooding. With two to three inches of rain falling on already saturated soils, the heavy rains caused flash flooding throughout Maryland. Specific to Howard County, flash flood warnings were issued after heavy rains caused numerous rivers and creeks to rise. According the National Weather Service (NWS), the Little Patuxent River near Savage rose to 13.6 feet on September 7th, its highest level in five years.[79] [80]

The storms and flooding also resulted in numerous road closures. More than 40 road closures were reported in Howard County, including portions of Route 1 and Route 29. Columbia's South Entrance Road, which connects Little Patuxent Parkway to Route 29 Southbound, was closed in the early afternoon of September 7th.

The most significant flooding from Tropical Storm Lee occurred along Main Street in Historic Ellicott City, an area prone to flooding in the past. The swollen Patapsco River and Tiber Creek River both flooded parts of Main Street. Portions of the road on Main Street were covered in rushing water, causing pockets of water that were several feet deep. Several shops closest to the river and creek were flooded, with up to six feet of floodwater in their basements.[81] As a result of the flooding, the Howard County Department of Fire and Rescue Services (DFRS) evacuated the area from the County line to Cocoa Lane (the 8200 through 8500 blocks). Figures 6.4.4-8 through 6.4.4-10 show flooding along Main Street, as well as behind a municipal parking lot adjacent to Main Street.

[79] Lindsey McPherson, *Heavy Rains Batter County; Flood Warning Extended to Thursday Morning*, Baltimore Sun, September 7, 2001, available at http://www.baltimoresun.com/explore/howard/news/community/ph-ho-cf-flooding-0915-20110907,0,3036295.story.

[80] The highest level ever recorded there previously was 18.38 feet in June 1972 after Hurricane Agnes.

[81] *Maryland Historical District: Ellicott City Flooding From Tropical Storm Lee*, http://www.mdhistoricdistrict.com/ellicott-city-flooding-from-tropical-storm-lee/ (last accessed March 24, 2012).

Figure 6.4.4-8
Flooding in the Valley Mede Subdivision
(Source: Howard County Office of Emergency Management)

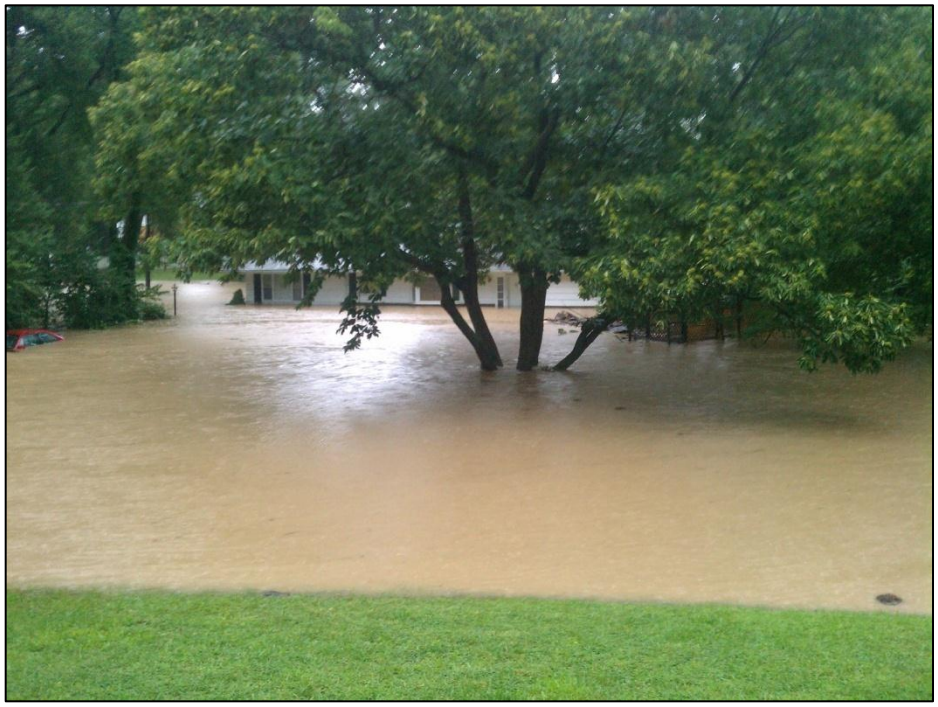


Figure 6.4.4-9
Tropical Storm Lee: Flooding Along Main Street Ellicott City
(Source: Elkridge Patch)

Figure 6.4.4-10
Tropical Storm Lee: Flooding at a Municipal Parking Lot in Historic Ellicott City
(Source: Baltimore Sun)

As a result of the flooding, a Presidential Disaster Declaration (FEMA DR-4038) was declared on October 5, 2011 for Howard County and several other Maryland counties.

With a total of 10 named tropical cyclones between 1950 and 2010, Howard County experiences a tropical cyclone on average approximately every six years. These 10 events occurred over a period of 60 years which, upon tabulation, equates to an expected 10% annual probability of future tropical cyclone occurrences in Howard County. While clearly it is possible for multiple tropical cyclones to occur in any given year, this result shows that these types of events have a medium probability of occurrence in Howard County.

6.4.5 Tornadoes and Wind Storms

Description of the Tornado and Wind Storms Hazard

A tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud."[82] Most of the time, vortices remain suspended in the atmosphere. When the lower tip of a vortex touches the earth, the tornado becomes a force of destruction.[83] Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the

[82] *Glossary of Meteorology*, American Meteorological Society (2000), available at http://www.spc.noaa.gov/faq/tornado/.
[83] Other definitions stress the destructive nature of tornadoes. For example, the Red Cross describes a tornado as a "violently rotating column of air extending from the base of a thunderstorm down to the ground." *Tornado Safety Checklist*, http://www.redcross.org/portal/site/en/menuitem.86f46a12f382290517a8f210b80f78a0/?vgnextoid=62a7da30df3ea110VgnVCM10000030f3870aRCRD (last accessed March 12, 2012).

hurricane eye. The most destructive tornadoes are formed in the most powerful thunderstorms, known as supercells, which have a well-defined radar circulation called a mesocyclone.[84]

Tornadoes can form any time, with the Nation's season of greatest activity running from March to August. The peak of tornado activity usually occurs in April, May, and June. According, the *2008 State of Maryland Hazard Mitigation Plan*, states that July is the peak month for tornado activity in Maryland. Tornadoes can occur at any time of the day, although they are more likely to occur between 3 p.m. and 9 p.m.

In terms of wind storms events, there are two basic types that may affect Howard County: Mesoscale and Microscale winds. Either type of wind storm events may result in property damage and loss of life. Mesoscale winds are high winds that are long-lasting and occur over a large area. They are typically associated with a cold frontal passages or a Nor'easter. Microscale winds last a short time period and are confided to a small area. Microscale winds are commonly associated with thunderstorms. When a thunderstorm produces winds over 50 knots (roughly 58 mph), that thunderstorm is considered severe.

A downburst, or a sub-set of thunderstorms, is a type of Microscale wind.[85] Downbursts results from a sudden descent of cold air hitting the ground and spreading outward, thus creating a high wind event. A downburst can have devastating effects. According to NOAA, there are two types of downbursts, a microburst and a macroburst. A microburst is a small downburst that brings damaging winds up to 168 mph, over an area of 2 ½ miles, and lasts 5 to 15 minutes. A macroburst is a large downburst that causes tornado-like damage, where winds can reach 134 mph, over an area of 2 ½ miles, and lasts 5 to 30 minutes.[86]

Location of the Tornado Hazard and Wind Storms

Compared to the Central United States, the risk of a tornado occurring in Howard County is present but relatively low. From 1950 to 2010, the NCDC database indicates that Maryland has experienced 294 tornadoes, an average of less than 5 per year.[87] Tornadoes can occur at any time, with the greatest frequency during the late spring and early summer months, and during late afternoon and early evening hours. Within Howard County, the risk to people and property from tornadoes cannot be distinguished by area; the hazard has a uniform probability of occurrence across the County. Although the impact of a tornado event will be different in different parts of the County, all people and assets are considered to have the same degree of exposure. This is the same for mesoscale (high wind) and microscale (thunderstorm wind) wind events.

Figure 6.4.5-1 shows how the frequency and strength of extreme windstorms that vary across the United States. This map is based on a combination of all past occurrences and shows that Central Maryland and Howard County falls within Wind Zone II, where wind speeds can reach as high as 160 mph.

[84] For additional information about tornadoes, see *NOAA's Severe Weather*, http://www.noaawatch.gov/themes/severe.php (last accessed April 9, 2012).
[85] See *National Weather Service's Downburst*, http://www.erh.noaa.gov/cae/svrwx/downburst.htm (last accessed April 9, 2012).
[86] For additional information about severe thunderstorms and high winds, see *NOAA's Severe Weather*, http://www.noaawatch.gov/themes/severe.php (last accessed April 9, 2012).
[87] To put these numbers into perspective, a state as large as Texas averages 139 tornadoes annually.

Figure 6.4.5-1
Wind Zones in the United States
(Source: FEMA)

Severity (or Extent) of the Tornado Hazard and Wind Storm Events

Tornado damage severity is currently measured by the Enhanced Fujita Tornado Scale (EF-Scale), named after Dr. T. Theodore Fujita, who introduced the scale in 1971. The original Fujita Scale (F-Scale) assigned numerical values based on wind speeds and the categorized tornadoes from 0 to 5, with the letter "F" often preceding the numerical value. The scale was based on tornado damage, correlated to the fastest ¼ mile wind speed at the height of a damaged structure. The miscalculation of two tornadoes in the 1990s revealed a problem of the F-Scale, namely the wind estimates in the F-scale were too high. As a result, a committee of meteorologist and engineers searched for a more accurate method of assessing the magnitude of tornadoes and then recalibrated the F-Scale by developing the Enhanced F-Scale. Table 6.4.5-2 is the original Fujita Scale.

Table 6.4.5-2
Fujita Tornado Measurement Scale
(Source: NOAA)

Category	Wind Speed	Examples of Possible Damage
F0	Gale (40-72 mph)	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted trees; damage to sign boards.
F1	Moderate (73-112 mph)	Moderate damage. Peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	Severe (158-206 mph)	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	Devastating (207-260 mph)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through air in excess of 100 yards; trees debarked; incredible phenomena will occur.

The Enhanced F-scale is a set of wind estimates based on observed damages after a tornado. It uses three-second gusts estimated at the point of damage. It is also based on a judgment of eight levels of damage and 28 indicators that include various commercial and residential building types, transmission towers, poles, and trees. Similar to the original scale, the new Enhanced F-scale includes five classes ranging from EF0 to EF5. The wind speeds from the Fujita Scale were used as the basis for development of the Enhanced F-scale.

Table 6.4.5-3 displays the wind speed ranges for the original Fujita Scale, the derived wind speeds (Enhanced F-Scale), and the new Enhanced F-Scale currently in use since February 2007. [88]

Table 6.4.5-3
Wind Speed Comparison of the Fujita Scale and Enhanced Fujita Scale
(Source: NOAA – National Weather Service)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

Within the planning area, it is possible for a tornado of any magnitude to occur, with the probability decreasing as the intensity scale increases. Tornadoes can impact Howard County equally and uniformly. Although the NCDC indicates the strongest historical tornado in Howard County was rated F2 on the Fujita scale[89], the potential for extreme atmospheric instability allows for the possibility that tornadoes in the planning area could reach EF-4 or EF-5 severity. For example, on April 28, 2002, an F4 tornado struck La Plata in Charles County, which killed three, injured 122 people, and caused over $138.5[90] million in damages. Charles County's climate conditions are fairly similar to Howard County, and its proximity suggests that a similar tornado may occur within the County. A tornado of this magnitude would potentially cause catastrophic damage to a localized area in Howard County.

Maryland has experienced over 3,000 thunderstorm wind events since 1969, and 178 high wind events since 1993, based on the NCDC database.[91]

Impact on Life and Property

Tornadoes pose a significant threat to life and safety in Howard County. When a tornado is on the ground, all citizens in its path are potentially in danger of injury or death. Infrastructure is also at risk from tornadoes. Historically, lightly constructed residential structures (such as manufactured housing like mobile homes) located within the planning area are most vulnerable to a tornado hazard. The NCDC database reports there have been two injures from tornadoes in Howard County.[92] The nine tornadoes that have

[88] For more information about both the Fujita Scale and the Enhanced Fujita Scale, please see *Storm Prediction Center, The Enhanced Fujita Scale*, http://www.spc.noaa.gov/efscale/ (last accessed April 9, 2012).
[89] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).
[90] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.
[91] Supra note 84.
[92] Id.

impacted Howard County have cumulatively caused an estimated $3.89 million in property damage.[93] Most of the damage was limited to downed trees, blown shingles off roofs, and disabled power lines.

Thunderstorm wind events have injured four and caused over $600,000 in property damage according to the NCDC database. High wind events have caused six injures and over $2 million in property damage.

Occurrences of the Tornado Hazard and Wind Storms

The NCDC database reports that nine tornadoes have occurred in Howard County between 1975 and 2011. The database indicates there were four F0s, three F1s, and two F2s tornadoes. Table 6.4.5-4 summarizes the nine tornadoes that have occurred within Howard County.

Table 6.4.5-4
Howard County: Tornado Events 1975 – February, 2011
(Source: NOAA/NCDC)

9 TORNADO(s) were reported in **Howard County, Maryland** between **01/01/1950** and **02/28/2011**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

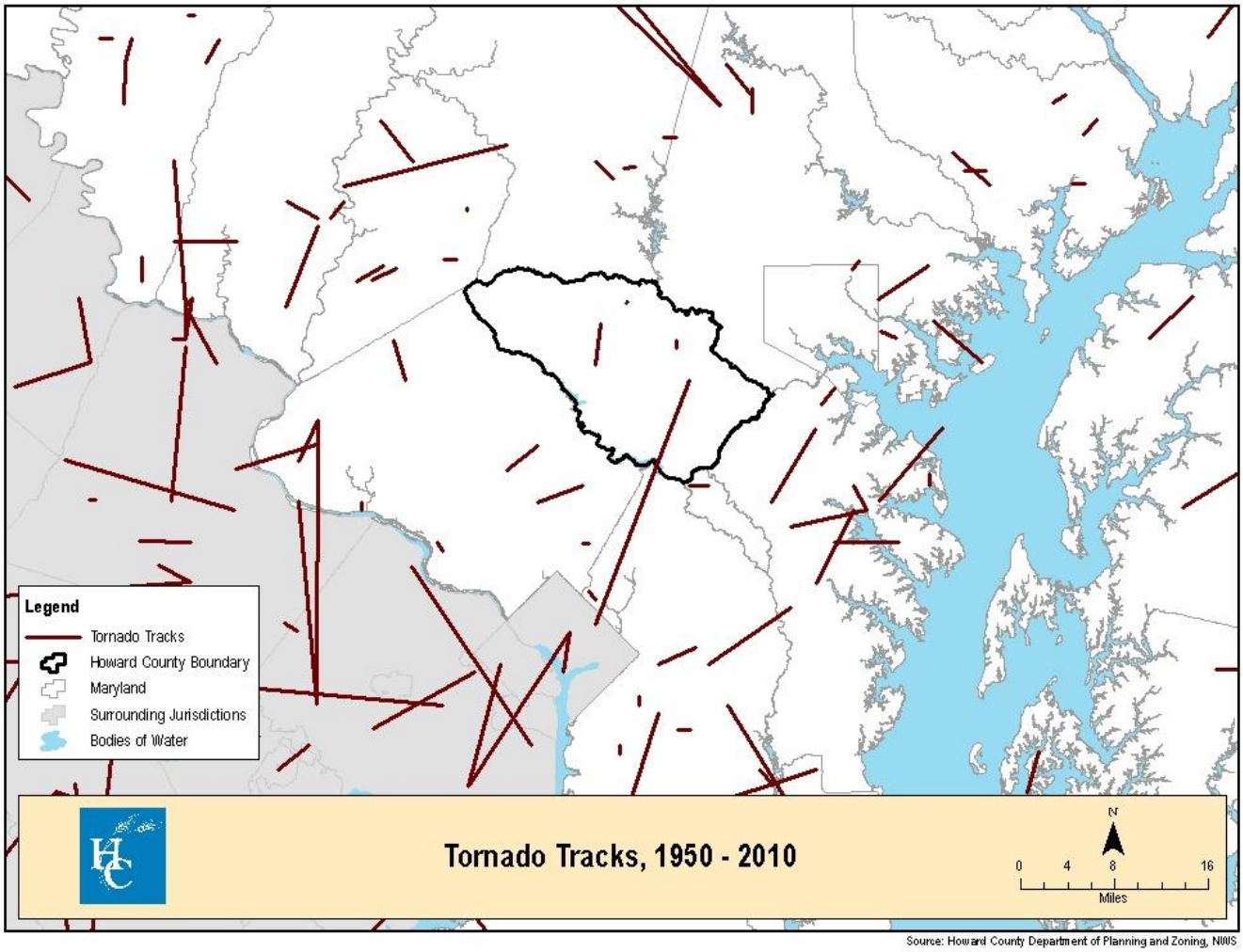
Maryland

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 HOWARD	07/03/1975	1535	Tornado	F0	0	0	0K	0
2 HOWARD	07/31/1978	1915	Tornado	F2	0	0	250K	0
3 HOWARD	08/28/1992	1500	Tornado	F1	0	2	2.5M	0
4 HOWARD	08/28/1992	1520	Tornado	F0	0	0	3K	0
5 West Friendship	07/06/1995	1607	Tornado	F0	0	0	75K	0
6 Columbia	08/27/1996	01:50 PM	Tornado	F0	0	0	15K	0
7 Savage	07/10/2000	04:30 PM	Tornado	F1	0	0	50K	0
8 North Laurel	09/24/2001	04:41 PM	Tornado	F2	0	0	1.0M	0
9 Alpha	07/31/2009	13:42 PM	Tornado	F1	0	0	0K	0K
				TOTALS:	0	2	3.893M	0

[93] Id.

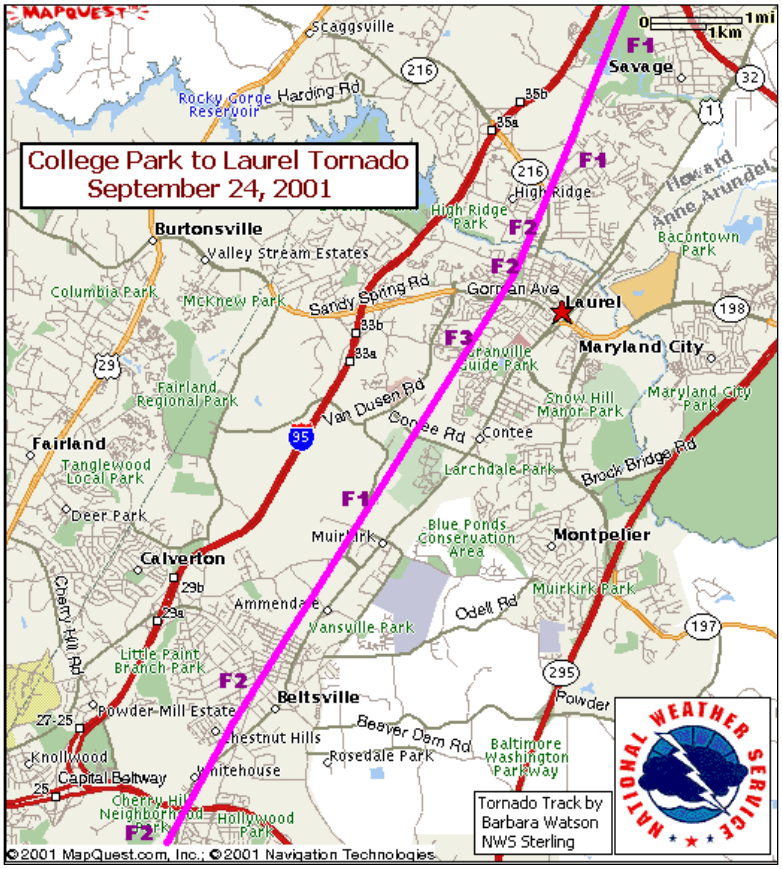
Figure 6.4.5-5 identifies the tornado tracks for Howard County and the surrounding area between 1950 and 2010.

Figure 6.4.5-5
Tornado Tracks for Howard County and Surrounding Area, 1950- 2010
(Source: NOAA, Howard County Department of Planning and Zoning)



Howard County has experienced two F2 tornadoes since 1975. The July 31, 1978 tornado was estimated to be 40 yards wide and travelled for a length of $^{8}/_{10}$ of a mile, causing $826,000[94] in damage. The tornado of September 24, 2001 originated in Prince George's County as an F3 and travelled north-northeast from Hyattsville, through College Park, and into Laurel. Along its destructive path, the tornado killed two and injured 55. Just before the tornado crossed into Howard County, it weakened from a F3 to an F2 tornado. In Howard County, the tornado caused severe damage to several townhomes in Settler's Landing, a subdivision in North Laurel. As the tornado continued northward, it slowly dissipated and ended one mile east-southeast of Columbia. The tornado traveled a total distance of six miles in Howard County and had a width of 100 yards. Along its destructive path, the tornado uprooted trees, blew off rooftops, and blew out car windows. Many homes were deemed unsafe for a period of time, and one was severely damaged. Property damage in Howard County was estimated at $123.4 million.[95] The tornado caused no fatalities or injures. Figure 6.4.5-6 shows the College Park tornado track as it moved northeast from Beltsville to Laurel.

Figure 6.4.5-6
September 24, 2001 Tornado Track – College Park to Laurel
(Source: National Weather Service – Baltimore/Washington Office, September 24, 2001 Tornadoes)



[94] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.
[95] Id.

Additional significant tornado events that have impacted Howard County are described below.

- **July 6, 1996 (F0 Tornado):** A small tornado briefly touched down in a wooded area, just south of Interstate 70 near the Marriottsville Road Exit. The tornado was only 20 yards wide and traveled $^{1}/_{10}$ of a mile. One house between Marriottsville and Ellicott City was heavily damaged by a falling tree. In total, an estimated $103,100[96] in property damage occurred.
- **August 27, 1996 (F0 Tornado):** A small tornado caused damage to several subdivisions along Frederick Road north of Columbia. A total of four trees were knocked down, including two trees that were blown into a home on Pine Bluffs Drive. The NCDC database estimates that there was $20,600[97] in property damages.
- **July 10, 2000 (F1 Tornado):** The tornado touched down three miles southeast of Savage. It brought down several trees and power lines. It also blew over two trailers and three semi-tractor trailers. In Howard County, the tornado was 100 yards wide and traveled $^{6}/_{10}$ of a mile before moving into Anne Arundel County. The tornado resulted in $62,600[98] in property damage.

With a total of nine tornado events between 1975 and 2011, Howard County experiences, on average, one tornado every four years. Based on this information, it is possible to infer an approximate 26% annual probability of occurrence countywide. Depending on atmospheric conditions, it is possible for any number of tornadoes to occur in any given year. Based on the history of tornadoes in Howard County, there is a high probability of future tornadoes occurring in the Howard County.

The NCDC database reports that 115 thunderstorm wind events have occurred in Howard County between 1969 and 2011. Of the 115 events, six included winds of 60 knots (69 mph) or greater.

[96] Id.
[97] Id.
[98] Id.

Table 6.4.5-7 summarizes the six high wind events in Howard County with greater than 60 knot winds.

Table 6.4.5-7
Howard County: Thunderstorm/High Wind Events Over 60 Knots,
Excluding Tornado Winds, 1950 – February, 2011
(Source: NOAA/NCDC)

Six Thunderstorm Winds event(s) were reported in Howard County, Maryland between 01/01/1950 and 12/31/2011.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

	Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1	Howard	6/29/1978	1800	Thunderstorm Wind	70 kts.	0	0	0	0
2	Ellicott City	05/31/2002	02:25 PM	Thunderstorm Wind	65 kts.	0	0	150K	0
3	Elkridge	05/25/2004	06:15 PM	Thunderstorm Wind	60 kts.	0	0	1K	0
4	Ellicott City	06/01/2004	02:10 PM	Thunderstorm Wind	60 kts.	0	0	3K	0
5	Alpha	07/31/2009	13:40 PM	Thunderstorm Wind	65 kts.	0	0	0	0
6	Howard	07/03/2011	17:00 PM	Thunderstorm Wind	61 kts.	0	0	5K	0
						0	0	159K	0

The database indicates that there were two thunderstorm wind events that caused over $50,000 in damages. On May 15, 1994, a thunderstorm, with winds exceeding 50 knots, damaged several homes and knocked down numerous trees in the central and eastern portions of the County. The total impact was estimated to be $72,500[99] in property damages. On May 13, 2002, a 75 mph downburst occurred within a 10 square block area northwest of Ellicott City. Numerous trees were brought down and the downburst caused widespread power outages. Two homes were heavily damaged by downed trees. The estimated total property damage for the downburst was $180,600.[100]

[99] Id.
[100] Id.

Additional significant thunderstorm wind events that have impacted Howard County are described below.

- **July 30, 1996:** A severe thunderstorm moved from east to west across the County. The storm brought down trees and power lines, and caused an estimated $20,600 in property damage and another $2,700 in crop damage. [101]
- **August 26, 2003:** A line of severe thunderstorms with winds up to 78 mph moved across the County during the afternoon hours. There were numerous reports of downed trees and power lines throughout the County and caused an estimated $17,700[102] in property damage.
- **June 1, 2006:** A low pressure trough, combined with upper level moisture and atmospheric instability, caused strong severe thunderstorms to ravage the area. The winds from these storms caused $27,000[103] in damage.
- **September 28, 2006:** As a cold front moved into the region during the afternoon, it spawned several thunderstorms. The most intense thunderstorm occurred along the Interstate 95 Corridor. In total, the storms caused an estimated $37,800[104] in property damage.

With a total of 115 thunderstorm wind events between 1969 and 2011, Howard County experiences on average 2.7 thunderstorm wind events per year. With 2.5 storms per year, there is a 100% annual probability of a thunderstorm wind event occurring in Howard County. Based on the history of past thunderstorm and high wind events, there is a high probability of these events occurring in Howard County in the future. Although the probability is high, the impact on life and property in the planning area will probably be minimal as compared to other hazards.

The NCDC database reports there have been 11 high wind events between 1993 and 2011 (excluding the wind events that were related to the remnants of a tropical cyclone). The most destructive high wind event in Howard County occurred on January 14, 2006. Not only did strong winds bring down trees and power lines which left tens of thousands without power for an extended period, it caused an estimated $1.7[105] million in property damages throughout the region.

Other high wind events include:

- **February 24, 1996:** With a storm over the Canadian Maritimes and a high pressure ridge over the Southeast United States, a strong wind gradient was created in the Mid-Atlantic. A steady wind of 25 to 35 mph, with gust up to 60 mph, was felt throughout the region. Over 22,000 homes were left without power.
- **March 19, 1996:** A low pressure system over the Ohio Valley produced gusts as high as 58 mph. The winds caused an estimated $103,100[106] in property damage and injured six individuals across the region.
- **February 10, 2008:** A strong cold front brought wind gusts in excess of 60 mph, with some areas in the region reporting gusts in excess of 40 mph for several hours. In Howard County, the winds caused an estimated $10,100[107] in property damage.

[101] Id.
[102] Id.
[103] Id.
[104] Id.
[105] Id.
[106] Id.

With a total of 11 high wind events between 1993 and 2011, Howard County experiences on average 1.5 high wind events per year. Based on this information, it is possible to infer an approximate 64% annual probability of occurrence. Also, the past history shows there is a high probability of future high wind events occurring in Howard County.

6.4.6 Lightning

Description of the Lightning Hazard

Lightning events are generated by atmospheric imbalance and turbulence due to a combination of conditions. Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees Fahrenheit.[108]

Location and Extent of the Lightning Hazard

Individual lightning strikes typically affect a relatively small geographic area. Lightning affects the entire County equally, particularly during the warmer months of the year.

Severity of the Hazard

Severe lightning events can occur anywhere in the planning area. The lightning current can branch off to strike a person from a tree, fence, pole, or other tall object. In addition, electrical current may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or other tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture. Lightning may damage property or cause fires using similar processes as outline above.

Impact on Life and Property

People and property are exposed to damage, injury, and loss of life from lightning in virtually the entire United States. According to the National Weather Service, the United States averaged 55 reported lightning fatalities per year from 1981 to 2010, with 495 people suffering some various degrees of injuries.[109] Most lightning-related deaths and injuries occurred when people were outdoors during summer afternoons and evenings.

Between 1995 and 2005, the NCDC did not identify any injuries or deaths in Howard County resulting from lighting strikes. However, total property damage from lightning strikes was estimated at $935,000.

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[107] Id.

[108] For additional information about lightning, see NOAA's *Severe Weather*, http://www.noaawatch.gov/themes/severe.php (last accessed April 9, 2012). See also generally *NOAA National Weather Service's Glossary*, http://www.weather.gov/glossary/index.php?letter=l (last accessed March 31, 2012).

[109] *National Weather Service's Lightning Safety*, http://www.lightningsafety.noaa.gov/medical.htm (last accessed March 31, 2012).

Occurrences of the Lightning Hazard

The NCDC database identified seven lightning events in Howard County between 1950 and 2011. Like other hazards, the list appears to only account for events from 1950 onwards. The seven events in the database listed occurred between 1994 and 2006. This indicates additional events outside this period are unlikely captured in the database. Although many more lightning events may have occurred, they were not reported to the NCDC.

Table 6.4.6-1 below summarizes the significant lighting events that have occurred in Howard County between 1994 and 2011.

Table 6.4.6-1
Lighting Events, Howard County, 1994 – February, 2011
(Source: NOAA/NCDC)

7 LIGHTNING event(s) were reported in **Howard County, Maryland** between **01/01/1950** and **02/28/2011**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Maryland

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 HOWARD	05/15/1994	1745	Lightning	N/A	0	0	5K	0
2 Columbia	07/08/1996	06:05 PM	Lightning	N/A	0	0	75K	0
3 Columbia	08/07/2000	07:47 PM	Lightning	N/A	0	0	100K	0
4 Clarksville	08/11/2001	03:38 PM	Lightning	N/A	0	0	100K	0
5 Clarksville	08/03/2002	02:00 PM	Lightning	N/A	0	0	500K	0
6 Hanover	08/10/2004	03:44 PM	Lightning	N/A	0	0	55K	0
7 Ellicott City	06/01/2006	06:10 PM	Lightning	N/A	0	0	100K	0
				TOTALS:	0	0	935K	0

The event causing the most property damage occurred on August 3, 2002, when a lightning strike destroyed a home in Clarksville along Talon Court. This event caused approximately $602,000[110] in property damage.

Howard County experiences a significant lightning event approximately once every two years. Averaging these seven events over a period of 17 years equates to a 43% annual probability of future lightning occurrences. The probability of lightning impacting Howard County is presumed to be about the same as it has been in the past. Based on historical data, the future probability of lightning strikes is reasonably high with a severe strike impacting the planning area every couple of years. However, the damage associated with these events is usually minor and not widespread.

6.4.7 Earthquake

Description of the Earthquake Hazard

An earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Tectonic plates become stuck, thus putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the Earth's surface, earthquakes may manifest themselves by a shaking or

[110] The figure has been adjusted for inflation and is provided in 2010 dollars, based on the Consumer Price Index.

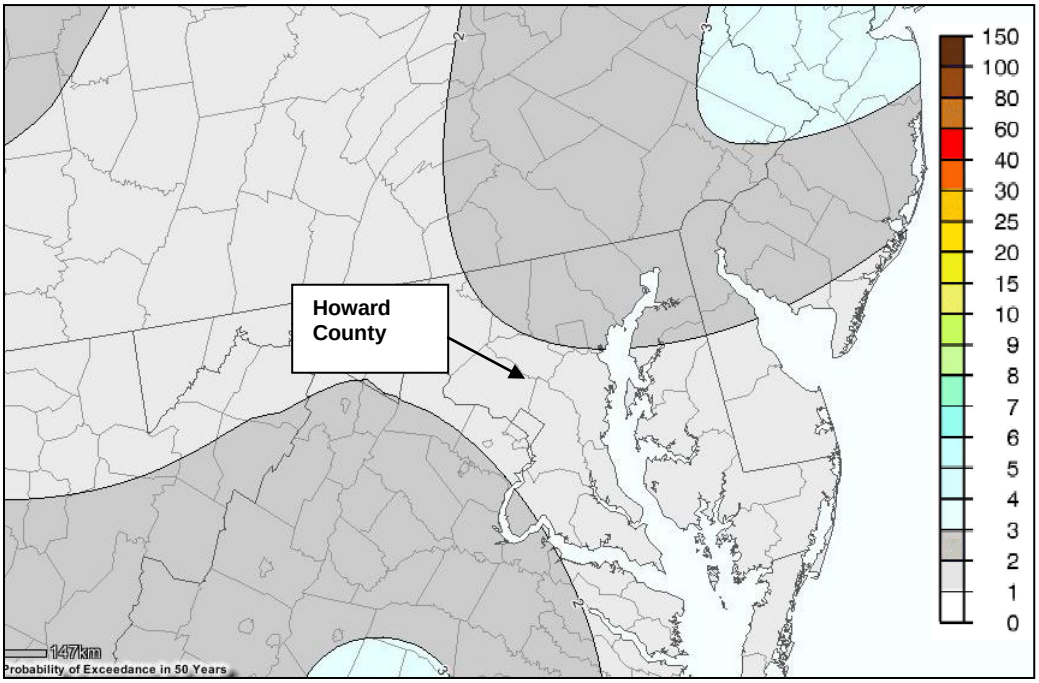
displacement of the ground. This may lead to loss of life and destruction of property. The size of an earthquake is expressed quantitatively as magnitude[111], while local strength of shaking is expressed as intensity.

Location of the Earthquake Hazard

The entire planning area is susceptible to the effects of earthquakes. The map shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years. The map shows a 1% to 2%*g* (the acceleration of gravity) range across most of Central Maryland, including Howard County. The *FEMA How-To Guidance*[112] suggests an earthquake hazard should be profiled if the pga is greater than 3%*g*.

Figure 6.4.7-1 displays the Mid-Atlantic portion of a United States Geological Survey (USGS) earthquake hazard map produced in 2008.

Figure 6.4.7-1
Seismic Hazard Map, showing Peak Ground Acceleration in Percent of G, with 10% exceedence in 50 years
(Source: USGS, 2008)



Severity of the Earthquake Hazard

The severity of earthquakes is influenced by several factors, including the depth of the earthquake, the geology in the area, and the soils. The severity of soil liquefaction is dependent on the soils grain size, thickness, compaction, and degree of saturation. Small earthquakes are possible almost anywhere, and all regions face possible ill effects from very large and distant earthquakes.

[111] The inherent size of an earthquake is commonly expressed using a magnitude.
[112] FEMA 386-2, *FEMA How-To Guidance; Understanding Your Risks*, p 1-7 (2001).

Earthquakes with epicenters in Central Maryland are rare. Most past earthquakes in Maryland have been of low magnitude. However, it is possible for earthquakes to occur in this region of the State. As shown in Figure 6.4.7-1, the probability of a severe earthquake in the area is relatively low. However, Howard County could be affected by very large and distant quakes. Based on past earthquake occurrences in Howard County, an earthquake in the magnitude 2 to 3 range could be possible in the planning area.

Impact on Life and Property

There are no known deaths or injuries from earthquakes in Howard County. Because of the nature of the built environment, the effects on life and property in the planning area could be significant if a large earthquake were to occur. The County is home to many structures that were built long before the advent of building codes, and many such structures are made of unreinforced masonry, which is particularly susceptible to damage during earthquakes. Given the relatively low probability of earthquakes of significant magnitude affecting the area, the potential impacts are relatively minor.

Occurrences of the Earthquake Hazard

Historically, there has been no record of earthquakes with an epicenter in Howard County, but the County has experienced minor shaking from earthquakes located outside of the region. Maryland's USGS earthquake history was reviewed to identify past earthquake occurrences that have impacted Howard County. The State's earthquake history shows there have been seven significant earthquakes felt within the State between 1900 and 2010. Of these seven events, the USGS's earthquake descriptions indicate that while several of these events were felt in Howard County, but none had a significant impact on the County nor were any damages or injuries reported.[113]

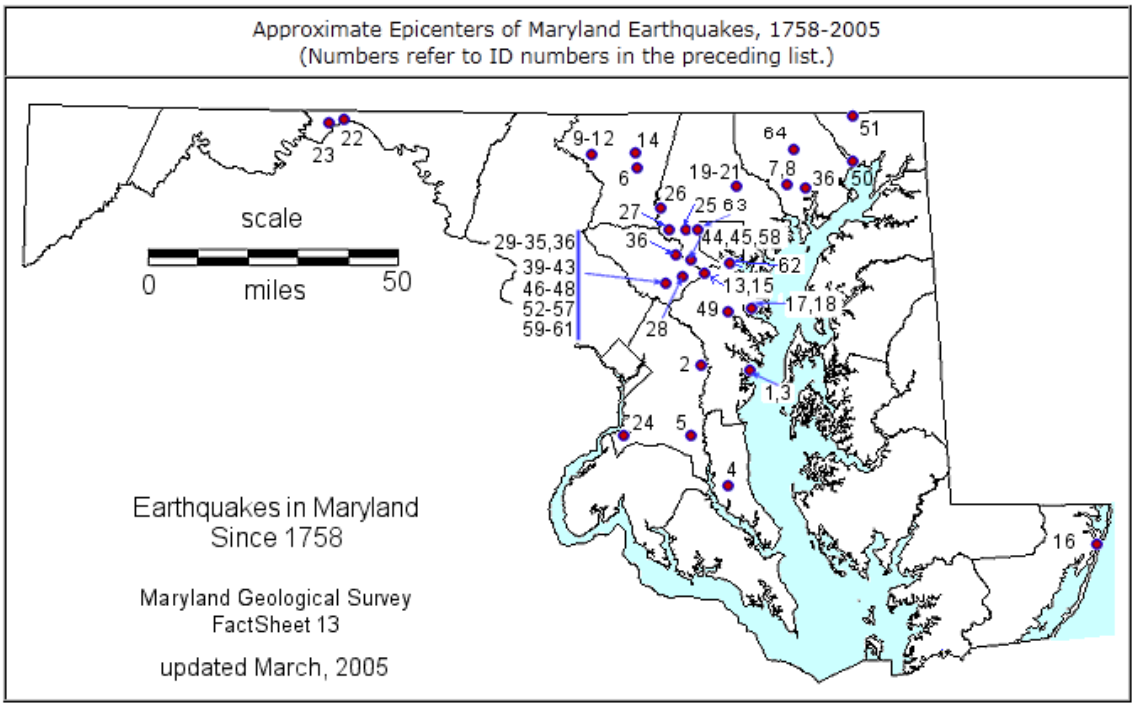
The USGS shows the earliest recorded earthquake with its epicenter in Maryland occurred in Annapolis on April 24, 1758. The shock lasted 30 seconds and could be felt as far away as Pennsylvania. In recent years, moderate-sized earthquakes in nearby states have been felt in Maryland with only minimal effects. On November 19, 1969, a 4.3 magnitude earthquake near Elgood, West Virginia was felt in Central Maryland, including Howard County. On February 28, 1973, residents throughout the Mid-Atlantic region were jolted awake by shock waves from a minor earthquake near the Delaware/New Jersey/Pennsylvania border. Numerous points in Northeastern Maryland reported this earthquake.[114]

Data from the Maryland Geological Survey (MGS) indicates there have been 64 earthquakes with epicenters in Maryland. Of these 64 earthquakes, 26 affected localities within Howard County.[115] Review of the events with epicenters in Howard County indicates these were all minor events, ranging in magnitude between 1.0 and 2.5.

[113] USGS' Maryland Earthquake History, http://earthquake.usgs.gov/earthquakes/states/?region=Maryland (last accessed April 9, 2012).
[114] Id.
[115] See Summary of Maryland Earthquakes, 1758- 2005, http://www.mgs.md.gov/esic/fs/fs13.html (last accessed June 8, 2012).

Figure 6.4.7-2 shows the approximate epicenters of these earthquakes that occurred between 1758 and 2005.

Figure 6.4.7-2
Approximate Epicenter of Maryland Earthquakes
(Source: Maryland Geological Survey, Fact Sheet 13, March 2005)[116]

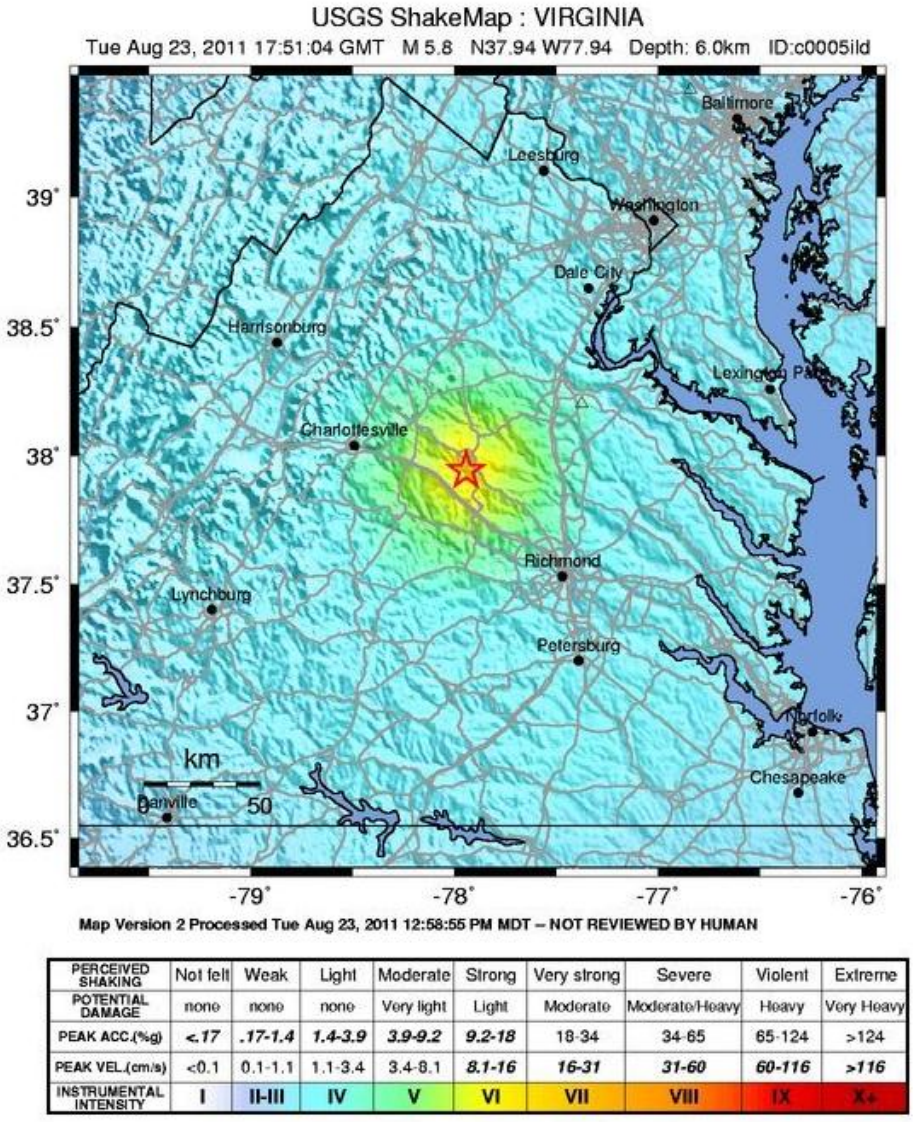


On August 23, 2011, Maryland experienced the effects of a nearby earthquake when a magnitude-5.8 quake centered in Virginia impacted much of the East Coast. Tremors were felt as far south as North Carolina, as far north as Buffalo and Boston, and as far west as Detroit. The epicenter of the earthquake was about 3.5 miles beneath Mineral, Virginia, which is 35 miles northwest of Richmond. The USGS indicated the earthquake was one of the strongest ever to occur in Virginia and the strongest felt in Maryland. After the ground shook for several seconds, buildings were evacuated and some businesses and agencies shut down for the afternoon. Rail travel was interrupted, and many commuters faced an early, congested rush hour.[117] Damage inspections after the earthquake found structural damage was limited, although in some areas there were significant localized damages. In Howard County, many residents were startled by the earthquake but there was no significant damage or injuries reported.[118]

[116] The reference numbers corresponds with a list of earthquakes from the Maryland Geological Survey. See *Summary of Maryland Earthquakes: 1758-2005*, http://www.mgs.md.gov/esic/fs/fs13.html (last accessed April 9, 2012).
[117] Calvert, Scott and Childs Walker, *Earthquake in Virginia Rattles Baltimore and the East Coast*, Baltimore Sun, August 23, 2011, available at http://articles.baltimoresun.com/2011-08-23/news/bs-md-earthquake-20110823_1_maryland-geological-survey-earthquake-smaller-temblors.
[118] Howard County County Administration, *Howard County Earthquake Update*, August 23, 2011.

Figure 6.4.7-3 below is a USGS "shake map" that shows the intensity of shaking from the Mineral earthquake. Note that the area west of Baltimore, where Howard County is located, experienced weak to low shaking intensity and no expected damages.

Figure 6.4.7-3
USGS Shake Map for the Mineral, Virginia Earthquake of 2011



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

The likelihood of significant earthquake damage in Howard County is low since the probability of the area being stricken by an earthquake is relatively low as compared to other parts of the country. Even though earthquakes do occur occasionally, the County is located in an area of very low seismic activity. Because of the very low risk associated with this hazard, a detailed risk assessment was not completed for earthquakes.

6.4.8 Drought and Extreme Heat

Description of the Drought Hazard

A drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and humans over a sizeable area."[119] It usually refers to a period of below-normal rainfall, but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions.[120]

Location of the Drought Hazard

Droughts may occur anywhere in the United States. Different regions may be affected by drought conditions differently, depending on normal meteorological conditions (such as precipitation and temperature) and geological conditions (such as soil type and subsurface water levels).

Drought is possible throughout the planning area, and in the Central Maryland region in general. As there is no defined geographic boundary for this hazard, all properties within Howard County are exposed equally to the risk of drought. The probability of a drought occurring in any specific region depends on atmospheric and climatic conditions.

Duration and frequency can be used as indicators of potential severity. Variation in drought risks to people and property cannot be distinguished by area. The hazard has a uniform probability of occurrence across the entire County.

Severity and Extent of the Drought Hazard

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low humidity. Due to its multi-dimensional nature, drought is difficult to define in exact terms, which makes comprehensive risk assessments difficult.

One method used by scientists to calculate the severity and duration of a drought is the Palmer Drought Severity Index (PDSI). The PDSI indicates the prolonged and abnormal moisture deficiency or excess and indicates general conditions, not local variations caused by isolated rain. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather.[121]

The equation for the PDSI was empirically derived from the monthly temperature and precipitation scenarios of 13 instances of extreme drought in Western Kansas and Central Iowa and by assigning an index value of -4 for these cases. Conversely, a +4 represents extremely wet conditions. From these

[119] *Definition of Drought*, http://md.water.usgs.gov/drought/define.html (last accessed April 9, 2012).
[120] For additional information about droughts, visit the National Integrated Drought Information System (NIDIS), www.drought.gov (last accessed April 9, 2012).
[121] *National Weather Service's Climate Prediction Center: Explanation*, http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/wpdanote.shtml (last accessed April 9, 2012).

values, seven categories of wet and dry conditions can be defined. Table 6.4.8-1 identifies the values used to define the PDSI.[122]

Table 6.4.8-1
Palmer Drought Severity Index
(Source: NOAA, National Weather Service - Climate Prediction Center)

Palmer Drought Severity Index
-4.0 or less (Extreme Drought)
-3.0 or -3.9 (Severe Drought)
-2.0 or -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 or +2.9 (Unusual Moist Spell)
+3.0 or +3.9 (Very Moist Spell)
+4.0 or above (Extremely Moist)

Impact on Life and Property

Droughts have the ability to impact many sectors of the economy, and reaches well beyond the area experiencing the physical drought. The impacts droughts may have on a community are commonly categorized as either "direct" or "indirect." Reduced crop productivity, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat are a few examples of direct impacts. Drought can cause extensive damage to commercial and residential structure foundations, framing and walls, levees, roads, bridges, pipelines, and other integral infrastructure. Indirect impacts of drought include increased prices for food, unemployment, and reduced tax revenues due to reduced supplies of agriculture products dependent upon rainfall.

All residents of Howard County could be adversely affected by drought conditions, which could limit water supplies and create health threats. During summer droughts, elderly persons, small children, infants, and the chronically ill who do not have adequate cooling units in their homes may be more vulnerable to injury and/or death.

The NDCD indicates droughts have caused no injuries, deaths or property damage in the planning area.[123] The drought hazard affects all residential and commercial building types equally within the planning area. Data related to the number of structures by building type and past damages for specific building types was unavailable at the time of the NHMP update.

Occurrences of the Drought Hazard

According to the NCDC database, Howard County has experienced 13 drought events from 1950 to 2011. All 13 events occurred between 1995 and 2007. The database provides no indication as to why no events were listed prior to 1995, although presumably occurrences followed the same pattern and frequency as shown in the NCDC list. Also note that the events are listed by months. If a drought lasted several

[122] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.
[123] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).

continuous months, it is listed in the database as separate events. If the continuous months are combined into single events, the number of events is reduced from 13 to 7 events.

With a total of seven significant drought events between 1995 and 2011, Howard County experiences a severe drought event, on average, approximately once every two years. The seven events have occurred over a period of 16 years, which equates to approximately a 46% annual probability of future drought occurrences. Based on previous occurrences, it is reasonable to assume that droughts will continue to occur in Howard County. It is also equally reasonable to assume that the impact will be reasonable with no projected injuries, deaths, or property damage.

Description of the Extreme Heat Hazard

Temperatures that are significantly above normal are considered extreme temperatures, even though there is no specific point at which it is determined as such. However, the National Weather Service will initiate alert procedures such as special weather statements when the heat index is expected to exceed 105 - 110 degrees Fahrenheit (depending on local climate) for at least two consecutive days.[124] Heat stress can be indexed by combining the effects of temperature and humidity.

Location of the Extreme Heat Hazard

The entire planning area is subject to the hazards associated with extreme temperatures from high heat.

Severity of Extreme Heat

The severity of extreme temperature events is measured by temperature, duration, and humidity. Most events are less than a week in duration. In Northeastern United States, periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years. The passing of a cold front usually moderates temperatures after a few days to a week.

Impact on Life and Property

The NCDC database combines the extreme cold and extreme heat into temperature extremes. The results of the database query indicate there have been 91 deaths, 432 injuries, and $30,000 in property damage in Howard County from excessive heat-related events. However, review of the detailed summary for each event indicates that most of the deaths and injuries occurred in Baltimore City and its surrounding counties. Thus, NCDC's Howard County death and injury statistics for past extreme heat events appears to cover all of Central Maryland. The extreme heat event causing the most injuries and deaths occurred on July 4 – 7, 1999. High pressure acted like a heat pump and drew extremely warm and humid air into the Mid-Atlantic region. Temperatures on the 4th through the 7th were oppressively hot, and extremely humid conditions added to the misery. This event resulted in 15 deaths and 241 injuries.[125] From the description provided in the NCDC database, most of these deaths and injuries occurred in Baltimore City.

[124] For more information, see *Excessive Heat – NOAAWatch*, http://www.noaawatch.gov/themes/heat.php (last accessed March 12, 2012).
[125] See *NCDC Storm Events*, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms (last accessed February 27, 2012).

The extreme heat hazard can be moderately disruptive to life in the planning area. Damages from the extreme heat hazard are generally confined to individuals, although there may be relatively minor effects on infrastructure, such as electrical grids.

Occurrences of Extreme Heat Hazard

The NCDC database indicates there have been 21 recorded extreme temperature events related to high heat in Howard County during the period of 1950 to February of 2011. Although the query results begin in 1950, the first reported event was in 1995. There are most likely additional extreme heat events prior to 1995 that are not captured in the NCDC database. The database provides no indication as to why there are no events prior to 1995, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list.

Table 6.4.8-2 lists the seven extreme heat events from the NCDC for Howard County that have resulted in both injuries and deaths.

Table 6.4.8-2
Reported Extreme Temperature Events, Howard County Resulting in Injuries and Deaths, 1995 – 2010
(Source: NOAA/NCDC)

6 TEMPERATURE EXTREMES event(s) were reported in **Howard County, Maryland** between **01/01/1950** and **02/28/2011** with **at least 1 deaths** with **at least 1 injuries**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Maryland

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 MDZ003>010 - 013>017	07/14/1995	1200	Excessive Heat	N/A	8	31	30K	0
2 MDZ002>007 - 009>011 - 013>014 - 016>018	07/13/1997	11:00 AM	Excessive Heat	N/A	2	100	0	0
3 MDZ002>007 - 009>011 - 013>014 - 016>018	08/16/1997	11:00 AM	Excessive Heat	N/A	1	50	0	0
4 MDZ003>007 - 009>011 - 013>014 - 016>017	07/20/1998	11:00 AM	Excessive Heat	N/A	2	2	0	0
5 MDZ002>007 - 009>011 - 013>014 - 016>018	07/04/1999	04:00 AM	Excessive Heat	N/A	15	241	0	0
6 MDZ002>007 - 009>011 - 013>014 - 016>018	08/01/2006	01:00 PM	Heat	N/A	6	5	0	0
				TOTALS:	34	429	30K	0

Based on the 21 events between 1995 through 2011, on average, an extreme heat event occurs one or two times per year. Based on NCDC historical data, extreme heat events will continue to occur in the County at least annually, but with relatively minor impacts on life and property.

6.5 Methodology for Identifying Hazards of Concern

The Interim Final Rule (IFR) requires all potential hazards that affect Howard County to be profiled in this section of the NHMP. Since this is a County-level hazard mitigation plan, it may be useful to concentrate

on hazards that have a greater impact on the region. Various National, Regional, and Local sources were used to identify and classify different hazards for Howard County. The criteria used were:

1. **History** – incorporating historical accounts and records that the hazard has affected the County often in the past, and that the hazard has occurred often and/or with widespread or severe consequences.

2. **Potential for mitigation** – acknowledging that there are ways to address the hazard and that the methods are technically feasible and have the potential to be cost-effective (i.e. mitigation measures that are available at a reasonable cost, and damages to property, lives, and/or community functions would be reduced or eliminated).

3. **Presence of susceptible areas or vulnerability** – indicating that Howard County has numerous facilities, operations, or populations that may be subjected to damage from the hazard.

4. **Data availability** – demonstrating that sufficient quality data is available to permit an accurate and comprehensive risk assessment.

5. **Federal disaster declarations and local emergency declarations** – noting that Howard County has received numerous disaster declarations for the particular hazard.

The table on the following page lists the hazards, describes the rationale for identifying (or not identifying) hazards as significant, shows the sources of information that were consulted in this determination, and the disposition of the hazard for the NHMP. The initial hazards in the shaded portion of the table are those that were identified by Howard County's NHM Planning Work Group as sufficiently significant to warrant a full risk assessment in Section 7.

However, it is important to note that many hazards and risks are site-specific. Thus, without further detailed risk assessments, this process and the resulting table should only be viewed as a guide.

Table 6.5-1
Howard County Qualitative Hazard Ranking

Hazard	Rationale	Sources	Disposition
Floods	Widespread impacts, history of occurrences in the County, significant annual damages	• FEMA Flood Insurance Studies • FEMA Flood Insurance Rate Maps • FEMA Public Assistance records • FEMA National Flood Insurance Program claims data • US Army Corps of Engineers (USACE), and National Oceanographic and Atmospheric Administration (NOAA), studies and records • NOAA's National Climatic Data Center (NCDC)	Profile and risk assessment
Hurricanes/Tropical Storm/High Winds	Relatively high annual probability with moderate to severe impacts, potential for widespread losses, history of occurrences in the County	• NOAA • NCDC • National Hurricane Center	Profile and risk assessment, with emphasis on wind hazard
Severe Winter Storms	Low to moderate annual probability with the potential for widespread impacts	• NOAA • NCDC • National Weather Service (NWS) – Baltimore/Washington - Office	Profile and risk assessment
Tornados	High annual probability, widespread impacts, losses generally limited except in most extreme events.	• NOAA • NCDC • National Weather Service (NWS) – Baltimore/Washington - Office	Profile and risk assessment
Wildfires	High annual probability of site-specific events, with moderate impacts	• NOAA • NCDC	Profiled, but not part of detailed risk assessment
Lightning	High annual probability, widespread impacts, losses considered moderate except in most extreme events	• NOAA • NCDC • National Weather Service (NWS) – Baltimore/Washington - Office	Profiled, but not part of detailed risk assessment

Hazard	Rationale	Sources	Disposition
Earthquakes	Low annual probability, but potential for significant consequences	• United States Geologic Survey (USGS)	Profiled, but not part of detailed risk assessment
Drought and Extreme Heat	High annual probability, but impacts generally limited	• NOAA • NCDC	Profiled, but not part of detailed risk assessment

Based on the qualitative ranking above, Howard County's NHM Planning Work Group recommended the analysis of the following four natural hazards in Section 7, Vulnerability Assessment and Loss Mitigation:

- Floods
- Hurricanes and Tropical Storm Winds
- Severe Winter Storms
- Tornados

Section 7
Vulnerability Assessment and Loss Estimation

Contents of this Section

7.1 IFR Requirement for Risk Assessments

IFR §201.6(c)(2): *The NHMP shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

IFR §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

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

IFR §201.6(c)(2)(ii)(B): *[The NHMP* ***should*** *describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.*

Requirement §201.6(c)(2)(ii)(C): *[The NHMP* ***should*** *describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

7.2 Overview and Analysis of Howard County's Vulnerability to Hazards

Section 6, *Hazard Identification,* describes the process by which the County reduced eight possible hazards to a list of four. Even though Howard County is exposed to various types of hazards, the probability of some of these hazards striking the County is so low that they do not pose a significant risk to the jurisdiction. Like most inland counties in the Mid-Atlantic region, Howard County is not considered

particularly vulnerable to most natural hazards. The following four hazards pose the most risk to people, assets, and operations within Howard County.

- Floods
- Hurricanes and Tropical Storm Winds
- Severe Winter Storms
- Tornadoes

In accordance with FEMA requirements, this section addresses the County's vulnerabilities to these hazards and estimates the future expected losses from their occurrences. Flooding (Subsection 7.3.1) and tropical storm/hurricane-related winds (Subsection 7.3.2) are the most common hazards affecting the County. There exists a wealth of information to sufficiently complete meaningful assessments of these events. For example, floodplain maps and flood data are available for flood hazard calculation. Similarly, hurricane/tropical storm-related wind damages can be determined using databases and historical records.

The County is also somewhat vulnerable to the effects of winter storms and tornadoes. Unfortunately, there is little reliable information available to assess quantitative loss estimates for snowstorms properly. Subsection 7.3.3 uses currently available data to surmise a reasonable estimate of damages from a snowstorm. Following section 7.3.4 addresses how FEMA's benefit-cost analysis (BCAR) software enables planners to better assess and estimate potential loss of life and injuries should a tornado strike Howard County. The methodology used, as well as the calculations performed are located in Subsection 7.3.4.

General Discussion of Flood Vulnerabilities in Howard County

Flooding can result from various weather events such as hurricanes, thunderstorms, and winter storms. When hurricanes reach inland, they often become tropical storms – which often bring torrential rain to the region. Likewise, winter storms can cause flooding, as temperature fluctuates causing rapid snowmelt. The NOAA's National Climatic Data Center (NCDC) reports 41 floods took place in Howard County from 1996 to 2010. Although the NCDC did not maintain flood information prior to 1996, historical data showed numerous instances of flooding, including a devastating flood caused by Tropical Storm Agnes in 1972.

The County recently finalized a Flood Mitigation Plan (FMP),[1] which was approved by the County Council on August 3, 2011. To avoid repetition and to maintain consistency, the 2011 FMP has been incorporated by reference into this NHMP update. Furthermore, Appendix G lists all flood related mitigation actions in the FMP. Prior to incorporation into the NHMP, flood mitigation information was reviewed to ensure the material remains current and complete.

The NHM Planning Work Group reviewed various materials while preparing the flood assessment. One of the documents reviewed in detail was *An Assessment of Maryland's Vulnerability to Flood Damage* (the State Assessment Report).[2] This 2005 Maryland Department of the Environment's State Assessment

[1] Deepa Srinivasan and Dr. Michael Scott, Flood Mitigation Plan; Howard County, Maryland, 26 (August 3, 2011) (on file with the Howard County Department of Public Works, Bureau of Environmental Services) [hereinafter *Flood Mitigation Plan*].

[2] John M. Joyce and Dr. Michael Scott, AN ASSESSMENT OF MARYLAND'S VULNERABILITY TO FLOOD DAMAGE (August 2005) *available at* http://www.esrgc.org/pdf/hazus/An%20Assessment%20of%20Maryland%27s%20Vulnerability%20to%20Flooding.pdf [*hereinafter* State Assessment].

Report proved useful when comparing relative risk across the region. Although some may question the use of a six-year-old report for fear of its outdated material, the information was invaluable for outlining some of the vulnerabilities in the region. Also, as the region does not experience numerous disasters unlike other parts of the country, many of the report's data were still useful for this analysis.

Table 7.2-1 below shows the number of people and structures in floodplains based on estimates from FEMA Community Assistance Visits (CAVs) and GIS analysis.[3]

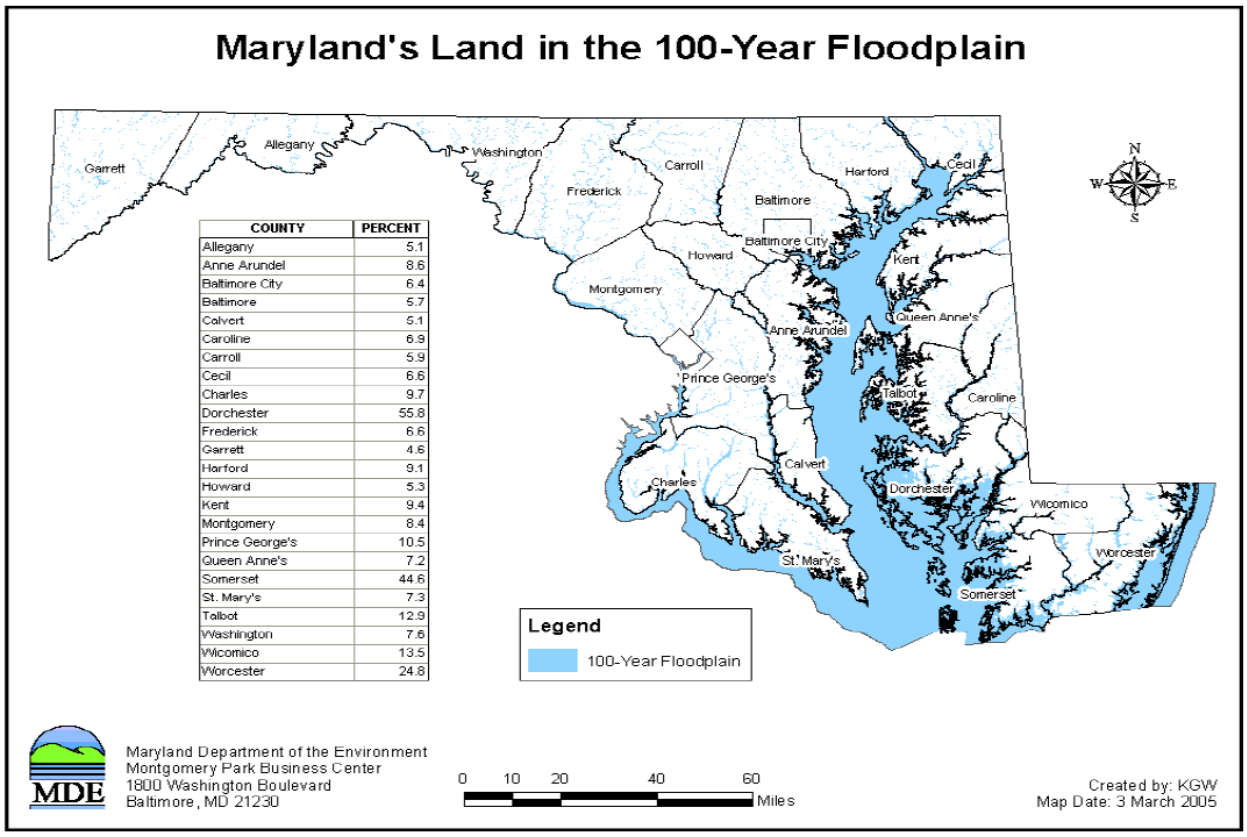
Table 7.2-1
Populations and Structures in Maryland Counties
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,* 2005, Maryland Department of the Environment)

County	People		Structures		Flood Insurance Policies (2002)	Percent Policies
	CAV	Overlay	CAV	Overlay		
Allegany	2420	2973	-	1265	419	33.1
Anne Arundel	10088	16067	3983	6063	44-6	72.7
Baltimore City	6000	4000	1672	1653	900	54.4
Baltimore	16323	15213	6712	6184	2962	47.9
Calvert	1523	3300	579	1134	558	49.2
Caroline	390	1608	158	609	185	30.4
Carroll	2288	1352	1103	481	146	30.4
Cecil	5096	6179	2210	2280	823	36.1
Charles	1098	1739	1037	608	275	45.2
Dorchester	6550	7264	2750	2761	1179	38.3
Frederick	682	3672	294	1350	321	23.8
Garrett	104	1211	31	475	139	29.3
Harford	1960	4504	741	1656	608	36.7
Howard	1740	2520	956	930	339	36.5
Kent	-	2756	4	1183	445	37.6
Montgomery	750	5559	277	2090	1059	50.7
Prince George's	10300	7491	4045	2734	984	36.0
Queen Anne's	2800	7829	1205	2988	1878	62.9
Saint Mary's	2705	3411	1105	1254	592	47.2
Somerset	7900	10523	316	4440	1488	33.5
Talbot	5273	4503	2228	1941	1822	62.9
Washington	2900	2221	1051	903	264	29.2
Wilcomico	-	2002	2	1187	401	33.8
Worcester	17500	74913	6375	32152	28792	89.5
Totals	**133097**	**193813**	**57795**	**78638**	**50394**	**64.1**

[3] The Maryland Department of the Environment is currently working with FEMA to update Maryland's DFIRM maps. As part of the process, Howard County's flood maps are slated to be completed by March 2013. DFIRM OUTREACH, http://mdfloodmaps.com/ (last visited February 22, 2012).

It is evident that Howard County falls below average in each of these categories, which is consistent with the County's inland location and the lack of significant flood sources. Unlike some of the other Counties in the State, Howard County does not border either the Chesapeake Bay or the Atlantic Ocean. The next figure shows the percentage of Maryland counties in the 100-year floodplain.

Figure 7.2-2
Percentage of Maryland Counties in the 100-year Floodplain
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,* 2005, Maryland Department of the Environment)[4]



COUNTY	PERCENT
Allegany	5.1
Anne Arundel	8.6
Baltimore City	6.4
Baltimore	5.7
Calvert	5.1
Caroline	6.9
Carroll	5.9
Cecil	6.6
Charles	9.7
Dorchester	55.8
Frederick	6.6
Garrett	4.6
Harford	9.1
Howard	5.3
Kent	9.4
Montgomery	8.4
Prince George's	10.5
Queen Anne's	7.2
Somerset	44.6
St. Mary's	7.3
Talbot	12.9
Washington	7.6
Wicomico	13.5
Worcester	24.8

5.3% of Howard County land lies in the 100-year floodplain, indicating that this County is less vulnerable than other Maryland Counties in the event of a 100-year flood.[5] In comparison, 55.8% of Dorcester County lies in a 100-year floodplain, while Somerset County has 44.6% of its land in a 100-year floodplain.

The State Assessment next discussed potential flood damages using a 100-year flood scenario as its basis by utilizing FEMA's Hazards U.S. software program (also known as HAZUS), a software program that produces general loss estimates based on a hazard "scenario."[6] In other words, the program's calculations compute how a specific hazard event could adversely affect a population. These "scenario"-based methodologies are limited since they are not developed to calculate for a series of mathematically

[4] Id.
[5] A 100-year flood is also known as a base flood and can be defined as a "statistic that indicates the magnitude of flood which can be expected to occur on average with a frequency of every 100 years." N.O.A.A. National Weather Service, http://www.nws.noaa.gov/glossary/index.php?letter=number (last visited January 31, 2012).
[6] See FEMA: Hazus, http://www.fema.gov/plan/prevent/hazus/ (last visited February 2, 2012).

integrated probabilities, and thus cannot be construed as deterministic. Another issue to bear in mind is that the HAZUS default data may be slightly outdated, as the last set of available data was released in 2005. Even with these limitations, these estimated figures can be useful for planning purposes.

The following table shows the total area and percentage of flood damage to structures in a 100-year flood.

Table 7.2-3
Degree of damage to structures in Maryland Counties in a 100-year flood, by square footage and degree of damage
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,* 2005, Maryland Department of the Environment)

County	Degree of Damage							Total Damaged
	None	1-10%	11-20%	21-30%	31-40%	41-50%	Substantial	
Allegany	276.30	1,509.51	613.82	112.42	69.63	31.15	15.88	2,352.41
Anne Arundel	2,522.95	9,110.29	2,795.45	1,311.88	692.55	561.13	1,061.04	15,532.34
Baltimore City	435.07	3,873.79	1,667.82	1,137.21	220.49	58.20	699.38	7,656.89
Baltimore	2,418.92	5,707.85	1,175.96	531.32	594.19	180.78	615.12	8,805.22
Calvert	430.17	1,088.86	375.49	212.12	131.67	152.09	366.44	2,326.66
Caroline	75.91	245.27	59.88	37.37	14.14	11.54	23.48	391.69
Carroll	985.20	335.92	22.33	7.28	1.20	2.51	2.89	372.13
Cecil	447.58	1,010.32	376.13	237.80	41.02	16.17	10.45	1,691.90
Charles	554.00	955.74	138.88	24.46	1.83	0.00	32.20	1,153.11
Dorchester	83.03	899.12	486.03	266.41	131.23	151.14	774.14	2,708.08
Frederick	1,739.66	2,799.65	797.63	311.92	69.75	98.31	218.61	4,295.87
Garrett	236.80	477.45	149.78	79.21	33.41	4.97	127.00	871.83
Harford	1,440.27	2,258.78	756.15	202.48	230.90	117.76	69.83	3,635.91
Howard	3,995.27	2,589.41	59.70	28.16	0.95	0.00	0.00	2,678.21
Kent	175.98	290.21	69.96	42.11	35.64	12.46	26.86	477.23
Montgomery	3,943.62	3,144.28	708.48	377.96	94.36	40.91	70.82	4,436.80
Prince George's	2,200.68	8,462.98	1,531.75	424.68	151.58	114.50	364.39	11,049.88
Queen Anne's	349.63	1,101.53	230.67	89.94	24.61	0.72	30.35	1,477.82
Somerset	113.97	883.18	319.30	202.72	217.39	203.76	3,854.91	5,681.27
St. Mary's	407.85	906.39	297.78	192.37	114.07	103.44	319.05	1,933.10
Talbot	283.50	1,284.42	416.14	166.84	93.14	52.60	154.56	2,167.70
Washington	1,227.36	2,787.68	658.33	226.75	353.78	436.54	1,009.08	5,472.15
Wicomico	120.43	807.96	174.35	69.28	11.71	27.95	75.41	1,166.66
Worcester	304.45	8,220.97	5,316.36	2,693.36	1,258.75	1,463.71	2,371.01	21,324.16
TOTAL	24,767.48	60,754.23	19,199.15	8,987.30	4,587.98	3,843.18	12,293.70	109,665.55

Since only a small percentage of Maryland floodplains lies in Howard County, the percentage of structures and population exposed to flooding are subsequently relatively low. However, a vulnerability determination must take into consideration the number of structures and people exposed to the potential flooding. So, if viewing the area and percentage metrics in a vacuum, it may be easy to conclude Howard County has a relatively low vulnerability to flood. However, that would be misleading, as the large number of structures and the large population in the floodplain must be taken into account when considering potential damages as a result of a 100-year flood.

The next two graphics illustrate this point, namely showing that the County's potential damages in a 100-year flood is higher than estimated due to the high population density in the 100-year floodplain. Map 7-4 shows that while the County has a low percentage of its area in the 100-year floodplain, the potential building damage in a 100-year flood scenario is relatively high with a figure extending to the middle of the

range (22.88 - 49.49 thousands of square feet). Map 7-5 illustrates the potential number of buildings that could be damaged by occupancy type (such as residential, commercial, or government). Again, even though the relative exposure is minimal, the sheer number of buildings increases the County's overall vulnerability to flooding.

Figure 7.2-4
Degree of damage to structures in Maryland Counties in a 100-year flood, by square footage and degree of damage
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,* 2005, Maryland Department of the Environment)

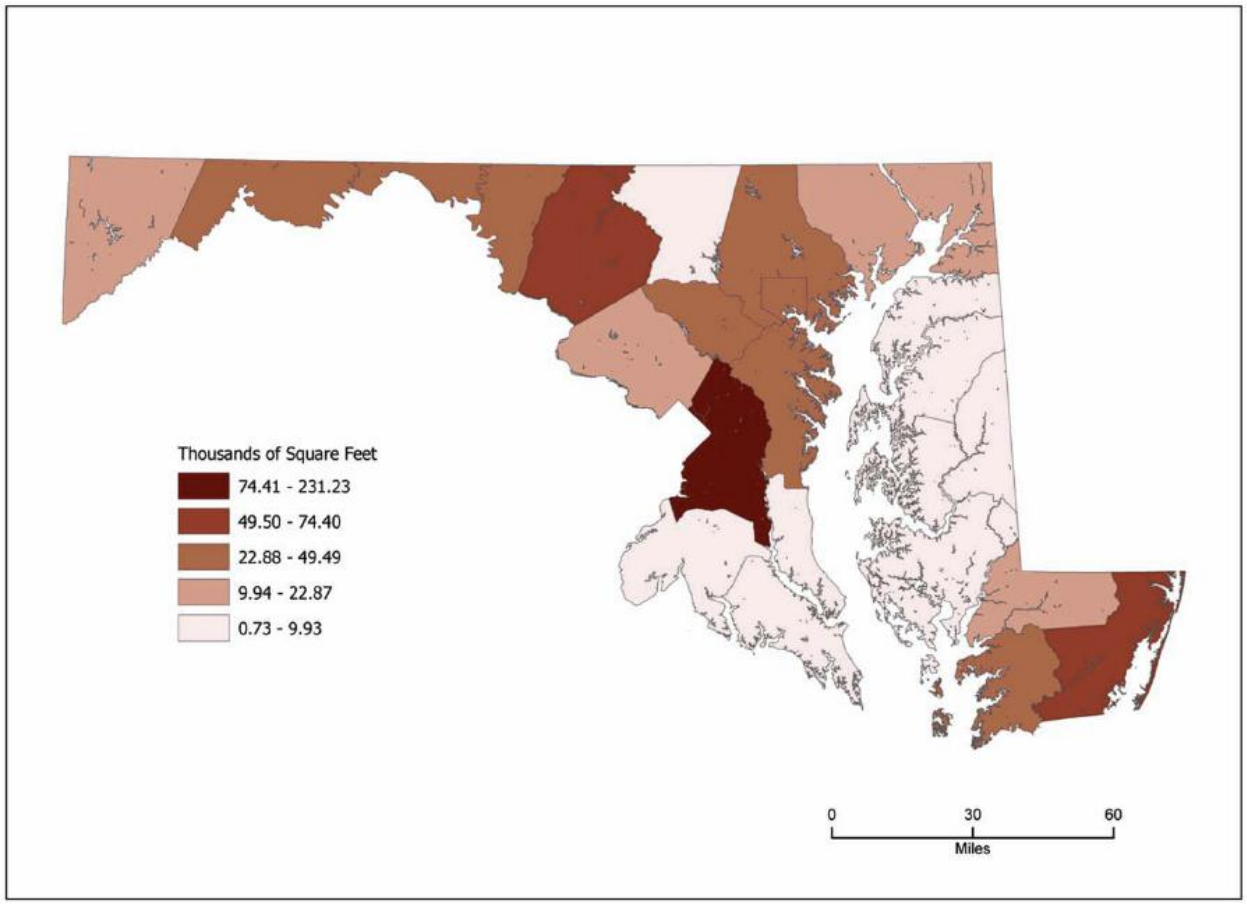
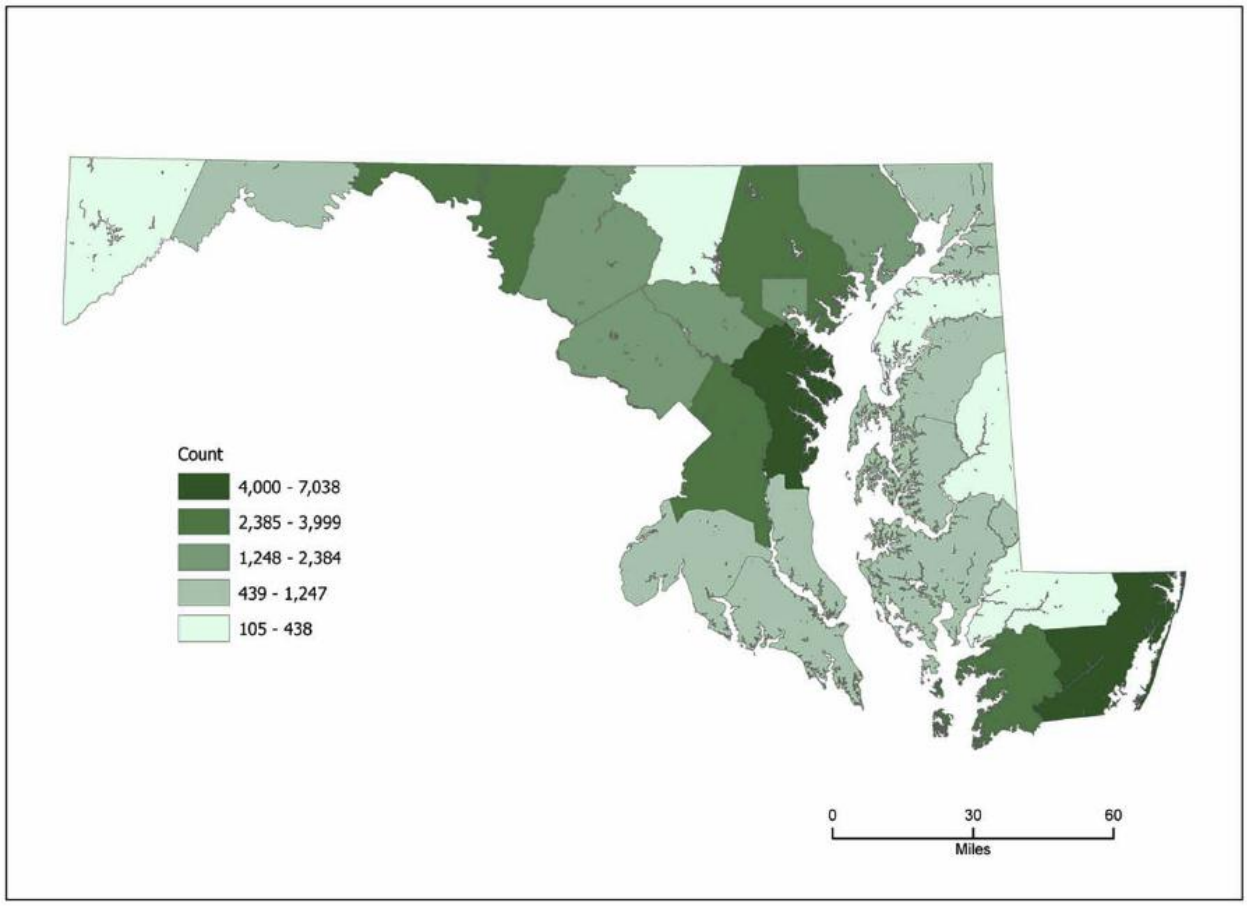


Figure 7.2-5
Potential number of buildings damaged in Maryland Counties in a 100-year flood,
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,*
2005, Maryland Department of the Environment)



The next section of the State Assessment examined HAZUS data to discuss potential economic losses from the flood scenario. Table 7.2-6 below summarizes the results.

Table 7.2-6
Potential direct economic losses to Maryland Counties in a 100-year flood,
(Source: *An Assessment of Maryland's Vulnerability to Flood Damage,* 2005, Maryland Department of the Environment)

County	Capital Stock Losses			Income Loss				Total Loss	Percent of Total
	Cost Structural Damage	Cost Contents Damage	Inventory Loss	Relocation Loss	Capital Related Loss	Wages Loss	Rental Income Loss		
Allegany	54,808	56,612	1,353	2,873	16,700	30,479	2,012	164,837	2.0%
Anne Arundel	378,116	329,639	7,752	9,604	69,116	121,574	3,890	919,691	11.3%
Baltimore City	152,517	169,640	4,669	11,355	84,456	94,664	9,352	526,653	6.5%
Baltimore	237,974	179,172	2,207	5,563	41,166	62,728	2,347	531,157	6.5%
Calvert	41,710	33,328	359	2,265	7,084	12,663	903	98,312	1.2%
Caroline	6,601	5,317	161	343	817	4,425	135	17,799	0.2%
Carroll	34,063	25,791	453	55	4,386	7,278	29	72,055	0.9%
Cecil	38,126	33,817	412	3,548	17,862	26,835	2,520	123,120	1.5%
Charles	31,473	23,190	240	117	4,520	10,512	35	70,087	0.9%
Dorchester	35,364	26,812	396	4,152	2,758	6,516	1,386	77,384	1.0%
Frederick	176,954	149,970	5,387	5,226	31,232	75,407	2,828	447,004	5.5%
Garrett	22,676	22,153	494	1,583	6,265	32,507	1,013	86,691	1.1%
Harford	128,561	103,420	1,543	2,972	21,618	41,849	1,310	301,273	3.7%
Howard	207,881	162,760	2,343	30	39,156	166,059	21	578,250	7.1%
Kent	13,122	9,949	132	396	1,766	6,882	203	32,450	0.4%
Montgomery	296,456	212,153	1,670	3,731	39,626	145,253	2,904	701,793	8.6%
Prince George's	333,738	295,480	5,348	7,237	76,348	561,061	4,190	1,283,402	15.8%
Queen Anne's	30,250	22,497	223	135	3,898	12,745	45	69,793	0.9%
Somerset	70,435	62,083	1,155	18,224	8,362	25,949	7,803	194,011	2.4%
St. Mary's	34,071	25,548	159	1,945	3,751	13,955	635	80,064	1.0%
Talbot	35,702	25,797	320	1,272	3,878	7,629	856	75,454	0.9%
Washington	242,126	190,479	6,649	13,722	35,378	99,575	6,637	594,566	7.3%
Wicomico	16,021	13,150	134	730	4,301	11,372	281	45,989	0.6%
Worcester	448,618	345,160	3,627	15,851	85,557	118,408	12,009	1,029,230	12.7%
TOTAL	3,067,363	2,523,917	47,186	112,929	610,001	1,696,325	63,344	8,121,065	100.0%

General Discussion of Hurricane/Tropical Storm Wind Vulnerabilities in Howard County

Given its proximity to the Atlantic Ocean, Howard County is occasionally subject to the effects of hurricanes and tropical cyclones. These events are rarely as severe as the ones further south on the eastern seaboard or in the Gulf of Mexico. Howard County's location makes extreme Hurricane or Thunderstorms wind events (such as Saffir-Simpson Category 4 or 5 hurricanes) very unlikely.

For Howard County, the most significant potential effect of hurricanes and tropical storms is flooding. In addition, these events could also bring about dangerous high winds. Most of the risk from hurricane and tropical storm winds in the mid-Atlantic region is related to structural damage rather than injuries and deaths. Howard County buildings are not especially vulnerable to wind effects from lower-intensity storms due to strong building code enforcement. Subsection 7.3.2 provides a FEMA BCAR loss estimation for hurricane winds for both publicly-owned and residential structures. The program incorporates historical probability data and user-entered structural data of County assets to calculate expected losses.

Unfortunately for this study, hard data concerning wind vulnerability is slim. In most instances, this information is not publicly available as private insurance covers wind damage except in the most extreme circumstances. Thus, the only source of information available regarding wind vulnerabilities remains NOAA's National Climatic Data Center (NCDC) data. While the NCDC data is useful, it appears under-reporting may be an issue. Under this category, the NCDC only listed one event in the database. It is evidently clear wind storms have impacted the County in the past, such as Hurricanes/Tropical Storms Agnes, Floyd, Isabel, Irene and Lee. It also appears the NCDC under-reports the magnitude of losses for many hazards including wind. For this reason, measure of wind vulnerability is better described as "exposure," which means examining the value of assets potentially at risk.

General Discussion of Winter Storm Vulnerabilities in Howard County

As discussed in Section 6, Howard County is located in a region that is subject to frequent winter storms. The County is also vulnerable to infrastructure damage from a roof collaspe. Other occurrences during winter storms may include automobile accidents and other personal injuries due to the road and sidewalk conditions. The County's strong building codes usually adequately protect against roof damage from snow and ice loading in all but the most extreme events.

Electrical system failures are also an issue, as a sudden temperature drop may cause the electrical system to malfunction. The large majority of Howard County's electrical infrastructure is owned and maintained by private-sector companies, mainly the Baltimore Gas and Electric (BGE) Company. These companies are responsible for repairing their own assets when impacted by snow or ice. Although these systems are vulnerable to the effect of hazards, there is no way to effectively characterize these in the context of a mitigation plan.

Unlike flood hazards, there is almost no open-source information about winter storm damages. Damages to residential structures are covered by private-sector insurance. In addition, the County does not keep hazard-specific records about damages to its facilities. Subsection 7.3.3 below uses NOAA's NCDC data to estimate winter storm damages, but the results must be considered in the context of the uncertain nature of the data.

General Discussion of Tornado Wind Vulnerabilities in Howard County

Historical incidents of tornadoes in Maryland are very low compared to states in the Central and Southern parts of the country. Also, tornadoes that do hit the State are often relatively low in intensity. In terms of the County's vulnerabilities, most non-engineered structures are most at risk (such as balloon-frame residential buildings, manufactured housing, and mobile homes). Engineered buildings are generally designed to withstand higher wind loads because they are built with connections and designs that resist positive and negative wind pressures. Subsection 7.3.4 below provides estimated future losses to residential structures using the FEMA BCAR software. The software uses historical probabilities and default values for loss of life and injuries to determine dollar losses over a planning horizon.

General Discussion of Other Hazard Vulnerabilities in Howard County

Section 6 explains the process by which the County reduced eight possible hazards to a list of four (which were discussed above). The other four hazards addressed in Section 6 must be considered in order to fully

assess hazard vulnerability affecting the County. The remaining four hazards are:

- **Wildfires**
- **Lightning**
- **Earthquakes**
- **Drought and Extreme Heat**

Please refer to Chapter 6 for more information about the nature of these hazards, including their location and extent, severity, and probability.

General Discussion of Wildfire Vulnerabilities in Howard County

Howard County experiences several wildfires each year, particularly during periods of extended drought. Detection and supression cabilities are good within the County, so wildfires are generally quickly extinguished. Wildland urban interface[7] exists within Howard County, but those are extremely limited in scope. Wood structures, and buildings built prior to the implementation of the building codes, remain the most vulnerable to wildfires. The overall low probability of severe wildfires in the region indicates the County is not particularly vulnerable to this hazard.

General Discussion of Lightning Vulnerabilities in Howard County

Howard County is subject to numerous lightning strikes each year. They mostly occur during the spring and summer months. Well-established building codes designed in part to minimize lightning damage ensure minimal damages occur. Damage can occur to privately owned assets such as residential structures and/or electrical systems, and thus there is no effective way of identifying nor calculating these figures. Presumably, damage is fairly limited in most instances.

General Discussion of Earthquake Vulnerabilities in Howard County

Even despite the recent 5.8 magnitude earthquake that rocked the Eastern seaboard in August 2011, most of Maryland lies in "seismic risk zone 1,"[8] meaning that only minor earthquake damage could occur in these parts. Although Howard County (and the State at large) do occasionally experience earthquakes, Howard County citizens are more likely to experience earthquakes that occur in nearby States.[9] Thus, while the County may be vulnerable to the effects of significant seismic events, the unlikelihood of a significant seismic event in the region makes this hazard low.

Even in the event of an incident, these vulnerabilities are generally limited to un-reinforced masonry structures built prior to the existence of building codes and are subject to failure when exposed to lateral loads. As there is no current database for these types of structures in the County, it is difficult to say with any degree of certainty the level to which Howard County is vulnerable to significant earthquake damage should one occur in the region.

General Discussion of Droughts and Extreme Heat Vulnerabilities in Howard County

[7] The term Wildland Urban Interface can have numerous definitions. In this instance, the term means "an area where human-made infrastructure is in or adjacent to areas prone to wildfire." Hermansen-Baez, L. Annie, University of Florida IFAS Extension, *Wildland Urban Interface: Varied Definitions*, http://edis.ifas.ufl.edu/fr287 (last visited January 31, 2012).
[8] MARYLAND GEOLOGICAL SURVEY, http://www.mgs.md.gov/esic/brochures/earthquake.html (last visited January 31, 2012).
[9] Id.

Howard County is somewhat vulnerable to the effects of droughts and extreme heat. Given that the County is not primarily agricultural in character, the potential effects of droughts are generally limited to the need for occasional water restrictions. Extreme heat is always a possibility in the summer months, but the County has taken proactive steps towards protecting its citizens during periods of extreme heat. For example, the County sets up cooling stations for those without cooling systems of their own in their residence, as well as utilizes a community notification system to inform citizens on actions to take during extreme heat conditions. These actions minimize injuries and loss of life throughout the County.

A Note on Future Trends

Howard County recognizes that hazards and the risks they present are likely to change from year to year, and that the emerging issue of global climate change will likely affect how hazards will impact the jurisdiction. Although there is no way to accurately anticipate these future developments, the County intends to closely monitor trends in terms of both probabilities and impacts[10] as a way to develop and calibrate mitigation activities.

7.3 Estimate of Potential Losses

This section describes Howard County's potential losses (or otherwise known as risks). The term *vulnerability assessment* describes the extent to which physical assets, people, or operations are damaged when they are exposed to natural hazards. The term *loss estimation* is analogous to *risk assessment,* and refers to expected future damage resulting from the impacts of natural hazards. Depending on the type of information available for the analysis, risk can be calculated or estimated in several different ways.

7.3.1 Flood Risk in Howard County

Generally, flooding in the County is "dispersed and infrequent,"[11] and damage from flooding is rare. Flood vulnerability is determined by several factors, the most significant being: (1) exposure, (2) relative elevation, (3) proximity to floodplain, and (4) physical and operational characteristics of assets potentially at risk. Complete information about these measures is rarely available, so one must use the best information available to assess flood vulnerability.

This subsection focuses on future flood loss estimates based on best available data. Due to economic limitations, detailed engineering studies were not performed as part of this planning process. The present section is intended to provide a moderately detailed overview of flood risk in the County. To reduce redundant analysis, this section replicates segments from the *2011 Howard County Flood Mitigation Plan* (FMP).

The first general measure is the number and value of structures in the 100-year floodplain within Howard County. Areas such as Ellicott City, Clarksville Pike / Columbia Road, and Elkridge experience moderate or significant flood vulnerability, as exemplified by Table 7.3.1-1.[12] This chart shows the number of structures that are completely, or partly, in the floodplain. These figures are based on both the FMP and from general queries completed by the County's Geographic Information System (GIS) Division.

[10] These values are based on empirical data from actual events.
[11] Supra note 1 at 26.
[12] Id.

Table 7.3.1-1
Geographic areas in Howard County with Moderate or Significant Flood Vulnerability
(based on number of structures in the 100-year floodplain)
(Source: Howard County Flood Mitigation Plan, 2011)

Area	Number of Structures
Ellicott City	77
Clarksville Pike/Columbia Road	39
Elkridge	10

In total, County GIS indicates that approximately 277 buildings are located in the floodplain. This figure may under-estimate the number of individually owned assets in the floodplain, as the term "building" includes multiple unit structures, such as townhomes.

There are 7,939 acres within the floodplain in Howard County, which affect some 8,009 parcels of land. Not all parcels have significant exposure to flooding, specifically those parcels that only have some portions of the property in direct contact with the 100-year floodplain. Table 7-8 shows specifically County-owned land that is located within the 100-year floodplain. Since the County owns 1,673 acres of floodplain out of the 7,939 total acres of floodplain in the County, 21% of all Howard County floodplain is under County management.[13]

Table 7.3.1-2
County-owned land, total area and area in 100-year floodplain
(Source: Howard County GIS)

Classification	Total	Estimated acreage located in the 100-year floodplain
Board of Education	1,681 acres	22 acres
Parks	5,593 acres	717 acres
Open space	3,406 acres	809 acres
Public Works	1,463 acres	125 acres
Total	**12,143 acres**	**1,673 acres**

Flood Loss Estimation

Analysis of NFIP Flood Insurance Claims Data

National Flood Insurance Flood Program (NFIP) claim statistics can help one better understand a community's flood vulnerability and risk. The NFIP is a federal program that enables property owners in participating communities to purchase insurance to protect against flood losses.[14] In order to participate, communities must develop and continuously implement floodplain management regulations that will reduce

[13] For more information about the County's effort in floodplain preservation, see Section 9.2.3 ("Subdivision Regulations").
[14] See FEDERAL EMERGENCY MANAGEMENT AGENCY, NATIONAL FLOOD INSURANCE PROGRAM, PROGRAM DESCRIPTION, National Flood Insurance Program, Program Description 2 (August 1, 2002), *available at* http://www.fema.gov/library/viewRecord.do?id=1480.

future flood damages.[15] If a community adopts and enforces floodplain management ordinances, the federal government will ensure flood insurance is available to those in the community.[16]

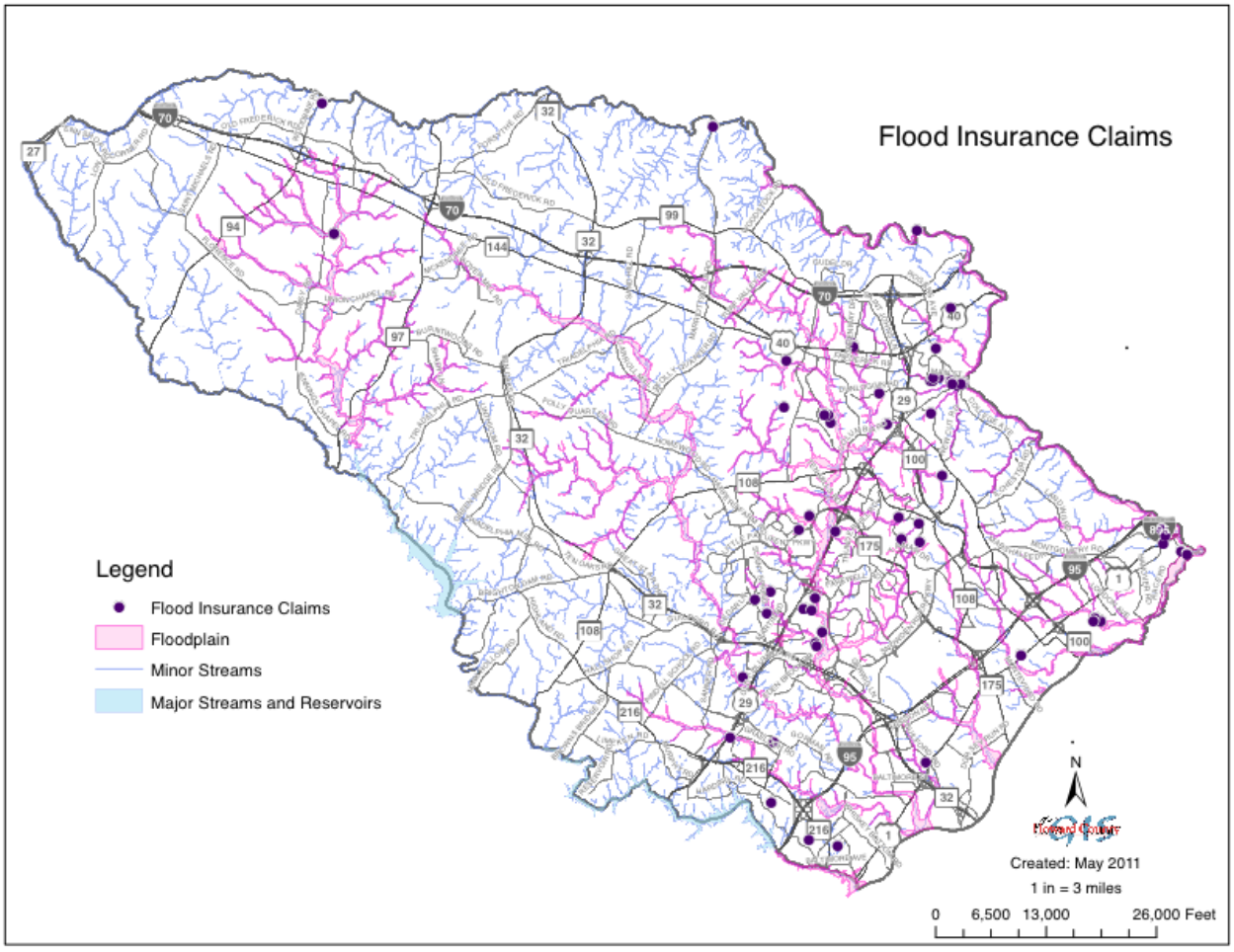
The first loss estimation methodology used below is based on a NFIP claims data analysis. Since NFIP's formation in 1977, Howard County flood insurance policy holders have submitted 113 claims totaling $577,442.[17] This is a relatively small number given the County's population and its number of structures. Unlike other flood-prone areas in the Country, the claims in Howard County are concentrated to specific incidents in 1977 and 1981. The low figure combined with the fact that the claims were filed 30 or more years ago may be attributed to proactive measures undertaken by the County. The County has been assisting homeowners with making their properties less flood prone, as well as buying out homes that are most at risk for flooding. It may also be prudent to note that the flood claim data represents only properties that have flood insurance claims, and not those properties that were flooded but no claim was filed.

To determine the average annual flood claim, the total amount of flood claims ($577,442) is divided by the number of years in the period (2011 – 1977 = 34), which results in $16,984. This number can then be multiplied by a present value coefficient[18] to project total losses over a planning horizon to include the effect of discounting today's dollars. Based on this methodology, the average annual flood claim based on expected flood losses is estimated at $242,362.[19]

[15] Id.
[16] Id.
[17] While it is possible to make a simple projection of future flood losses based on the claim data available data, a larger data set is needed to calculate the future risk estimate properly.
[18] In this case, the County used a present value coefficient of 14.27, which represents a 100-year horizon and a 7% discount rate (which is mandated by the President's Office of Management and Budget).
[19] It should be noted that this calculation does not include inflation of past claims.

Figure 7.3.1-3 displays the locations of NFIP claims in the County from 1977 to 2010.

Map 7.3.1-3
Historical National Flood Insurance Program Claims in Howard County, Maryland 1977-2010
(Source: NFIP query, Spring 2011)



Residential Repetitive Loss Properties

As of spring 2011, Howard County has six "repetitive loss" properties, which are defined as properties that have received at least two NFIP insurance payments of more than $1,000 each in any ten-year period.[20] The cumulative amount of claims on those six properties is $298,890, with a total of 14 claims for the repetitive loss properties. Only one of the properties has more than two claims (having filed four claims totaling $154,336).

Although flood risk can be calculated using annualized losses and projecting them over a planning horizon[21], there are too few claims to do such a projection for Howard County in this instance.

[20] See National Flood Insurance Act, 42 U.S.C. 4102a, § 1361A (b) (1968).
[21] A planning horizon is defined as the "time frame for planning strategic activities and for accomplishing strategic goals". See PLANNING HORIZON, http://planningskills.com/glossary/69.php (last accessed February 22, 2012).

Severe Repetitive Loss Properties

In 2008, FEMA initiated the Severe Repetitive Loss (SRL) Grant Program in an effort to reduce or eliminate flood damages to residential properties that met certain minimum requirements. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.[22]

While this sub-section was included to ensure compliance with FEMA planning requirements, there are presently no NFIP SRL properties located within Howard County.

Flood Loss Estimates using HAZUS-MH

The 2011 Howard County FMP is an excellent source of detailed information about flood risks and potential flood mitigation projects in the County, and has been included here to offer corroborating data to support conclusions regarding potential flood losses. The FMP's section on risk utilizes HAZUS-MH[23] to calculate potential flood losses. The HAZUS assessment identified 198 buildings in the County within the boundaries of the 100-year floodplain.[24] As explained in the FMP, flood depth grids are then intersected with the buildings' foundation elevation data to calculate expected losses in a 100-year flood. Table 2.4[25] in the FMP summarizes the findings, which is reprinted below as Figure 7.3.1-4.

Table 7.3.1-4
Potential Damage in a 100-year Flood, by Damage Category
(Source: 2011 Howard County Flood Mitigation Plan)

Degree of Damage	Building Count	% of Total Count	Value of Structure and Contents	Value per Building	Total Potential Damage	Damage per Building	% of Total Damage
Less than 1%	5	2.5%	$ 2,498,295	$499,659	$ 11,801	$2,360	0.1%
1 - 10%	33	16.7%	$18,406,442	$557,770	$1,161,276	$35,190	4.1%
10 - 20%	50	25.3%	$24,436,255	$488,725	$3,555,156	$71,103	12.3%
20 - 30%	42	21.2%	$26,415,363	$628,937	$6,529,502	$155,464	22.6%
30 - 40%	18	9.1%	$9,308,190	$517,121	$3,224,391	$179,132	11.2%
40 – 50%	24	12.1%	$10,460,800	$435,866	$4,731,686	$197,154	16.4%
50% or more	26	13.1%	$15,048,550	$578,790	$9,633,688	$370,526	33.4%
Total	198	100%	$106,573,895	$538,251	$28,848,031	$145,697	100%

[22] See supra note 20, § 1361A (b)(1)(b)(i).
[23] FEMA, supra note 6.
[24] FMP, supra note 1, 23.
[25] Id. at 26.

Figures 2.6,[26] 2.7, [27] and 2.8[28] of the 2011 FMP also graphically depict flood-prone areas in the County, and shows where structures are in relation to the floodplain.

7.3.2 Hurricane and Tropical Storm Wind Risk in Howard County

Howard County's proximity to the Atlantic Ocean makes it slightly vulnerable to hurricane and tropical cyclone wind. Compared to other locations closer to the coast, potential losses to assets and operations are relatively minimal. This subsection presents the results of wind loss estimations that were completed with the FEMA BCAR software. Although this software is specifically intended to assess mitigation projects, it is possible to use it to estimate losses / risk when sufficient data is available. Since the software provides only general results, a detailed site-specific risk assessment / mitigation project proposal should be conducted using information such as structural characteristics, physical surroundings, and occupancies. Several of these data parameters were estimated for the calculations below.

Hurricane and Tropical Storm Wind Risk – Residential Assets

Table 7.3.2-1 summarizes some basic information and assumptions used for the risk assessment calculation.

Table 7.3.2-1
Hurricane and Tropical Storm Risk Assessment – Summary of Data Parameters
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

Data	Value
Planning horizon (years)	50
Roof Shape	Hip
Average residential square footage (estimated)	2,000
Housing units, County-wide (2010 Census)	109,282
Gross square footage residential property (County-wide)	218,564,000 square feet (s.f.)
Zip code as center of analysis	21044
Demolition threshold	50% (default)
Displacement Costs ($/s.f./month)	$1.44
Predominant structure type (for damage function)	Wood frame residential

[26] Id. at 29.
[27] Id. at 30.
[28] Id. at 32.

Figure 7.3.2-2 illustrates the damage inputs for one- or two-story wood frame residential structure types in the BCAR software based on engineering information and HAZUS data.

Table 7.3.2-2
Damage Function for 1- or 2-Story Wood Frame Residential Structure
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

HURRICANE WIND - DAMAGE FUNCTIONS

Building | Contents | Loss Of Function | Other Damages

Recurrence Interval (yr)	Wind Speed (mph)	Before Mitigation Pct.	Before Mitigation User Entered (Pct)	Before Mitigation Value ($)	After Mitigation Pct.	After Mitigation User Entered (Pct)	After Mitigation Value ($)
10	30	0.00%		$0	0.00%		$0
20	45	0.00%		$0	0.00%		$0
30	50	0.00%		$0	0.00%		$0
40	55	0.00%		$0	0.00%		$0
50	55	0.00%		$0	0.00%		$0
60	60	0.02%		$87	0.04%		$123
70	60	0.02%		$87	0.04%		$123
80	60	0.02%		$87	0.04%		$123
90	65	0.07%		$252	0.10%		$360
100	65	0.07%		$252	0.10%		$360
200	75	0.32%		$1,124	0.46%		$1,604
300	80	0.52%		$1,829	0.74%		$2,606
400	80	0.52%		$1,829	0.74%		$2,606
500	85	0.76%		$2,660	1.08%		$3,769
1000	90	1.06%		$3,696	1.47%		$5,129

Total Building Damages

Based on these inputs, this methodology estimates the total Countywide risk to residential properties from hurricane and tropical storm winds is $1,748,512 annually, and $24,151,322 over a 50-year planning horizon.[29] Again, the calculation is based on generalized inputs that do not represent conditions for all County properties in the planning area.

Hurricane and Tropical Storm Wind Risk – Public Assets

The BCAR software is also used to calculate risk to Howard County public facilities. As part of the 2012 NHMP update, the County provided information for 640 County owned facilities. [30] The available facility data included square footage, building replacement value, contents replacement value, and structure type. The list was then reviewed to exclude facilities with insufficient data, as well as non-building sites (such as radio towers, picnic areas, and water storage tanks). Of the 640 facilities, 220 were identified for the risk assessment analysis. Using the facility data to calibrate the software, the results are shown in Table 7.3.2-3 below.

[29] The results include direct damages to structures and contents, as well as displacement costs.
[30] The facility list is current as of May 2010.

Table 7.3.2-3
Howard County Hurricane and Tropical
Storm Wind Data Parameters
(FEMA Benefit-Cost Analysis [BCAR] Tool, Version 4.5.5.0)

Data	Value
Loss estimation (planning) horizon	50 years
Displacement Costs ($/s.f./month)	$1.44
Occupancy	150 s.f. per occupant
Assumed wind debris source	Residential/Commercial mix
Facility Type - Police Station	
Type of area serviced by the police station	Metropolitan
People served by the police station (Howard County population)	287,085
How many officers will serve the police station if shut down	50%
Facility Type - Other	
Annual Budget	$75,000 per occupant
Facility Type – Fire Station	
People served by the fire station (Howard County Population)	287,085
Type of area served by the fire station	Suburban
Does the fire station provide EMS	Yes
Distance in miles between this fire station and proxy	3
Demolition threshold	50% (default)

The next table summarizes the abbreviations used for HAZUS-based structure and content damage[31] functions.

Table 7.3.2-4
Abbreviations for HAZUS Structure Types
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5.0)

HAZUS Structure Type	Abbreviation
Steel frame engineered commercial, low rise (1-2 stories)	SECBL
Steel frame engineered commercial, mid-rise (3-5 stories)	SECBM
Steel frame engineered commercial, high-rise (6+ stories)	SECBH
Steel, pre-engineered metal building, small	SPMBS
Steel, pre-engineered metal building, medium	SPMBM
Wood, single Family, one Story	WSF1
Wood, single family, two or more stories	WSF2
Wood, multi-unit housing, three or more stories	WMUH3
Masonry, low rise industrial/warehouse/factory buildings	MLRI
Masonry, engineered commercial building, low-rise (1-2 stories)	MECBL
Masonry, engineered commercial building, mid-rise (3-5 stories)	MECBM

The County facility data included ISO building construction codes 1-6 for each of the 220 public facilities. Based on the ISO building codes, it was then possible to assign each facility to a specific HAZUS structure type. Table 7.3.2-5 identified how the ISO building codes were matched with the various HAZUS types.

Table 7.3.2-5
ISO Descriptions / HAZUS Structure Types
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5.0)

ISO Code	ISO Description	HAZUS Building Type	HAZUS Abbreviation
1	Frame - Protected/Unprotected wood frame	Wood, Single-Family, One Story	WSF1, WSF2, or WMUH3
2	Heavy Timber or Joisted Masonry	Wood, Single-Family, One Story	WSF1, WSF2, or WMUH3
3	Light Non-Combustible	Steel, pre-engineered metal building	SPMBS, SPMBM
4	Masonry Non-Combustible	Masonry, Engineered Commercial Building	MECBL or MECBM
5	Modified Fire-Resistive - Steel Frame	Steel, Engineered Commercial Building	SECBL or SECBM
6	Fire-Resistive - Heavy Steel Frame	Steel, Engineered Commercial Building	SECBL or SECBM

The following tables (Table 7.3.2-6 and 7.3.2-7) summarize the hurricane and tropical storm wind risk for public facilities in Howard County based on the methodologies and inputs described above. Sorted based on a 50-year planning horizon for wind risk, the first table uses the HAZUS building category to determine the total wind risk from hurricanes. The last column in Table 7.3.2-6 (50-year Wind Risk) indicates that the cumulative expected wind damages based on the 50-year risk is $143,565.[32] Based on this chart, it is clear that the masonry, low-rise industrial (MLRI) category has the highest 50-year wind risk. Table 7.3.2-7 sorts

[31] Content damage function determines the possible extent of damage when structures are exposed to wind forces of various magnitudes.

[32] Again, the figure has been adjusted based on the mandated 7% discount rate for net present value, as instructed by the President's Office of Budget and Management.

the same data by risk per square foot. By square footage, the steel pre-engineered metal (WSF1) building category has the highest 50-year wind risk.

Again, these loss estimates are intended to serve as initial assessments. This process allows the County to determine priorities for additional studies and/or mitigation actions properly.

Table 7.3.2-6
Estimated Hurricane Wind Risk to Howard County Assets, ordered by 50-year Risk
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

HAZUS Structure Type	Properties	Total SF	Occupancy	BRV	Content Value	Risk per SF	50-yr Wind Risk
MLRI	51	297,554	546	$41,299,000	$2,369,000	$0.48	$143,565
SECBL	26	871,046	5,557	$157,825,000	$32,374,000	$0.13	$114,452
SECBM	4	304,510	2,030	$75,652,000	$18,366,000	$0.21	$65,084
MECBL	39	777,837	2,363	$93,817,000	$21,376,000	$0.07	$55,419
SECBH	1	120,000	800	$15,000,000	$510,000	$0.34	$40,754
SPMBS	13	17,899	99	$680,000	$312,000	$0.84	$15,067
WSF1	52	90,424	603	$11,074,000	$17,400,000	$0.11	$10,036
MECBM	5	47,520	317	$3,510,000	$0	$0.18	$8,485
WSF2	10	34,039	5	$7,277,000	$238,000	$0.21	$7,310
WMUH3	14	77,000	513	$6,651,000	$0	$0.05	$3,668
SPMBM	5	42,818	9	$2,327,000	$1,204,000	$0.06	$2,760
Grand Total	**220**	**2,680,647**	**12,842**	**$415,112,000**	**$94,149,000**	**----**	**$466,600**

Table 7.3.2-7
Estimated Hurricane Wind Risk to Howard County Assets, ordered by Risk per Square Foot
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

HAZUS Structure Type	Properties	Total SF	Occupancy	BRV	Content Value	50-yr Wind Risk	Risk Per SF
SPMBS	13	17,899	99	$680,000	$312,000	$15,067	$0.84
MLRI	51	297,554	546	$41,299,000	$2,369,000	$143,565	$0.48
SECBH	1	120,000	800	$15,000,000	$510,000	$40,754	$0.34
WSF2	10	34,039	5	$7,277,000	$238,000	$7,310	$0.21
SECBM	4	304,510	2,030	$75,652,000	$18,366,000	$65,084	$0.21
MECBM	5	47,520	317	$3,510,000	$0	$8,485	$0.18
SECBL	26	871,046	5,557	$157,825,000	$32,374,000	$114,452	$0.13
WSF1	52	90,424	603	$11,074,000	$17,400,000	$10,036	$0.11
MECBL	39	777,837	2,363	$93,817,000	$21,376,000	$55,419	$0.07
SPMBM	5	42,818	9	$2,327,000	$1,204,000	$2,760	$0.06
WMUH3	14	77,000	513	$6,651,000	$0	$3,668	$0.05
Grand Total	**220**	**2,680,647**	**12,842**	**$415,112,000**	**$94,149,000**	**$466,600**	**-----**

The results of the hurricane / tropical storm wind risk assessment can be further broken down by focusing on individual facilities with the highest 50-year risk. Table 7-18 shows the 15 public facilities with the highest 50-year hurricane wind risk within Howard County. The table shows Laurel Center has the highest 50-year hurricane wind risk in the County, with a 50-year wind risk of $40,754.

Table 7.3.2-8
Facilities with the Highest Hurricane Wind Risk to Howard County Assets, ordered by 50-year Risk
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

Building	Square Footage	HAZUS Structure Type	BRV	Content Value	Occupancy	50-year Risk
Laurel Center	120,000	SECBH	$15,000,000	$510,000	800	$40,754
Fleet Facility Main Building	70,500	MLRI	$7,898,000	$1,000,000	14	$34,015
Rouse Student Services Hall (RCF)	103,770	SECBM	$26,225,000	$5,540,000	692	$22,179
Gateway Building	93,000	SECBM	$13,812,000	$4,866,000	620	$19,877
Meadowbrook Park Athletic Complex	38,200	MLRI	$3,670,000	$0	8	$18,431
Horowitz Visual & Performing Arts Center (HVPA)	78,090	SECBM	$26,615,000	$5,860,000	521	$16,690
Dorsey Building	197,518	MECBL	$26,193,000	$1,601,000	198	$14,073
Detention Center	99,300	SECBL	$25,280,000	$500,000	662	$13,048
Howard	95,850	SECBL	$16,270,000	$3,745,000	639	$12,594
Circuit Court	79,592	SECBL	$17,200,000	$1,550,000	531	$10,458
James Clark, Jr. Library (CL)	75,294	SECBL	$12,780,000	$1,520,000	502	$9,893
Southern District Station	18,240	MLRI	$2,700,000	$265,000	122	$8,801
Alpha Ridge Training Facility Fire Grounds Building	18,000	MLRI	$1,800,000	$0	120	$8,685
Ascend One - Office Building (financial assistance)	106,720	MECBL	Leased	$1,000,000	711	$7,604

7.3.3 Winter Storm Risk in Howard County

The NOAA NCDC database recorded 93 winter storm/snow/ice events in Howard County from 1993 to 2010. The NCDC database should not be considered a complete archive of all damages caused by winter storms in the County, as the database does not include storm events prior to 1993. Even without that information, the available NCDC data is sufficient for a simple risk assessment. Table 7.3.3-1 shows the basic data required for the assessment, which is available from public sources. Since no injuries or deaths were reported for Howard County by the NCDC, this risk assessment focused on property damages associated with winter storms.

Table 7.3.3-1
Data Parameters for Howard County Winter Storm Risk Assessment;
Data from the NOAA/NCDC Database (1993-2010)
(Source: NOAA/NCDC)

Data	Value
Winter storm events	93
Reporting Years	17
Average annual number of winter storm events	5.5
Total reported damages	$8.5 million
Annual damages	$500,000

A simple projection of future expected damages based on a standard present value coefficient of 14.27 representing a 100-year time horizon and a 7% discount rate (the latter required by the Office of Management and Budget) appears below.

Table 7.3.3-2
Estimate of Risk to Howard County from Winter Storms
(Source: NOAA/NCDC)

Data	Value
Annual damages to Howard County	$500,000
Projected 100-year risk from direct winter storm damages	$7,135,000

While the Howard County Office of Risk Management maintains general information about damages to County facilities, it does not archive the specific hazard that caused the damage. Unfortunately, the County also does not retain records regarding additional costs borne by the jurisdiction due to winter storms. Like most jurisdictions that are exposed to winter storm and ice hazards, the County forecasts for such response costs in its budget. These expenses typically include increased fire, rescue, and police services; snow and ice removal; and occasional staff overtime.

7.3.4 Tornado Risk in Howard County

The overall risk of tornadoes in Howard County is low compared to other parts of the Country. However, there is sufficient exposure to this hazard to perform a simple risk assessment to characterize potential future losses.

The calculation was performed using FEMA's BCAR software (version 4.5.5.0). While this software was designed to assess risk for a single site or building, the methodology may be adapted to reflect an assessment for an entire community. The software bases the risk calculation on avoided injuries and casualties, not damage to structures or loss of operations. Again, this means that the result of the analysis should be regarded as a preliminary indication of the potential life / safety risk. Unfortunately, evaluation of specific previous mitigation actions requires technical information that was not available for this plan update.

The potential future losses / risk calculation is based on the entire population at risk, thus making it unnecessary to separate public assets from private ones. The software uses default values for various levels of injury related to tornadoes. These values are $5.8 million for death and $1.088 million for injuries requiring hospitalization.

Tornado Risk – Residential Assets

The FEMA BCAR software requires some basic information and assumptions to complete the risk assessment, which is summarized in Table 7.3.4-1 below. The software uses this information and the location of the County (by zip code) to calculate the probability of tornadoes of varying intensities to possibly occur in Howard County.

Table 7.3.4-1
Tornado Risk Assessment – Summary of Data Parameters
(Source: FEMA BCA Software, Version 4.5.5.0)

Data	Value
Planning horizon (years)	100
Population (2010 Census Results)	287,085
Maximum design wind speed (mph) of safe room	200 mph
Predominant structure type	One- or two- story residential
Zip code as center of analysis	21044
County land area – square miles	252
Average radius in miles[33]	8.95
Occupancy Percentage	
Day	50%
Evening	80%
Night	100%

Looking at the number of total occupants and sorted by time of day, the software calculates the population on-site based on statistical probabilities of tornadoes affecting the community.

[33] The general radius of the County was determined using the size of the County's land area (252 total square miles) and the area formula ($a = pi * r^2$).

Table 7.3.4-2 shows the average exposed population would be 163,638 residents.

Table 7.3.4-2
Population Based on Occupancy
Percentage and Warning Response
(Source: FEMA BCA Software, Version 4.5.5.0)

Occupancy Results

Calculated Number Of Occupants Per Structure Type Based On Occupancy Percentage And Warning Response: *

	Time	Residences
Night	Midnight - 6:00 AM	172251.00
Evening	6:00 PM - Midnight	195217.80
Day	6:00 AM - 6:00 PM	143542.50
	Average Occupancy:	163,638.45

The software then calculates the expected loss of life and number of injuries from tornado classes EF0 to EF5. Figure 7.3.4-3 summarizes the results of the tornado risk assessment. The figures in the "*Expected Avoided Damages After Mitigation* box are the calculated benefits, which in this case is the total expected losses from the tornado hazard over the 100-year planning horizon. The annual benefits are calculated at $8,234,307 and the net present value of the benefits over the 100-year project lifetime is $117,497,389.

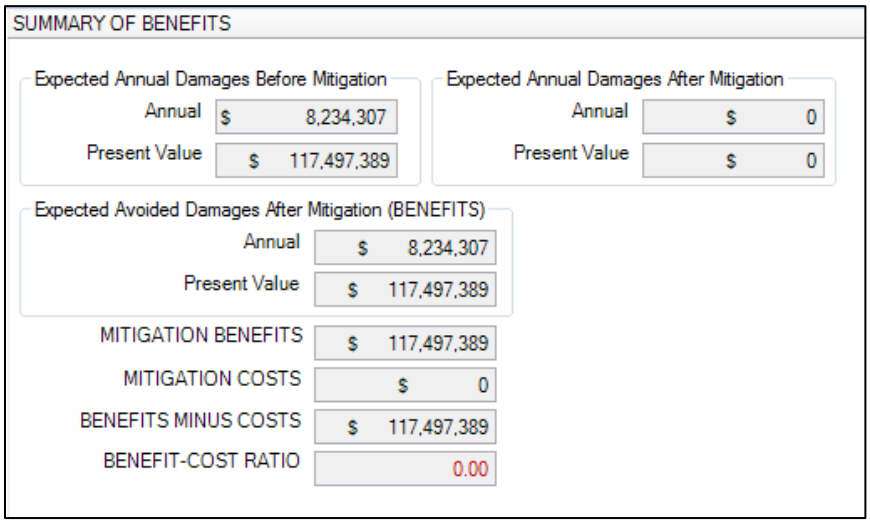
Although this figure is much higher when compared to other hazards' risk benefits, it is prudent to bear in mind the following: (1) the figure is predominantly affected by FEMA's assignment of high values to life / safety concerns, and (2) it is very difficult to develop meaningful tornado mitigation measures for large populations like Howard County.[34]

The purpose of using the BCAR software's tornado element for the risk assessment was to determine the *Annual Benefits* and the *Expected Avoided Damages After Mitigation*. Therefore, important benefit/cost analysis figures such as the project cost, net benefits[35], and benefit/cost ratio are not relevant as part of the present risk assessment. While these figures have been part of the module's calculation, they ultimately do not play a significant role in this analysis.

[34] Although warning systems can address risk to a certain degree, such measures will not mitigate risk to significant percentages of the population. Several factors contribute to this, including the expected effectiveness of warning systems, availability of shelters, and access to shelters.

[35] Net benefit is defined as benefits minus cost. See SOURCE WATER PROTECTION COST/BENEFIT TOOL, www.swptool.org/glossary.cfm (last visited February 2, 2012).

Figure 7.3.4-3
Annual and 100-year Tornado Risk in Howard County
(Source: FEMA BCA Software, Version 4.5.5.0)



Tornado Risk – Public Assets

In addition to the residential tornado risk assessment, an analysis was also completed for the County's public facilities. The tornado risk assessment for public facilities in Howard County was completed for only 27 of the buildings owned or leased by the County as those buildings have at least 100 occupants on a typical day. The analysis was completed based on data provided by the County and entered into the tornado module of the FEMA BCAR software. Table 7.3.4-4 below summarizes the non-residential data inputs.

Table 7.3.4-4
Non-Residential Tornado Risk Assessment - Project Information
(Source: FEMA BCA Software, Version 4.5.5.0)

Data	Value
Loss estimation horizon	100
Assumed structure design wind speeds (mph) of the safe room	200
Zip code as center of analysis	21044
Assumed structure type	Small Professional Building (steel frame)
Occupancy (estimated)	One occupant per 150 s.f. of building space
Occupancy Percentage	
Day	100%
Evening	25%
Night	5%

The software utilizes building occupancy based on time of day to calculate the expected loss of life and number of injuries for tornado classes F0 to F5. The results of the analysis are shown below in Table 7.3.4-5. The table shows that the Laurel Center has the highest annual, as well as 100-year risk, for public facilities in Howard County.

Table 7.3.4-5
Tornado Risk Assessment – Howard County Public Assets, Annual and 100-Year Tornado Risk, Sorted by Occupancy
(Source: FEMA BCA Software, Version 4.5.5.0)

Facility Name	Square Footage	Occupancy	Replacement Value	Annual Risk	100-Year Risk
Laurel Center	120,000	800	$15,000,000	$70,342	$1,003,727
Ascend One - Office Building (financial assistance)	106,720	711	Leased	$62,517	$892,064
Rouse Student Services Hall (RCF)	103,770	692	$26,225,000	$60,846	$868,225
Detention Center	99,300	662	$25,280,000	$58,208	$830,584
Howard	95,850	639	$16,270,000	$56,186	$801,728
Gateway Building	93,000	620	$13,812,000	$54,515	$777,889
Circuit Court	79,592	531	$17,200,000	$46,689	$666,224
Horowitz Visual & Performing Arts Center (HVPA)	78,090	521	$26,615,000	$45,810	$653,678
James Clark, Jr. Library (CL)	75,294	502	$12,780,000	$44,140	$629,839
Science and Technology (ST)	51,414	343	$11,542	$30,159	$430,349
Patrick and Jill McCuan Hall (MH)	49,860	332	$8,464	$29,192	$416,548
Athletic & Fitness Center (AF)	48,064	320	$8,158	$28,137	$401,491
Central Library	47,000	313	$7,977	$27,521	$392,709
Station 3: West Friendship	38,000	253	$8,500	$22,246	$317,428
Northern District Headquarters	37,000	247	$6,280	$21,718	$309,902
Nursing Building (N)	33,097	221	$5,618	$19,432	$277,279
Mary Ellen Duncan Hall (DH)	105,035	210	$13,928	$18,465	$263,478
Robinson Nature Center	29,650	198	$9,000	$17,410	$248,423
Dorsey Building	197,518	198	$26,193,000	$17,410	$248,423
Rockland Arts Center	28,490	190	$3,325	$16,706	$238,386
Station 2: Ellicott City	20,394	136	$2,122	$11,958	$170,634
Utilities Admin	19,700	131	$2,199	$11,519	$164,361
Carroll	18,500	123	$3,140	$10,851	$154,323
Ligon	18,500	123	$3,140	$10,851	$154,323
Southern District Station	18,240	122	$2,700,000	$10,727	$153,068
Alpha Ridge Training Facility Fire Grounds Bldg	18,000	120	$1,800,000	$10,551	$150,559
Glenwood Center	55,735	111	$10,500	$9,760	$139,268
Total	**1,685,813**	**9,369**	**$183,978,893**	**$823,866**	**$11,754,910**

7.4 Summary of Risk Assessment

Mitigation planning provides communities a rational method when deciding what actions to undertake to reduce their natural hazards risks. While it is important to determine and implement specific mitigation actions, often overlooked is the risk assessment portion of a mitigation plan, which establishes an objective basis for prioritizing mitigation efforts. The risk assessment in the NHMP: (1) provides a sense of what the most significant risks to Howard County are; (2) identifies the hazards that present the most potential damage to the County assets; (3) ascertains where

additional study may be warranted; and, (4) begins the process of identifying and prioritizing mitigation actions.

Table 7.4-1 summarizes the results of the risk assessments for floods, hurricane/tropical storm winds, winter storms, and tornadoes for Howard County. The figures are based on calculations of direct damages, losses of functions, and casualties.

Table 7.4-1
Summary of Howard County Loss Estimation
by Asset and Hazard Type (100-year horizon)

Hazard	Asset	Risk
Floods	Residential (using NFIP claims projection)	$242,362
Hurricane wind	County assets (50-year horizon)	$466,600
Winter Storm	County wide, based on NCDC	$7,135,000
Tornado wind	Residential properties	$117,497,389
Tornado wind	County facilities (all over 100 occupancy)	$11,754,910

Section 8
Mitigation Strategy

Contents of this Section

8.1 IFR Requirements for Mitigation Strategy

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

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

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

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

8.2 Mitigation Goals and Objectives

State and federal guidance and regulations pertaining to mitigation planning require the development of mitigation goals to reduce or avoid long-term vulnerabilities to identified hazards. For the purposes of this Plan Update, Goals are defined as observable and measureable results, which may have one or more objectives to be achieved, within a fixed timeframe. Objectives can be described as well-defined intermediate points in the process of achieving goals. The Maryland Emergency Management Agency (MEMA) and Howard County staff helped establish mitigation goals for the Natural Hazards Mitigation Plan Update.

MEMA's Mitigation Goals

The Maryland Emergency Management Agency is the State's coordinating agency for disaster preparedness, emergency response and disaster recovery assistance. MEMA is also tasked with coordination of the State's natural disaster mitigation initiatives and the administration of FEMA grant funding. MEMA is tasked with updating the 2008 *State of Maryland Hazard Mitigation Plan*. The 2011 State of Maryland's Hazard Mitigation Goal is:

To protect life, property, and the environment from hazard events through:

- Increased public awareness of hazard events, mitigation and preparedness.
- Enhance coordination with jurisdictions to develop a relationship at the state and local level.
- Efficient use of State resources.

Howard County's Mitigation Goals

The 2004 plan addressed six overarching mitigation goals to serve as guidelines for the Howard County government, its agencies and stakeholders. The following goals were developed to reduce the impact of natural hazards across the County.

- Saving lives and property;
- Reducing vulnerabilities to future natural hazards;
- Guiding and speeding post-disaster recovery;
- Enhancing mitigation efforts;
- Taking advantage of mitigation funding opportunities; and
- Promoting public participation.

As part of the 2011 NHMP Update process, the Natural Hazards Mitigation Plan Steering Committee (NHMPSC) reviewed and discussed the six original goals. At a work group session held in May of 2011, the Committee determined that the last five goals supported the objective of the first goal, namely the "saving lives and property" and decided to replace these six goals with a single overarching mitigation goal.

The 2011 mitigation goal statement is: *Strive to save lives and protect property within Howard County.* The remaining five goals were enhanced and further developed as objectives for the plan update as indicated below.

1. Enhance mitigation efforts to reduce vulnerabilities to future natural hazards;
2. Improve preparedness, response, recovery and mitigation functions within the County;
3. Continue to pursue available mitigation funding opportunities for future projects;
4. Continue to engage and educate the public on mitigation natural hazards; and
5. Ensure continual implementation of mitigation actions.

Analyzing Mitigation Techniques

In formulating the Mitigation Strategy, the NHMPSC explored six mitigation categories for attaining the plan's goal and objectives. They include: Prevention, Property Protection, Natural Resource Protection, Structural Projects, Emergency Services, and Public Information and Awareness. These categories formed the basis of the mitigation actions in the Plan Update. Descriptions of these categories and examples for each category are included below:

1. Prevention

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

2. Property Protection

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

3. Natural Resource Protection

   Natural resource protection activities include those actions that can reduce the impact of hazards by preserving or restoring the function of natural systems. Natural systems that can be classified as high hazard areas include floodplains, wetlands and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing water quality or recreational opportunities. These actions are usually implemented by parks, recreation or conservation agencies. Examples include: floodplain protection; fire resistant landscaping; erosion and sediment control; wetland restoration; habitat preservation; and slope stabilization.

4. Structural Projects

   Structural mitigation projects are designed to reduce the impact of hazards by building new structures or hardening existing structures. Structural projects are usually designed by engineers and managed or maintained by public works staff. Examples include: reservoirs; levees, dikes, and floodwalls; detention and retention basins; channel modification; and storm sewer construction.

5. Emergency Services

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

6. Public Information and Awareness

   Public Information and awareness activities are conducted to advise and educate residents, business owners, potential property buyers, and visitors about hazards and mitigation techniques that can be used to protect lives and property. Examples of measures used to educate and inform the public include: outreach and education; training; demonstrations; real estate disclosure; and hazard expositions.

8.3 Previous and Ongoing Mitigation Initiatives

Once various categories of mitigation actions were examined, the NHMPSC reviewed the actions in the 2004 Plan (92 mitigation actions in all). Each action from the original plan was discussed at the Steering Committee meeting and categorized as "In Progress," "On-Going," "Not Applicable," "Completed" or "Cancelled." Table 8.3-1 defines each category and lists the number and percentage of actions under each category.

Table 8.3-1
2004 Plan Mitigation Actions Review

2004 NHMP Actions	Definition	Number	Percent
In Progress	Work has been initiated on these actions. These projects have a definite end-date.	6	7%
On-Going	Actions that are performed on a regular and continuous basis by the Department.	14	15%
Not Applicable	Actions that were deemed by the NHMPSC to not apply to the NHMP.	23	25%
Completed	The department has completed the action since the development of the 2004 plan.	33	36%
Cancelled	The department has decided to terminate the project.	16	17%
Total Mitigation Actions Reviewed		92	100%

8.4 Continued Compliance with the National Flood Insurance Program (NFIP)

We understand that while FEMA is the official administering agency for NFIP participation, it is the community's responsibility to have the capability and to serve as a resource for flood mitigation activities. Howard County is a participant in the NFIP and is committed to continuing compliance with the NFIP via three basic components of the NFIP:

- floodplain identification and mapping risk;
- responsible floodplain management; and
- flood insurance.

How the County currently addresses and will continue to address NFIP compliance and requirements in the future:

Flood Identification and Mapping

- The County makes the Flood Insurance Rate Map and Flood Insurance Studies available to the public. These documents are housed in the County's Stormwater Management Division (Bureau of Environmental Services). Digital Flood Insurance Rate Maps have recently been developed for the County and will be made available to the public as well.
- All Letters of Map Revisions (LOMRs) are reviewed and signed by County officials. If during the subdivision review process a new development determines a reduction in the floodplain delineation of the FIRM floodplain, the developer is required to submit a LOMR submission to FEMA.
- The County provides advice to community residents regarding elevation certificates and Letter of Map Amendment (LOMA) applications.
- The County maintains records of approved letters of map change.
- The Department of Public Works (Bureau of Environmental Services) assists residents in interpreting the FIRM and County flood studies to determine the property's status in the floodplain.

Floodplain Management

- Restrictions on flood plain use are enforced through the subdivision and building permit process.
- All proposed development requires plans to go through the County's subdivision approval process or to acquire a building permit for new structures. However, County Code prohibits any new structures in the 100-year flood plain.
- Subdivisions that involve drainage areas of 30 acres or greater or 10-year storm flows greater than 100 cfs are required to develop 100-year flood plain delineations in the development. There is no specific requirement for 50 lots or 5-acre development sizes.
- All new structures are required to be at least two feet above the 100-year base flood elevation.

Flood Insurance

- The County is committed to educating residents about the value and availability of flood insurance. An annual letter is sent to residents in the flood plain explaining the importance of flood insurance and where it may be obtained.
- Currently, the County is notifying affected property owners of the changes being proposed in the new DFIRM.
- The County assists residents in interpreting the FIRM and County flood studies to determine the resident's property's flood plain status, and offers advice regarding elevation certificates and LOMA applications.
- The last Community Assistance Visit was conducted on November 9, 2005 and, as of that date, Howard County was found to meet the requirements for continued participation in the NFIP.

8.5 Mitigation Action Items

As part of the update process, the Natural Hazard Mitigation Planning Work Group (Planning Work Group) worked closely with NHMPSC members to develop new mitigation actions during several work sessions discussed in Section 5. Based on qualitative ranking during the Hazard Identification and Vulnerability Analysis phase, the following four hazards were deemed as high priority hazards by the Planning Working Group. These included: flood, hurricane and tropical storms, severe winter weather and tornados. Efforts

were made to ensure that mitigation actions were included for each of these hazards.

Actions from the 2004 Plan that were categorized as "On-Going" and "In Progress," were included in the 2011 Plan Update. In addition to these actions from the original plan, 37 new actions were developed for inclusion in the Plan Update, which resulted in a total of 57 mitigation actions. Once these actions were finalized, an implementation strategy was developed, which identified the following for each of the mitigation actions:

- related hazard;
- lead and supporting Departments for implementation;
- relevant objective;
- funding source (Federal, State, County funds or grants);
- current status of the action; and
- general timeline (short term – 1 to 2 years; medium term 3 to 5 years; long term – 5 to 10 years; or continuous/ongoing).

All of these actions and its attributes are identified in Table 8.5.1-1, 8.6-1, 8.6-2, and 8.6-3.

8.5.1 Evaluating Mitigation Actions for Cost-Effectiveness

In accordance with FEMA mitigation planning requirements, the Natural Hazards Mitigation Plan Steering Committee evaluated the cost-effectiveness of each of the actions listed in the table below. This usually involved coordination and discussions with the specific Departments and individuals in the County that will be responsible for implementing the actions. In many cases, the actions listed in the table are part of larger mitigation strategies, or are studies intended to be precursors to potential mitigation actions, if the actions are determined to be feasible and cost-effective through more detailed evaluations.

The County used three sources to develop the actions tables below: (1) the original Natural Hazard Mitigation Plan; (2) other plans and documents such as the Capital Improvement Plan; and (3) directly soliciting information from County Departments and individuals with specific knowledge of certain kinds of hazards and actions. Although there was generally little information available about cost-effectiveness available from any of these sources, the County sought this information and reviewed it when it was available. Regarding the feasibility of the listed actions, as part of the interim review of the NHMP update document, this and other sections were circulated to members of the NHMPSC for technical review. As part of that process, the members were asked to provide a preliminary assessment of the feasibility of the actions – only actions that were determined feasible are included in the tables.

Table 8.5.1-1
Mitigation Action Items

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
1	Establish pre-disaster debris contracts and craft debris site MOUs with appropriate County agencies and regions. Ensures effective response post-disaster.	All Hazards	Public Works, Bureau of Environmental Services, Solid Waste (Operations Division)	2	General fund	Staff time	Not independently cost-effective, but essential to the County's effectiveness during disasters and emergency events.	New Action	Short-term
2	Through partnerships with the Maryland Department of Natural Resources, the Department of Recreation and Parks and the Columbia Association, identify areas within the County where hazards exist in the wild land/urban interface setting. Work with the appropriate organizations to develop strategies to remove the accumulation of hazards and excessive fuels (trees, trash, etc.) within the identified areas. Precursor to initiating mitigation actions to reduce the effects of wildfires.	Wildfires	Fire and Rescue Services	1	General fund	Staff time	Not independently cost-effective, but a necessary precursor to completing work in removing fuels.	New Action	Long Term
3	Based on the results of the identification process in Item 2, initiate a process to remove sources of fuel in potential wildfire areas. Protects assets and citizens from effects of wildfires.	Wildfires	Fire and Rescue Services	1	General fund	$75,000	Degree of cost-effectiveness depends on fire potential from year to year. Presume cost-effective over a long period because the action is relatively inexpensive.	New Action	Long Term/ Ongoing
4	Implement the operational strategies and Cistern Plan for dealing with rural water supply during protracted drought events. Helps to maintain water supply during periods of prolonged drought.	Drought	Fire and Rescue Services	5	General fund	Staff time	Highly cost-effective during drought events.	New Action	Short-term
5	Partner with the Maryland Department of Natural Resources - Forest Service to explore the possibility of Howard County becoming a "Fire wise" community. Leads to longer-term actions to reduce risks from wildfire across the county.	Wildfires	Fire and Rescue Services/ Office of Emergency Management	1	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
6	Devise a process to protect refrigerated critical health care supplies during extended power outages caused by natural hazards. Direct positive impacts in protecting the health and welfare of County citizens during emergencies and disasters.	All Hazards	Health Department	2	PHEP Grant	$1,000	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
7	Devise a robust public outreach plan/program to educate the general public and stakeholders on how to prevent, prepare for, and recover from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County (http://www.fema.gov/library/index.jsp). Direct benefits to citizens during emergencies and disasters.	All Hazards	Office of Emergency Management, Public Information Office	4	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
8	Update the County and OEM websites with pertinent hazard preparedness and mitigation information, including downloadable documents and web links for FEMA, MEMA, National Oceanic and Atmospheric Administration and the National Weather Service. Direct benefits to citizens during emergencies and disasters.	All Hazards	Office of Emergency Management, Public Information Office	4	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
9	Educate key emergency management stakeholders (Emergency Management Advisory Group and Emergency Management Operations Group members) by holding workshops on major disaster recovery efforts and /initiatives, such as debris management, damage assessments, volunteer management and donation management. Wide-ranging benefits mainly related to response and recovery activities.	All Hazards	Office of Emergency Management	2 / 4	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
10	Conduct a feasibility study to identify existing Class 4 buildings, and establish policy that all existing and new Class 4 buildings and critical facilities are hardened and considered for incorporating safe rooms. Future benefits include maintaining the operations of safe rooms and other critical facilities during emergencies and disasters.	All Hazards	Department of Public Works, Bureau of Facilities	2	PDMG	$10,000	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Medium-term
11	Develop an Emergency Preparedness, Training, and Exercise Plan that includes a regular maintenance plan and an annual budget. Direct benefits to citizens during emergencies and disasters.	All Hazards	Office of Emergency Management	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
12	Expand existing mutual aid agreements and establish a pre-EMAC personnel and equipment identification process to deploy County Emergency Management personnel (Department of Fire and Rescue Services, Police Department, Department of Public Works, Department of Citizen Services, Health Department, Department of Inspection, Licenses and Permits, and Department of Planning and Zoning), and equipment to surrounding jurisdictions and/or regional/national disaster events. Direct benefits to citizens during emergencies and disasters.	All Hazards	Office of Emergency Management	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
13	Continue to enforce Subdivision and Land Development Regulations[1], namely Section 16.115 which prohibits clearing, grading, paving and construction activity in the 100 year flood plain, and Section 16.116 which protects streams, wetlands, and steep slopes from future development. Long-term benefits to citizens by preventing increased flood problems.	Flooding	Department of Planning and Zoning	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
14	Continue to enforce the incorporation of State and local storm water management regulations and progressive techniques into all development plans. Long-term benefits to citizens by preventing increased flooding.	Flooding	Department of Planning and Zoning	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
15	Continue to identify all existing critical infrastructure and then create a GIS map layer. Long-term benefits include developing baseline understanding of risks.	All Hazards	Police Department	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
16	Conduct annual training/exercises for Emergency Operations Center and Department Operations Center personnel on how to continuously staff the centers through a protracted disasters. Future benefits include maintaining effective operations during emergencies and disasters.	All Hazards	Office of Emergency Management	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term

[1] Subdivision and Land Development Regulations, §§ 16.115, 16.116 (2005).

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
17	Install transfer switches at all County designated shelters. Future benefits include maintaining the operations of shelters during emergencies and disasters.	All Hazards	Department of Public Works, Bureau of Facilities	2	CIB	$100,000	Highly cost-effective because the action is relatively inexpensive and likely reduces risk considerably during specific hazard events.	New Action	In-progress
18	Develop a County Emergency Water Supply Plan. Long-term benefits to all county residents include maintaining adequate water supply during droughts.	All Hazards	Public Works, Bureau of Utilities	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
19	Develop a policy setting out County's role in curbside debris pick up. Develop list of contractors for debris removal for private property. Benefits include enhanced recovery operations following emergences and disasters.	All Hazards	Public Works, Bureau of Environmental Services, Office of Law, Risk Management	2	General fund	Staff time	Not independently cost-effective, but essential to the County's effectiveness during disasters and emergency events.	New Action	Short-term
20	Continue to provide the Department of Technology and Communication Services, GIS Unit with information regarding access points and trails for emergency vehicle use within the County's park system.	All Hazards	Recreation and Parks, Columbia Association	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
21	Continue to evaluate and remove trees throughout the County's park system that are at risk of falling during storms and high wind events. Localized benefits related to protecting citizens and assets in hazardous areas.	Wind Storms and Tornados	Department of Recreation and Parks	5	AOB	$100,000 ($1,000 per tree)	Difficult to complete benefit-cost analysis because probability cannot be determined, but relatively inexpensive and presumed cost-effective on a large scale.	New Action	Continuous
22	Continue to administer the Forest Mitigation Program to establish new forests in parkland and along streams and rivers, to protect against erosion and uprooting trees. Long-term benefits include reduced erosion and maintaining stability of banks and trees.	Flood	Department of Recreation and Parks	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Continuous

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
23	Continue to work with property owners to increase vegetation in riparian buffers through the Plant-It-Green program, which consists of supplying free trees to plant adjacent to the streams to reduce velocity of storm water and to stabilize soil. Benefits include reducing negative downstream flood effects by slowing conveyance.	Flood	Department of Recreation and Parks	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
24	Continue to adopt the most updated version of the National Electrical Code (NEC). Long-term, general benefits include protecting citizens from fires.	All Hazards	Department of Inspections, Licensing and Permits	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Medium-term
25	Continue to host annual workshops for local builders to discuss how to build homes that are more resistant to natural hazards. Generalized benefits to citizens, as effects of a range of hazards are reduced.	All Hazards	Department of Inspections, Licensing and Permits	4	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Medium-term
26	Review and, if needed, improve the process for fast-tracking permits and inspections following disasters. When a disaster occurs those structures affected will be processed first before the normal work load. Benefits include improved recovery capability.	All Hazards	Department of Inspections, Licensing and Permits	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Medium-term
27	Review existing building codes every three years to ensure they have been deemed satisfactory in assessing serious damage caused by specific hazards. Generalized long-term benefits.	All Hazards	Department of Inspections, Licensing and Permits	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Continuous
28	Evaluate Department of Public Work's ability to maintain a suitable workforce during a protracted disaster. Benefits include maintaining effective operations during emergencies and disasters.	All Hazards	Department of Public Works	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Medium-term
29	Evaluate infrastructure on frequently flooded roadways to determine whether the roads/bridges/culverts need to be upgraded to lessen the frequency of flooding. Prioritize projects and seek funding. Benefit is establishing an accurate basis for mitigation activities.	Flooding	Department of Public Works, Bureau of Engineering, Transportation and Special Projects Division	2	HMGP	$250,000 (including hydrologic studies)	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	On-Going	Short-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
30	Continue to station Public Works and Fire Department personnel in key locations for flood level monitoring and notification to the Office of Emergency Management. Benefits include improved effectiveness of response and recovery operations.	Flooding	Department of Public Works, Bureau of Environmental Services, Fire and Rescues Services	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Short-term
31	Continue to perform routine maintenance to keep street trees healthy so they are less likely to fall or break during a severe weather event. Localized benefits to citizens and assets that are protected from damage and injury, mainly during high-wind events that are coupled with rain.	Severe Weather	Department of Public Works, Bureau of Highways	5	General fund	Staff time	Difficult to complete benefit-cost analysis because probability cannot be determined, but relatively inexpensive and presumed cost-effective on a large scale.	On-Going	Continuous
32	Continue to conduct an annual snow emergency coordination meeting in the fall with the County Departments involved in snow emergency response. Benefits include enhanced capabilities in response and recovery from snow emergencies.	Blizzards	Department of Public Works, Bureau of Highways	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Continuous
33	When beaver dams are identified and located, continue to dismantle the dams to reduce the impact of flooding. Localized benefits from decreased jam flooding.	Flood	Department of Recreation and Parks	1	General fund	Staff time	Presumed cost-effective, though a lack of probability information makes benefit-cost analysis impossible.	On-Going	Continuous
34	Continue to improve an annual plan to supplement Public Work's snow removal teams with Department of Recreation and Parks and Fire Department personnel. Long-term benefits related to avoiding damage and injury.	Blizzards	Department of Public Works, Department of Recreation and Parks, Fire and Rescue Services	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	On-Going	Short-term
35	Conduct an assessment of the County's critical facilities to assure that all technology sites have backup power. Benefits related to developing specific mitigation actions.	All Hazards	Department of Comm.and Technology Services	2	General fund	Staff time	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	In Progress	Short-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
36	Conduct regular training sessions for emergency response personnel regarding the County's legal authority during emergency situations. Benefits are ensuring that response and recovery operations are effective.	All Hazards	Howard County Office of Law	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	In Progress	Medium-term
37	Implement a community notification system to notify residents of hazards affecting the community. Widespread benefits related to increased life safety and response.	All Hazards	Office of Emergency Management	2	UASI	$256,000 (start-up) $86,000 annual maintenance	Presumed cost-effective on a large scale because the action is relatively inexpensive and a large percentage of the community is assisted.	In Progress	Short-term
38	Upload preparedness information onto the County and OEM websites, and develop pamphlets and other outreach material discussing how residents and businesses can protect themselves, their property and assets from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County (http://www.fema.gov/library/index.jsp).	All Hazards	Office of Emergency Management, Public Information Office	4	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	In Progress	Short-term
39	Evaluate all County government buildings for high wind resiliency and related hazards. Benefit is that the action is a precursor to developing site-specific mitigation.	All Hazards	Department of Inspections Licensing and Permits, Department of Public Works	1	General fund	Staff time	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	In Progress	Short-term
40	Educate all building safety coordinators about safety, evacuations, appropriate assembly areas and shelter-in-place guidelines. Benefits related to life safety.	All Hazards	Risk Management	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
41	Work with Department of Public Works to combine the Natural Hazards Mitigation Plan and Flood Mitigation Plan to ensure annual review cycles are synchronized.	All Hazards	Office of Emergency Management , Department of Public Works – Storm Water Management	5	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-tem
42	Review and reevaluate the existing codes for County retaining walls. Probable benefits related to ensuring effectiveness of retaining walls.	Flood	Department of Inspections, Licensing and Permits	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
43	Identify and develop a GIS layer for public retaining walls in the County. Benefits related to long-term safety and stability of walls.	Flood	Department of Public Works, Department of Technology and Comm. Services, GIS Unit	2	HMGP	Staff Time	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	New Action	Medium-term
44	Assess all county-owned retaining walls to see if they need to be reinforced and prioritize that work. Benefit is that the action forms the basis of additional mitigation activities that may limit structural damage.	Flood	Department of Technology and Comm. Services, GIS Unit	2	General fund	$50,000	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	New Action	Medium-term
45	Adopt and implement the National Grid Coordinate mapping system and incorporate into the computer-aided dispatch system to indicate the locations of all County critical infrastructures to include water/sewer valves. Benefits related to ensuring effective monitoring and response activities.	All Hazards	Department of Technology and Comm. Services, Department of Public Works	2	HMGP	$25,000	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Medium-term
46	Establish an MOU with Howard County General Hospital as a backup storage facility for refrigerated critical health care supplies. Benefits related to improved response and recovery operations.	All Hazards	Health Department	2	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
47	Evaluate the new FEMA floodplain, including non-structure hazards within 100 feet of the flood zone. Long-term benefits related to best possible enforcement of floodplain regulations.	Floods	Department of Public Works, Storm Water Management , Department of Technology and Comm. Services	1	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term
48	Conduct an assessment of the County's critical facilities to determine emergency backup power requirements. Prioritize the listed emergency backup power projects and implement as funds are available. Benefits related to identifying additional mitigation projects.	All Hazards	Department of Public Works, Bureau of Facilities, EMOG	2	HMGP	$100,000	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	New Action	Medium-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
49	Survey streams above "critical public facilities" to determine where maintaining debris free stream flow is required to avoid an "imminent hazard" to those facilities and then create a GIS layer. Benefits related to reducing impacts of flooding.	Flood	Department of Public Works, Department of Technology and Comm.Services, GIS Unit	2	General fund	Staff time	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	New Action	Medium-term
50	Inventory existing culverts that are maintained by the Department of Public Works, Bureau of Highways and create an addressable GIS layer. Benefits related to reducing impacts of flooding.	Flood	Department of Public Works, Bureaus of Highways; Engineering, Department of Technology and Comm. Services, GIS Unit	1	General fund	Staff time	Not independently cost-effective, but a necessary phase in identifying areas at risk and initiating appropriate mitigation measures.	New Action	Short-term
51	Design, site and install Road Weather Information Systems to allow quicker response to changing road conditions and facilitate in keeping the transportation network open. Benefits related to life safety.	Ice/Snow	Department of Public Works, Bureau of Highways	2	HMGP	$200,000	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Medium-term
52	Purchase 800/900 MHz radios for Debris Management Team (9 vehicles). Benefits related to maintaining or enhancing response and recovery operations.	All Hazards	Department of Public Works, Bureau of Environmental Services	2	HMGP	$45,000	Not independently cost-effective, but essential to the County's effectiveness during disasters and emergency events.	New Action	Short-term
53	Develop a Department of Public Works DOC (Department Operations Center) at the Bureau of Utilities facility. Benefits related to improved operations during and after emergencies or disasters.	All Hazards	Department of Public Works	2	EMPG	$200,000	Not independently cost-effective, but essential to the County's effectiveness during disasters and emergency events.	New Action	Medium-term

No.	Action Item Description / Benefits	Hazard	Lead and Support Departments	Objective	Funding Source	Estimated Cost	Cost Effectiveness	Status	Timeline
54	Plan and design a hardened/secure facility at the PSTC for a future 911 Communications Center and Emergency Operations Center that meets all applicable homeland security and fire safety codes, regulations and standards. Benefits related to improved operations during and after emergencies or disasters.	All-Hazards	Department of Public Works, Facilities Bureau, Police Department, Fire and Rescue Services and Office of Emergency Management	2	EMPG	$75,000	Not independently cost-effective, because it is a plan and design project, but this is a critical initial step in developing a state of the art 911 Center and EOC, which is presumed highly cost-effective because it reduces risk for a large percentage of the County's population.	New Action	Long-term
55	Establish a comprehensive critical infrastructure protection program that focuses on security and consequence management. Widespread benefits related to life safety and maintaining operations prior to and following emergency events.	All-Hazards	Police Department, Office of Emergency Management, Fire and Rescue Services, Department of Public Works, Department of Technology and Comm. Services, Risk Management, and Health Department	2	General fund	Staff time	Not independently cost-effective, but essential to the County's effectiveness during disasters and emergency events.	New Action	Short-term
56	Continue to work on a number of issues related to floodplain identification and mapping risk; responsible floodplain management; and flood insurance as indicated in Section 8.4 of this report. Continue to ensure compliance with the National Flood Insurance Program. Long-term benefits of reducing potential flooding.	Flood	Department of Planning and Zoning, Department of Public Works, Department of Licensing, Inspections, and Permits	1	General fund	Staff time	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Continuous
57	Conduct flood study of the 2011 Ellicott City flashflood during TS Lee to determine why/how it happened and what mitigation actions can be taken to prevent or reduce the hazard in the future. Benefits include establishing a baseline to develop additional mitigation activities.	Flood	Department of Public Works, Storm Water Management	1	HMGP	$10,000	Not independently cost-effective, but part of a larger strategy to reduce risk.	New Action	Short-term

Funding Sources: PHEP – Public Health Emergency Preparedness; PDMG – Pre Disaster Mitigation Grant; CIB – Capital Improvements Budget; AOB – Annual Operating Budget; HMGP – Hazard Mitigation Grant Program; UASI – Urban Areas Security Initiative; EMPG – Emergency Management Planning Grant

8.6 Prioritized Mitigation Action Items

Once the mitigation actions and implementation plan were finalized, the Planning Working Group developed specific criteria to prioritize the actions. The NHMPSC agreed on the following three criteria which involved addressing the following questions:

Social Considerations – Life/Safety Impact

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

Administrative Considerations – Administrative/Technical Assistance

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

Economic Considerations – Project Cost

- What is the approximate cost of the project?

For each criterion, the level of importance (high, medium, or low) was determined and corresponding points were assigned, as indicated in Table 8.6.1.

Table 8.6-1
Evaluation Criteria for Project Prioritization

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

Points were then assigned to each action and totaled, in order to determine the ranking of actions as shown in Table 8.6-2.

Table 8.6-2
Prioritization of Mitigation Actions

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
1	Establish pre-disaster debris contracts and craft debris site MOUs with appropriate County agencies and regions. Ensures effective response post-disaster.	6	5	5	16
2	Through partnerships with the Maryland Department of Natural Resources, the Department of Recreation and Parks and the Columbia Association, identify areas within the County where hazards exist in the wild land/urban interface setting. Work with the appropriate organizations to develop strategies to remove the accumulation of hazards and excessive fuels (trees, trash, etc.) within the identified areas. Precursor to initiating mitigation actions to reduce the effects of wildfires.	2	5	5	12
3	Based on the results of the identification process in Item 2, initiate a process to remove sources of fuel in potential wildfire areas. Protects assets and citizens from effects of wildfires.	2	5	5	12
4	Implement the operational strategies and Cistern Plan for dealing with rural water supply during protracted drought events. Helps to maintain water supply during periods of prolonged drought.	6	5	5	16
5	Partner with the Maryland Department of Natural Resources - Forest Service to explore the possibility of Howard County becoming a “Fire wise” community. Leads to longer-term actions to reduce risks from wildfire across the County.	2	5	5	12

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
6	Devise a process to protect refrigerated critical health care supplies during extended power outages caused by natural hazards. Direct positive impacts in protecting the health and welfare of County citizens during emergencies and disasters.	10	5	5	20
7	Devise a robust public outreach plan/program to educate the general public and stakeholders on how to prevent, prepare for, and recover from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County. http://www.fema.gov/library/index.jsp. Direct benefits to citizens during emergencies and disasters.	10	5	5	20
8	Update the County and OEM websites with pertinent hazard preparedness and mitigation information, including downloadable documents and web links for FEMA, MEMA, National Oceanic and Atmospheric Administration and the National Weather Service. Direct benefits to citizens during emergencies and disasters.	6	5	5	16
9	Educate key emergency management stakeholders (Emergency Management Advisory Group and Emergency Management Operations Group members) by holding workshops on major disaster recovery efforts and /initiatives, such as debris management, damage assessments, volunteer management and donation management. Wide-ranging benefits mainly related to response and recovery activities.	6	5	5	16
10	Conduct a feasibility study to identify existing Class 4 buildings, and establish policy that all existing and new Class 4 buildings and critical facilities are hardened and considered for incorporating safe rooms. Future benefits include maintaining the operations of safe rooms and other critical facilities during emergencies and disasters.	10	5	5	20
11	Develop an Emergency Preparedness, Training, and Exercise Plan that includes a regular maintenance plan and an annual budget. Direct benefits to citizens during emergencies and disasters.	6	5	5	16
12	Expand existing mutual aid agreements and establish a pre-EMAC personnel and equipment identification process to deploy County Emergency Management personnel (Department of Fire and Rescue Services, Police Department, Department of Public Works, Department of Citizen Services, Health Department, Department of Inspection, Licenses and Permits, and Department of Planning and Zoning), and equipment to surrounding jurisdictions and/or regional/national disaster events. Direct benefits to citizens during emergencies and disasters.	6	5	5	16

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
13	Continue to enforce Subdivision and Land Development Regulations[2], namely Section 16.115 which prohibits clearing, grading, paving and construction activity in the 100 year flood plain, and Section 16.116 which protects streams, wetlands, and steep slopes from future development. Long-term benefits to citizens by preventing increased flood problems.	2	5	5	12
14	Continue to enforce the incorporation of State and local storm water management regulations and progressive techniques into all development plans. Long-term benefits to citizens by preventing increased flooding.	6	5	5	16
15	Continue to identify all existing critical infrastructure and then create a GIS map layer. Long-term benefits include developing baseline understanding of risks.	6	5	5	16
16	Conduct annual training/exercises for Emergency Operations Center and Department Operations Center personnel on how to continuously staff the centers through a protracted disaster. Future benefits include maintaining effective operations during emergencies and disasters.	10	5	5	20
17	Install transfer switches at all County designated shelters. Future benefits include maintaining the operations of shelters during emergencies and disasters.	10	5	1	16
18	Develop a County Emergency Water Supply Plan. Long-term benefits to all county residents include maintaining adequate water supply during droughts.	10	5	5	20
19	Develop a policy setting out County's role in curbside debris pick up. Develop list of contractors for debris removal for private property. Benefits include enhanced recovery operations following emergences and disasters.	2	3	5	10
20	Continue to provide the Department of Technology and Communication Services, GIS Unit with information regarding access points and trails for emergency vehicle use within the County's park system.	10	3	5	18
21	Continue to evaluate and remove trees throughout the County's park system that are at risk of falling during storms and high wind events. Localized benefits related to protecting citizens and assets in hazardous areas.	6	5	1	12
22	Continue to administer the Forest Mitigation Program to establish new forests in parkland and along streams and rivers, to protect against erosion and uprooting trees. Long-term benefits include reduced erosion and maintaining stability of banks and trees.	6	5	5	16

[2] Subdivision and Land Development Regulations, §§ 16.115, 16.116 (2005).

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
23	Continue to work with property owners to increase vegetation in riparian buffers through the Plant-It-Green program, which consists of supplying free trees to plant adjacent to the streams to reduce velocity of storm water and to stabilize soil. Benefits include reducing negative downstream flood effects by slowing conveyance.	2	5	5	12
24	Continue to adopt the most updated version of the National Electrical Code (NEC). Long-term, general benefits include protecting citizens from fires.	6	5	5	16
25	Continue to host annual workshops for local builders to discuss how to build homes that are more resistant to natural hazards. Generalized benefits to citizens, as effects of a range of hazards are reduced.	6	5	5	16
26	Review and, if needed, improve the process for fast-tracking permits and inspections following disasters. When a disaster occurs those structures affected will be processed first before the normal work load. Benefits include improved recovery capability.	6	5	5	16
27	Review existing building codes every three years to ensure they have been deemed satisfactory in assessing serious damage caused by specific hazards. Generalized long-term benefits.	6	5	5	16
28	Evaluate Department of Public Work's ability to maintain a suitable workforce during a protracted disaster. Benefits include maintaining effective operations during emergencies and disasters.	6	5	5	16
29	Evaluate infrastructure on frequently flooded roadways to determine whether the roads/bridges/culverts need to be upgraded to lessen the frequency of flooding. Prioritize projects and seek funding. Benefit is establishing an accurate basis for mitigation activities.	10	5	1	16
30	Continue to station Public Works and Fire Department personnel in key locations for flood level monitoring and notification to the Office of Emergency Management. Benefits include improved effectiveness of response and recovery operations.	10	5	5	20
31	Continue to perform routine maintenance to keep street trees healthy so they are less likely to fall or break during a severe weather event. Localized benefits to citizens and assets that are protected from damage and injury, mainly during high-wind events that are coupled with rain.	6	5	5	16
32	Continue to conduct an annual snow emergency coordination meeting in the fall with the County Departments involved in snow emergency response. Benefits include enhanced capabilities in response and recovery from snow emergencies.	10	5	5	20

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
33	When beaver dams are identified and located, continue to dismantle the dams to reduce the impact of flooding. Localized benefits from decreased jam flooding.	6	5	5	16
34	Continue to improve an annual plan to supplement Public Work's snow removal teams with Department of Recreation and Parks and Fire Department personnel. Long-term benefits related to avoiding damage and injury.	6	5	5	16
35	Conduct an assessment of the County's critical facilities to assure that all technology sites have backup power. Benefits related to developing specific mitigation actions.	6	5	5	16
36	Conduct regular training sessions for emergency response personnel regarding the County's legal authority during emergency situations. Benefits are ensuring that response and recovery operations are effective.	6	5	5	16
37	Implement a community notification system to notify residents of hazards affecting the community. Widespread benefits related to increased life safety and response.	10	5	1	16
38	Upload preparedness information onto the County and OEM websites, and develop pamphlets and other outreach material discussing how residents and businesses can protect themselves, their property and assets from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County (http://www.fema.gov/library/index.jsp).	6	5	5	16
39	Evaluate all County government buildings for high wind resiliency and related hazards. Benefit is that the action is a precursor to developing site-specific mitigation.	10	5	5	20
40	Educate all building safety coordinators about safety, evacuations, appropriate assembly areas and shelter-in-place guidelines. Benefits related to life safety.	10	5	5	20
41	Work with the Department of Public Works to combine the Natural Hazards Mitigation Plan and Flood Mitigation Plan to ensure annual review cycles are synchronized.	10	5	5	20
42	Review and reevaluate the existing codes for County retaining walls. Probable benefits related to ensuring effectiveness of retaining walls.	10	5	5	20
43	Identify and develop a GIS layer for public retaining walls in the County. Benefits related to long-term safety and stability of walls.	10	3	5	18
44	Assess all county-owned retaining walls to see if they need to be reinforced and prioritize that work. Benefit is that the action forms the basis of additional mitigation activities that may limit structural damage.	6	3	3	12

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
45	Adopt and implement the National Grid Coordinate mapping system and incorporate into the computer-aided dispatch system to indicate the locations of all County critical infrastructures to include water / sewer valves. Benefits related to ensuring effective monitoring and response activities.	6	1	3	10
46	Establish an MOU with Howard County General Hospital as a backup storage facility for refrigerated critical health care supplies. Benefits related to improved response and recovery operations.	6	5	5	16
47	Evaluate the new FEMA floodplain, including non-structure hazards within 100 feet of the flood zone. Long-term benefits related to best possible enforcement of floodplain regulations.	10	5	5	20
48	Conduct an assessment of the County's critical facilities to determine emergency backup power requirements. Prioritize the listed emergency backup power projects and implement as funds are available. Benefits related to identifying additional mitigation projects.	6	3	1	10
49	Survey streams above “critical public facilities” to determine where maintaining debris free stream flow is required to avoid an “imminent hazard” to those facilities and then create a GIS layer. Benefits related to reducing impacts of flooding.	10	3	5	18
50	Inventory existing culverts that are maintained by the Department of Public Works, Bureau of Highways and create an addressable GIS layer. Benefits related to reducing impacts of flooding.	6	3	5	14
51	Design, site and install Road Weather Information Systems to allow quicker response to changing road conditions and facilitate in keeping the transportation network open. Benefits related to life safety.	6	3	1	10
52	Purchase 800/900 MHz radios for Debris Management Team (9 vehicles). Benefits related to maintaining or enhancing response and recovery operations.	6	5	3	14
53	Develop a Department of Public Works DOC (Department Operations Center) at the Bureau of Utilities facility. Benefits related to improved operations during and after emergencies or disasters.	6	3	1	10
54	Plan and design a hardened/secure facility at the PSTC for a future 911 Communications Center and Emergency Operations Center that meets all applicable homeland security and fire safety codes, regulations and standards. Benefits related to improved operations during and after emergencies or disasters.	10	3	3	16
55	Establish a comprehensive critical infrastructure protection program that focuses on security and consequence management. Widespread benefits related to life safety and maintaining operations prior to and following emergency events.	6	3	5	14

No.	Action Item Description / Benefits	Life / Safety Impact	Administrative / Tech Assistance	Project Cost	Total Points
56	Continue to work on a number of issues related to floodplain identification and mapping risk; responsible floodplain management; and flood insurance as indicated in Section 8.4 of this report. Continue to ensure compliance with the National Flood Insurance Program. Long-term benefits of reducing potential flooding.	6	3	5	14
57	Conduct flood study of the 2011 Ellicott City flashflood during TS Lee to determine why/how it happened and what mitigation actions can be taken to prevent or reduce the hazard in the future.	10	3	5	18

Once the total points were calculated for each action, they were then classified into three categories (high, medium, and low priorities) based on their scores:

- High priority projects included those that scored a total of 20 points and above;
- Medium priority projects included those that scored between 15 and 19 points; and
- Low priority projects included those that scored 14 points or less.

Table 8.6-3 identifies the high, medium, and low priority projects based on their total scores.

Table 8.6-3
Mitigation Actions in Priority Order

No.	Action Item Description / Benefits	Total Score
	High Priority	
6	Devise a process to protect refrigerated critical health care supplies during extended power outages caused by natural hazards. Direct positive impacts in protecting the health and welfare of County citizens during emergencies and disasters.	20
7	Devise a robust public outreach plan/program to educate the general public and stakeholders on how to prevent, prepare for, and recover from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County (http://www.fema.gov/library/index.jsp). Direct benefits to citizens during emergencies and disasters.	20
10	Conduct a feasibility study to identify existing Class 4 buildings, and establish policy that all existing and new Class 4 buildings and critical facilities are hardened and considered for incorporating safe rooms. Future benefits include maintaining the operations of safe rooms and other critical facilities during emergencies and disasters.	20
16	Conduct annual training/exercises for Emergency Operations Center and Department Operations Center personnel on how to continuously staff the centers through a protracted disaster. Future benefits include maintaining effective operations during emergencies and disasters.	20
18	Develop a County Emergency Water Supply Plan. Long-term benefits to all county residents include maintaining adequate water supply during droughts.	20

No.	Action Item Description / Benefits	Total Score
30	Continue to station Public Works and Fire Department personnel in key locations for flood level monitoring and notification to the Office of Emergency Management. Benefits include improved effectiveness of response and recovery operations.	20
32	Continue to conduct an annual snow emergency coordination meeting in the fall with the County Departments involved in snow emergency response. Benefits include enhanced capabilities in response and recovery from snow emergencies.	20
39	Evaluate all County government buildings for high wind resiliency and related hazards. Benefit is that the action is a precursor to developing site-specific mitigation.	20
40	Educate all building safety coordinators about safety, evacuations, appropriate assembly areas and shelter-in-place guidelines. Benefits related to life safety.	20
41	Work with Department of Public Works to combine the Natural Hazards Mitigation Plan and Flood Mitigation Plan to ensure annual review cycles are synchronized.	20
42	Review and reevaluate the existing codes for County retaining walls. Probable benefits related to ensuring effectiveness of retaining walls.	20
49	Survey streams above "critical public facilities" to determine where maintaining debris free stream flow is required to avoid an "imminent hazard" to those facilities and then create a GIS layer. Benefits related to reducing impacts of flooding.	20
	Medium Priority	
20	Continue to provide the Department of Technology and Communication Services, GIS Unit with information regarding access points and trails for emergency vehicle use within the County's park system.	18
43	Identify and develop a GIS layer for public retaining walls in the County. Benefits related to long-term safety and stability of walls.	18
48	Conduct an assessment of the County's critical facilities to determine emergency backup power requirements. Prioritize the listed emergency backup power projects and implement as funds are available. Benefits related to identifying additional mitigation projects.	18
56	Continue to work on a number of issues related to floodplain identification and mapping risk; responsible floodplain management; and flood insurance as indicated in Section 8.4 of this report. Continue to ensure compliance with the National Flood Insurance Program. Long-term benefits of reducing potential flooding.	18
1	Establish pre-disaster debris contracts and craft debris site MOUs with appropriate County agencies and regions. Ensures effective response post-disaster.	16
4	Implement the operational strategies and Cistern Plan for dealing with rural water supply during protracted drought events. Helps to maintain water supply during periods of prolonged drought.	16
8	Update the County and OEM websites with pertinent hazard preparedness and mitigation information, including downloadable documents and web links for FEMA, MEMA, National Oceanic and Atmospheric Administration and the National Weather Service. Direct benefits to citizens during emergencies and disasters.	16

No.	Action Item Description / Benefits	Total Score
9	Educate key emergency management stakeholders (Emergency Management Advisory Group and Emergency Management Operations Group members) by holding workshops on major disaster recovery efforts and /initiatives, such as debris management, damage assessments, volunteer management and donation management. Wide-ranging benefits mainly related to response and recovery activities.	16
11	Develop an Emergency Preparedness, Training, and Exercise Plan that includes a regular maintenance plan and an annual budget. Direct benefits to citizens during emergencies and disasters.	16
12	Expand existing mutual aid agreements and establish a pre-EMAC personnel and equipment identification process to deploy County Emergency Management personnel (Department of Fire and Rescue Services, Police Department, Department of Public Works, Department of Citizen Services, Health Department, Department of Inspection, Licenses and Permits, and Department of Planning and Zoning), and equipment to surrounding jurisdictions and/or regional/national disaster events. Direct benefits to citizens during emergencies and disasters.	16
14	Continue to enforce the incorporation of State and local storm water management regulations and progressive techniques into all development plans. Long-term benefits to citizens by preventing increased flooding.	16
15	Continue to identify all existing critical infrastructure and then create a GIS map layer. Long-term benefits include developing baseline understanding of risks.	16
17	Install transfer switches at all County designated shelters. Future benefits include maintaining the operations of shelters during emergencies and disasters.	16
22	Continue to administer the Forest Mitigation Program to establish new forests in parkland and along streams and rivers, to protect against erosion and uprooting trees. Long-term benefits include reduced erosion and maintaining stability of banks and trees.	16
24	Continue to adopt the most updated version of the National Electrical Code (NEC). Long-term, general benefits include protecting citizens from fires.	16
25	Continue to host annual workshops for local builders to discuss how to build homes that are more resistant to natural hazards. Generalized benefits to citizens, as effects of a range of hazards are reduced.	16
26	Review and, if needed, improve the process for fast-tracking permits and inspections following disasters. When a disaster occurs those structures affected will be processed first before the normal work load. Benefits include improved recovery capability.	16
27	Review existing building codes every three years to ensure they have been deemed satisfactory in assessing serious damage caused by specific hazards. Generalized long-term benefits.	16
28	Evaluate Department of Public Work's ability to maintain a suitable workforce during a protracted disaster. Benefits include maintaining effective operations during emergencies and disasters.	16
29	Evaluate infrastructure on frequently flooded roadways to determine whether the roads/bridges/culverts need to be upgraded to lessen the frequency of flooding. Prioritize projects and seek funding. Benefit is establishing an accurate basis for mitigation activities.	16
31	Continue to perform routine maintenance to keep street trees healthy so they are less likely to fall or break during a severe weather event. Localized benefits to citizens and assets that are protected from damage and injury, mainly during high-wind events that are coupled with rain.	16

No.	Action Item Description / Benefits	Total Score
33	When beaver dams are identified and located, continue to dismantle the dams to reduce the impact of flooding. Localized benefits from decreased jam flooding.	16
34	Continue to improve an annual plan to supplement Public Work's snow removal teams with Department of Recreation and Parks and Fire Department personnel. Long-term benefits related to avoiding damage and injury.	16
35	Conduct an assessment of the County's critical facilities to assure that all technology sites have backup power. Benefits related to developing specific mitigation actions.	16
36	Conduct regular training sessions for emergency response personnel regarding the County's legal authority during emergency situations. Benefits are ensuring that response and recovery operations are effective.	16
37	Implement a community notification system to notify residents of hazards affecting the community. Widespread benefits related to increased life safety and response.	16
38	Upload preparedness information onto the County and OEM websites, and develop pamphlets and other outreach material discussing how residents and businesses can protect themselves, their property and assets from natural hazards. Refer to the FEMA library for information on various topics and tailor information to fit the needs of the County (http://www.fema.gov/library/index.jsp).	16
46	Establish an MOU with Howard County General Hospital as a backup storage facility for refrigerated critical health care supplies. Benefits related to improved response and recovery operations.	16
54	Plan and design a hardened/secure facility at the PSTC for a future 911 Communications Center and Emergency Operations Center that meets all applicable homeland security and fire safety codes, regulations and standards. Benefits related to improved operations during and after emergencies or disasters.	16
Low Priority		
49	Inventory existing culverts that are maintained by the Department of Public Works, Bureau of Highways and create an addressable GIS layer. Benefits related to reducing impacts of flooding.	14
51	Purchase 800/900 MHz radios for Debris Management Team (9 vehicles). Benefits related to maintaining or enhancing response and recovery operations.	14
55	Establish a comprehensive critical infrastructure protection program that focuses on security and consequence management. Widespread benefits related to life safety and maintaining operations prior to and following emergency events.	14
56	The County is working on a number of issues related to floodplain identification and mapping risk; responsible floodplain management; and flood insurance as indicated in Section 8.4 of this report. Continue to ensure compliance with the National Flood Insurance Program. Long-term benefits of reducing potential flooding.	14
2	Through partnerships with the Maryland Department of Natural Resources, the Department of Recreation and Parks and the Columbia Association, identify areas within the County where hazards exist in the wild land/urban interface setting. Work with the appropriate organizations to develop strategies to remove the accumulation of hazards and excessive fuels (trees, trash, etc.) within the identified areas. Precursor to initiating mitigation actions to reduce the effects of wildfires.	12
3	Based on the results of the identification process in Item 2, initiate a process to remove sources of fuel in potential wildfire areas. Protects assets and citizens from effects of wildfires.	12

No.	Action Item Description / Benefits	Total Score
5	Partner with the Maryland Department of Natural Resources - Forest Service to explore the possibility of Howard County becoming a "Fire wise" community. Leads to longer-term actions to reduce risks from wildfire across the County.	12
13	Continue to enforce Subdivision and Land Development Regulations[3], namely Section 16.115 which prohibits clearing, grading, paving and construction activity in the 100 year flood plain, and Section 16.116 which protects streams, wetlands, and steep slopes from future development. Long-term benefits to citizens by preventing increased flood problems.	12
21	Continue to evaluate and remove trees throughout the County's park system that are at risk of falling during storms and high wind events. Localized benefits related to protecting citizens and assets in hazardous areas.	12
23	Continue to work with property owners to increase vegetation in riparian buffers through the Plant-It-Green program, which consists of supplying free trees to plant adjacent to the streams to reduce velocity of storm water and to stabilize soil. Benefits include reducing negative downstream flood effects by slowing conveyance.	12
44	Assess all county-owned retaining walls to see if they need to be reinforced and prioritize that work. Benefit is that the action forms the basis of additional mitigation activities that may limit structural damage.	12
19	Develop a policy setting out County's role in curbside debris pick up. Develop list of contractors for debris removal for private property. Benefits include enhanced recovery operations following emergences and disasters	10
45	Adopt and implement the National Grid Coordinate mapping system and incorporate into the computer-aided dispatch system to indicate the locations of all County critical infrastructures to include water / sewer valves. Benefits related to ensuring effective monitoring and response activities.	10
48	Conduct an assessment of the County's critical facilities to determine emergency backup power requirements. Prioritize the listed emergency backup power projects and implement as funds are available. Benefits related to identifying additional mitigation projects.	10
51	Design, site and install Road Weather Information Systems to allow quicker response to changing road conditions and facilitate in keeping the transportation network open. Benefits related to life safety.	10
53	Develop a Department of Public Works DOC (Department Operations Center) at the Bureau of Utilities facility. Benefits related to improved operations during and after emergencies or disasters.	10

8.7 Existing Plans, Policies, Programs, and Resources

In order to ensure that the County can accomplish its suggested hazard mitigation actions through its existing mechanisms, the County's existing authorities, policies, programs, and available resources, have been identified. A detailed analysis of existing plans and programs is included in Section 9 of the updated NHMP.

[3] Subdivision and Land Development Regulations, §§ 16.115, 16.116 (2005).

County Departments who are typically most involved in mitigation activities include those in planning, public works, licensing and inspections, and emergency management. Staffing details for each Department are outlined below.

- **Department of Planning and Zoning (DPZ)**

  The Department of Planning and Zoning has a total of 57 personnel. The Department is comprised of different sub-units that work on various subject matters. These include Agricultural Preservation, Environment, Historic Preservation, Community Planning, Development, Transportation, and Zoning and Subdivision.

  Two individuals work in Agricultural Preservation. Six people work in the Environment unit on conservation of resources throughout the county. A staff of eight works in community planning, with some of these members working as transportation planners. The Development unit is comprised of 12 members who work on various engineering-related issues. A total of 14 people comprise the Land Development section.

  Transportation issues technically falls under County Administration's authority – and is staffed by four people, two of whom are grant –funded. The Zoning and Subdivision units employ a total of eleven individuals.

  The County does not have an official floodplain administrator. The Department of Planning and Zoning has a Building Official/Inspector and one Code Official who conducts plan reviews and serves as the Floodplain Administrator. All site plan reviews are performed by the Department of Planning and Zoning Director. The County does not have a Surveyor. A GIS Specialist was recently hired to develop property and zoning layers for the unincorporated areas and small communities within the County.

  GIS and Building Inspection staff have training on building inspection, building code administration, and building retrofits.

- **Department of Public Works (DPW)**

  The Department of Public Works consists of five different Bureaus: Bureau of Environmental Services (50 personnel); Bureau of Engineering (53 personnel); Bureau of Facilities (67 personnel); Bureau of Highways (121 personnel), and Bureau of Utilities (139 personnel). It is one of the largest Departments in Howard County government.

- **Department of Inspections, Licenses, and Permits (DILP)**

  The Department of Inspections, Licenses, and Permits is divided into different bureaus, such as Licenses and Permits, Inspection and Enforcement, Plan Review, Operations and Administration. DILP employs 60 personnel, two of which are grant funded.

- **Office of Emergency Management (OEM)**

The Office of Emergency Management is located within Department of Fire and Rescue Services. The Office of Emergency Management consists of six full time employees (FTE) and six grant funded positions who all support emergency planning and preparedness.

All of these employees are trained in the National Incident Management System (NIMS) Training Program, specifically NIMS 700 and 800, and ICS 100 and 200. The Incident Command System is used during emergency situations and Emergency Operations Center activations. OEM staff are also trained in Fundamentals of Emergency Management, Emergency Planning, Exercise Design, Leadership and Influence, Decision Making and Problem Solving, Effective Communication and Developing and Managing Volunteers.

Funding through taxing authority

The County has the ability to fund mitigation projects through its taxing authority. The County receives United States - Housing and Urban Development's Community Development Block Grants. It also has the authority to incur debt through general obligation bonds, special tax bonds, and revenue bonds.

Howard County also charges fees for water, sewer, and trash services. Gas and electric services are provided by private companies. Although impact fees are not charged to homebuyers for the new homes, the County does levy development excise taxes on new developments.

Annual Budgets

The 2013 Year Capital Improvement Program was recently approved by the County Council and is allotted for infrastructure planning, bridge repairs, and other large-scale projects. The County's Capital budget for FY 2013 is $182,131,000. The projected five year Capital Improvement Program for FY 2013 is $4,090,232,000.

Regulatory authorities for comprehensive planning, building codes, and ordinances

Comprehensive plans, Zoning, Subdivision and Land Development Regulations are administered by the Department of Planning and Zoning. The County's Building Code (including the Residential Code, Mechanical Code, Energy Conservation Code and Life Safety Code) is administered by the Department of Inspections, Licenses and Permits. The County's efforts to implement and integrate hazards mitigation principles throughout its various plans, ordinances, regulations and programs are well-coordinated and further outlined in Section 9.

Section 9
Plan Integration

Contents of this Section

9.1 IFR Requirements for Plan Integration

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

9.2 Introduction

Through the various County Departments' dedication and hard work, Howard County continues to maintain a high level of preparedness through the application of hazard mitigation principles. For example, the County maintains strong flood-control practices, which includes rigorous permitting procedures to ensure flooding is kept to a minimum in the region. However, the County is constantly looking for opportunities to implement and cross-pollinate hazards mitigation principles throughout its various plans, ordinances, regulations and programs. This approach ensures that all documents are well-coordinated and that effective hazard mitigation principles are applied in all aspects of County management.

The subsections below include a review of the planning documents and ordinances used by the County in the areas of building standards, storm water management, comprehensive planning, emergency operations and capital improvements programming. Areas where hazard mitigation principles are addressed or should be addressed are indicated. Options to add mitigation principles in these documents have been included so that mitigation principles can be integrated into the documents.

9.2.1 Plan Howard 2030 – General Plan

The Department of Planning and Zoning is in the process of developing "Plan Howard 2030," a General Plan which outlines 12 visions for the County. Of these 12, three areas are of particular interest for the incorporation of hazard mitigation principles. These include:

- Quality of Life and Sustainability - A high quality of life is achieved through universal stewardship of the land, water, and air resulting in sustainable communities and protection of the environment.
- Environmental Protection - Land and water resources, including the Chesapeake and coastal bays, are carefully managed to restore and maintain healthy air and water, natural systems, and living resources.
- Resource Conservation - Waterways, forests, agricultural areas, open space, natural systems, and scenic areas are conserved.

The General Plan provides an excellent framework to incorporate universal hazard mitigation principles. The following policies in the 2030 General Plan document address these issues.

- Watershed Management Plans: Prepare comprehensive watershed management plans for all watersheds, to set priorities and guide efforts to protect, restore, and improve the County's water resources. Complete and update all watershed management plans on a regular cycle.
- Forest Cover and Riparian Forest Buffers: Establish and achieve measurable goals for forest cover and riparian forest buffers in all County watersheds.
- Wetlands: Develop a wetlands program to inventory, map, protect, and enhance wetland resources.
- Patuxent and Patapsco Rivers: Coordinate and cooperate with other local, regional, and State agencies and organizations on joint watershed planning and management for the Patuxent and the Patapsco Rivers.
- Best Management Practices: Expand current outreach and education efforts to promote and assist private property owners with the implementation of best management practices, including installing rain gardens and rain barrels, planting stream buffers, replacing lawn with native plants, increasing tree canopy, and limiting use of lawn chemicals.
- Streams, Wetlands, and Floodplains: Evaluate the effectiveness of current regulations in protecting streams, wetlands, and floodplains.
- Environmentally Sensitive Development: Encourage, and advocate for, more environmentally sensitive design in residential zoning districts other than the Residential Environmental Development (R-ED) District. Promote the use of the neighborhood preservation parcel option, as well as the use of smaller, tightly clustered lots to limit site disturbance and maximize open space for natural resource protection.
- Redevelopment: Ensure redevelopment is designed and implemented to reduce stormwater runoff and pollution to the maximum extent practicable.
- Incentives for Enhancements: Create incentives for new development and redevelopment to provide on-site or off-site water quality enhancements that exceed minimum regulatory requirements.
- Zoning Regulations: Revise the Zoning Regulations to better promote compact redevelopment and appropriate infill.
- Planned Unit Development: Consider Planned Unit Development (PUD) zoning to allow increased

flexibility for unique, well-designed, site-specific developments.

- Infrastructure Gaps: Expand existing infrastructure for older communities that were constructed under previous regulations, where these communities would benefit from additional improvements such as storm drains and sidewalks.
- Environmental Enhancement: Expand environmental remediation to address stormwater management, stream bank erosion, and buffer conservation.
- Flexible Infill: Consider zoning modifications that would allow for more flexibility. This would in turn encourage limited, compatible infill that will enhance an existing community.
- Regional Collaboration: Monitor regional efforts to conserve or restore environmental (such as air, land, and water) quality, while expanding efforts to protect water and air quality and natural resources.

The 2030 General Plan should consider incorporating the following hazard mitigation principles into this update, including:

- Include a policy on effective land use planning: "Heighten the priority of natural hazard mitigation as an essential element in land-use planning";
- Include a policy to consider natural hazards when making land use and development decisions;
- Include an implementing action that advocates relocating land use away from natural hazard areas and relying on resilient building practices to withstand natural hazards;
- Include an implementing action for the future collaboration between the Department of Planning and Zoning and the Office of Emergency Management. This partnership will improve policy implementation and regulation enforcement across the County;
- Include a policy to develop County-level outreach activities that not only informs the public of natural hazard risks around the County, but also informs the public of mitigation actions that can be taken at the County or personal level; and,
- Include a policy in the Future Land Use section of the NHMP to address growth management techniques (i.e. land conservation, buffering and cluster development). This will better protect and conserve natural resources and reduce damage from natural disasters by concentrating development outside of high natural hazard areas. The County should consider natural hazards and the natural hazard mitigation plan when making land use decisions, including subdivision regulations, comprehensive planning, and various other procedures and planning mechanisms.

9.2.2 Zoning Ordinance

The County's Comprehensive Zoning and Zoning Ordinance Plan were adopted in 2004 and 2006, respectively. The Zoning Plan is administered by the Department of Planning and Zoning and works in conjunction with other regulations and ordinances such as the Subdivision and Land Development Regulations[1], Adequate Public Facilities Ordinance[2], and Forest Conservation Ordinance[3]. Three zones in particular help maintain the County's environmental integrity:

[1] http://www.co.ho.md.us/uploadedFiles/Home/Department_Hidden_Content_(PDF_and_HTML)/Planning_and_Zoning/2011SubRegs.pdf.

[2] http://www.co.ho.md.us/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=6442462314.

[3] See http://www.ellicottmeadows.com/files/HCFCHandoutMasterGardeners071007.pdf for more information regarding the program.

- The Residential Environmental Development (R-ED) District is established to accommodate residential development at a density of two dwelling units per net acre in areas with high proportions of sensitive environmental and/or historic resources. Protection of environmental and historic resources is achieved by minimizing the site disturbance and directing development to the most appropriate areas of a site, away from sensitive resources.
- The Resource Conservation (R-C) District is established to preserve the natural environment and the rural landscape, while allowing low density and clustered residential development.
- The Rural Residential (R-R) District is established to allow low-density residential development within a rural environment. As the County is already committed to low-density residential subdivisions, cluster development will protect environmental and landscape resources and to preserve agricultural land.

Options for Incorporating Hazard Mitigation Principles into the Zoning Ordinance:

- Continue promoting cluster development in the R-C and R-R zones while discouraging development in high natural hazard areas within these clusters (such as the 100-year floodplain, wetlands, forested areas).
- Continue to protect environmental and historical resources in R-ED zones by minimizing the amount of site disturbance and directing development to the most appropriate areas of a site, away from sensitive resources.
- Include language on limiting the density or increasing the minimum lot size of parcels located in designated hazard areas.
- Include language on restricting development in areas with inadequate access to public protection services (police, fire, EMS).

9.2.3 Subdivision Regulations

In 2001, the County began prohibiting the inclusion of the 100-year floodplain on residential lots smaller than 10 acres. As a result, stream buffers, wetland buffers, floodplains and forest conservation easements must be on lots greater than 10 acres and/or be located in open space or on preservation parcels. The County's Subdivision and Land Development Regulations were revised in October of 2009. Subtitles 11 and 12 are comprised of the Adequate Public Facilities Ordinance and the Forest Conservation Ordinance, respectively.

Section 16.115 of the Subdivision and Land Development Regulations contains information on Floodplain Preservation. The County has already implemented effective floodplain preservation and regulation policies. For example, most land within the 100-year floodplain is considered a protection area (i.e. a stream valley or a valuable ecological area or scenic resource). In subdivision and site development plans containing a 100-year floodplain, the floodplain land is protected by either deeding the floodplain land or by granting a floodplain easement to the County. The County has also implemented several prohibitions in floodplain land, such as the general ban of storing or discarding building materials and other debris. The County also bars the clearing, excavating, filling, altering drainage or impervious paving on floodplain land unless required by the County.

Options for incorporating Hazard Mitigation Principles into the Subdivision Regulations:

- Continue prohibiting building materials and other debris from being stored or discarded in the floodplain;

- Continue prohibiting clearing, excavating, filling, altering drainage or impervious paving on land located in a floodplain unless required by the County.
- Consider higher standards for subdivision regulations for infrastructure and facilities. Also consider increasing performance standards for these buildings. These provisions may help ensure infrastructure and facilities are adequate for the hazard risk posed in that area, including sufficient drainage and storm water management facilities.

9.2.4 Howard County Building Code

Howard County uses the International Building Code (IBC) as the basis of the County's Building Code. [4] The IBC regulates construction materials and methodologies employed for all structures (except for one- and two-story family dwellings, which are regulated by the International Residential Code [IRC]). The IBC and IRC establish criteria for buildings to resist damage from natural hazards including wind (for hurricane, tornados, thunderstorms and winter storms), seismic activity, snow load and flooding.

The Howard County Building Code prohibits the construction of any new building in any 100-year floodplain, stream or drainage course. It also prohibits development in areas subject to flooding, erosion, unstablized slope within a certain distance of any high-hazard dam. The Howard County Code also has wind loading requirements for new structures and tie-down requirements for mobile homes.

Options for incorporating Hazard Mitigation Principles into the Building Code:

- The Building Code is not retroactive, and thus do not include older buildings. Pre-existing structures are only subject to the codes that existed at the time of construction. Additionally, when there are major additions or renovations to structures, it must be brought up to the new code's standards.
- Explore requirements that address older buildings' vulnerability to natural hazards.

9.2.5 Floodplain Development Regulations

The Department of Public Works, Bureau of Environmental Services manages floodplain land for Howard County. The Design Manual (Manual) applies to all storm drainage, floodplains, and stormwater management systems in the County. The Design Manual's Chapter 6, *Floodplain Management*, includes information pertaining to buildings located in the floodplain:

- The County demands a two foot freeboard requirement;
- New development or substantial improvements to structures in the floodplain are prohibited;
- Fill and building foundations must be designed to protect against scour and erosion; and
- New structures in the floodplain are required to submit first floor elevations.

The Howard County Code does not permit construction of new residential, industrial, institutional or commercial buildings within the 100-year floodplain. If the 100-year floodplain is increased, then all affected property owners must be granted appropriate flowage easements. The new plans must also be approved by the Department of Public Works, the Department of Planning and Zoning (Development Engineering Division) and where necessary, the Maryland Department of the Environment, Water Management Administration.

[4] See Howard County Code tit. 3 § 100 (b)(1) (2009).

Existing buildings within the 100- year floodplain are regarded as non-conforming uses. If the floodplain cannot be altered, flood-proofing these buildings is encouraged. In a situation where it is not feasible to flood-proof the buildings, these structures are required to be removed from the 100-year floodplain. However, the County may choose to acquire these properties by eminent domain, to ensure owners are compensated for their losses.

Options for incorporating Hazard Mitigation Principles into the Floodplain Development Regulations:

- In this regard, Howard County is at the forefront of floodplain regulations. The County actively enforces floodplain regulations, which often exceed legally mandated requirements. For example, the County's Floodplain Development Regulations exceed the State Model Floodplain Ordinance requirements, thus imposing a stricter standard countywide than the State requires. Refer to the recently completed 2011 Flood Mitigation Plan (FMP) for further information.

9.2.6 Stormwater Management

Chapter 5 of the Design Manual, *Stormwater Management*, includes standards for designing safe, efficient and coordinated storm drainage systems. These standards are compatible with those of the Howard Soil Conservation District, the Maryland Department of the Environment, the Maryland State Highway Administration, and other governmental agencies and departments.

These new standards require new projects to be designed in accordance with the Design Manual when a new project abuts or is affected by an existing project. Design criteria, operation and maintenance requirements for the following stormwater management are included in the Manual: retention ponds (wet basins), detention ponds (dry basins), extended detention ponds, private underground facilities, stormwater retrofits, rain gardens, dry wells and bioretention facilities.

A Stormwater Management Plan detailing appropriate stormwater management measures aimed at controlling or managing runoff is required for all residential, commercial, industrial or institutional uses that disturb over 5,000 square feet of land area. Additions or modifications to existing single-family residential structures or developments that do not disturb over 5,000 square feet of land are not required to provide a Stormwater Management Plan, if the project will not adversely impact the receiving wetland, watercourse or water body. All redevelopment projects exceeding 5,000 square feet as a stand-alone impact on previously developed areas are also required to reduce the existing site imperviousness by at least 20 percent.

Stormwater management facilities cannot be located in wetlands or 100-year floodplains. Certain exceptions exist for road crossings, wetland ponding systems in degraded wetlands, and retention facilities.

The County encourages non-structural stormwater management practices to minimize the reliance on structural best management practices. The following non-structural stormwater management practices are encouraged to minimize increases in new development runoff: natural area conservation, disconnection of rooftop runoff, disconnection of non-rooftop runoff, sheet flows to buffers, grass channel, and environmentally sensitive development.

Options for Incorporating Hazard Mitigation Principles into the Stormwater Management Regulations:

- Stormwater management requirements for redevelopment could be strengthened in coordination with State requirements, which is based on the State's own Stormwater Design Manual.

- The following recommendations from the 2030 Plan Howard General Plan should also be incorporated:
    - Best Management Practices. Expand current outreach and education efforts to promote and assist private property owners with the implementation of best management practices, including installing rain gardens and rain barrels, planting stream buffers, replacing lawn with native plants, increasing tree canopy, and limiting use of lawn chemicals.
    - Environmentally Sensitive Development. Encourage more environmentally sensitive design in residential zoning districts other than the R-ED District. Promote the use of the neighborhood preservation parcel option, as well as the use of smaller, tightly clustered lots to limit site disturbance and maximize open space for natural resource protection.
    - Redevelopment. Ensure redevelopment is designed and implemented to reduce stormwater runoff and pollution to the maximum extent practicable.
    - Incentives for Enhancements. Create incentives for new development and redevelopment to provide onsite or off-site water quality enhancements that exceed minimum regulatory requirements.

9.2.7 Emergency Operations

The County's Emergency Operation Plan (EOP) was approved in July 2009. In accordance with Federal, State and local legislation and regulations, the EOP provides a framework through which Howard County prepares for, responds to, recovers from and mitigates the impact of various disasters. Specific strategies, assumptions and instruments are found in the EOP to guide and support personnel through the response and recovery process for the County.

Options for incorporating Hazard Mitigation Principles into the Emergency Operations Plan:

- Include references in the Emergency Operations Plan, particularly Departments involved with specific functions such as damage assessment and flood control for various hazards. This will ensure the two plans are well-integrated and harmonious.
- Continue to ensure that subsequent versions of the EOP reference hazard mitigation activities in the following sections :
    - Maintain that hazard mitigation is a continuous effort to prepare for the potential loss of life and property;
    - Support public education and awareness so citizens may be prepared and educated about local hazards and the mitigation process;
    - Continue to recognize the NHMP as the overarching document when a natural hazard situation arises; and
    - Cooperate and support neighboring jurisdictions in mitigation, preparedness, response, and recovery activities.

9.2.8 Columbia Watershed Management Plan

The Columbia Association developed the Columbia Watershed Management Plan to assist in the protection and restoration of Columbia waters. This plan outlines long-term strategies for restoring watershed infrastructure, investigates pollution sources and designs restoration projects to reduce pollutants. The Plan emphasizes involving and educating residents and property owners in watershed stewardship.

Options for incorporating Hazard Mitigation Principles into the Columbia Watershed Management Plan:

- Continue developing the following goal and objective stated in the plan: reduce stormwater impacts on the Columbia watersheds from impervious areas to help restore and protect the streams.
- Ensure and support adequate funding for the Columbia Association's stormwater management program.
- The plan identifies a list of 18 sites within the Lake Elkhorn sub-watershed for future retrofit projects to diminish stormwater runoff. Identify additional restoration projects where stormwater retrofits can be implemented.
- Continue encouraging best management practices through the maintenance and retrofitting of stormwater management facilities, using Low Impact Development (LID) in areas without stormwater controls.
- Work with the Department of Public Works to promote education of stormwater runoff from impervious surfaces.

9.2.9 2006 Land Preservation, Recreation and Parks Plan

The County's Land Preservation, Recreation and Parks Plan identifies recreational and open space needs, and discusses natural resource areas, including wetlands. The Plan provides goals, strategies and techniques used to protect the existing natural environment and recreation areas. This examination is vital as development encroaches on these valuable areas.

Options for incorporating Hazard Mitigation Principles into the Land Preservation, Recreation and Parks Plan:

- Consider addressing the impacts of flooding on parks and open spaces.
- The following objectives have been elaborated in other County documents such as the Floodplain Development Regulations and the Stormwater Management Regulations, and should continue to be enforced:
    - Continue to support the prohibition of development within the 100-year floodplain and strictly regulate development on large areas of slopes greater than 25 percent.
    - Enforce storm water requirements and provide facilities to more developed areas that do not have storm water facilities.

The County Council adopts an operating budget and a capital improvement budget for each County department annually. Capital expenditures are prioritized yearly. The approved operating budget for 2013 allocates 11.7 percent of its budget for public facilities and 13.6 percent for public safety. The recently approved 2013 Capital Budget allocates approximately $5,820,000 for bridge improvements, $11,055,000 for storm drainage projects and $27,260,000 for road construction projects.

Options for incorporating Hazard Mitigation Projects into the Capital Improvement Program (CIP):

- Encourage adopting policies limiting public spending in hazard areas and prioritizing hazard mitigation projects in the CIP.
- Review projects in Priority Funding Areas.

- Work to ensure hazard mitigation principles are introduced into the capital improvements process, including both new construction and reconstruction projects. Emphasize projects mitigating the impact of natural hazards and rank them as high priority projects.
- On renovation/new addition projects in the proposed CIP, identify opportunities to incorporate hazard mitigation principles (i.e., improving resistance to wind or flood).
- Consider a more coordinated approach to better integrate efforts between the General Plan, the Hazard Mitigation Plan and the CIP by utilizing a staff member who is knowledgeable about hazard mitigation when prioritizing the CIP.
- Include hazard mitigation projects into the CIP, while also keeping the goals and objectives of the General Plan and the Hazard Mitigation Plan in mind while developing future CIPs. The County Council, with input from the Mitigation Plan Review Steering Committee members, should review mitigation projects from the NHMP for incorporation into the CIP. Examples of mitigation projects include: drainage improvements, upgrading utilities, building retrofits, external modifications to flood prone buildings and detailed vulnerability studies for high occupancy or critical facilities.
- Encourage the County officials to identify, prioritize, fund and implement key hazard mitigation projects as a critical part of the county CIP.

Section 10
Plan Monitoring and Maintenance

Contents of this Section

10.1 IFR Requirements for NHMP Monitoring and Maintenance

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

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

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

10.2 Distribution

The 2012 NHMP will be posted on Howard County's Department of Fire and Rescue Services (DFRS) website under the Office of Emergency Management's tab. Notices of the website's availability have been distributed to the following groups:

- The Federal and State agencies that were notified and invited to participate in the NHMP's development;
- The organizations, agencies, and elected officials who received notices of public meetings; and,
- Citizens who attended public meetings and provided contact information.[1]

10.3 Implementation

Several Howard County Departments developed mitigation actions to minimize future risk from a variety of natural hazards. Actions were identified and prioritized, and are shown in Tables 8.5.1-1, 8.6-2 and 8.6-3.

[1] For more information about stakeholders' involvement, please refer to Section 5.4.1.

Specifically, for each mitigation action, Table 8.5.1-1 identifies the lead agency, support agencies, priority level, and time period for implementation. Each lead agency is responsible for factoring the action into its work plan and schedule over the indicated time period. Lead agencies will submit annual reports to the Office of Emergency Management (OEM), regarding status of implementation (including obstacles to progress). Progress on the mitigation action items will be monitored and evaluated by OEM and the Natural Hazards Mitigation Planning Steering Committee.

10.4 Monitoring & Progress Reports

This NHMP will be monitored by the County for several related purposes:

1. Maintain the currency of hazard and risk information.
2. Ensure mitigation projects and actions reflect the priorities of the County, the Natural Hazards Mitigation Planning Steering Committee and the general public.
3. Comply with Federal Emergency Management Agency (FEMA) and Maryland Emergency Management Agency (MEMA) requirements for NHMP maintenance, and to maintain eligibility for Federal disaster assistance and mitigation grants.

OEM is responsible for coordinating the Natural Hazards Mitigation Planning Steering Committee (NHMPSC), and the Committee shall monitor and maintain the NHMP update. OEM and the NHMPSC shall continuously monitor the NHMP for the purposes noted above and with respect to the update triggers noted in Section 10.5 below.

Upon adoption of this plan, OEM will annually convene a meeting of representatives from the NHMPSC to discuss and determine implementation accomplishments and/or implementation problems and recommended solutions. Although the individuals filling the positions may change from year to year, future Steering Committee members will continue to be comprised of the same departments and organizations involved in this current update.

OEM will also be responsible for monitoring and preparing the annual progress reports. OEM will utilize the data obtained from the annual meeting to note the progress made on mitigation action items in annual progress reports.

10.5 Circumstances that will initiate NHMP Review and Updates

Circumstances or conditions under which Howard County will initiate NHMP reviews and updates.

1. On the recommendation of the County Executive or on its own initiative, the County Council may initiate a NHMP review at any time.
2. At approximately the one-year anniversary of the NHMP's re-adoption, and approximately at the same anniversary every year thereafter.
3. After natural hazard events that appear to significantly change the apparent risk to County assets, operations and/or citizens.
4. When activities within the County, Region or State significantly alter the potential effects of natural hazards on County assets, operations and/or citizens. Examples include completed mitigation projects that reduce risk, actions or circumstances that increase risk.

5. When new mitigation opportunities or sources of funding are identified.

In addition to the circumstances listed above, revisions that warrant changing the text of this NHMP or incorporating new information may be prompted by a number of circumstances, including identification of specific new mitigation projects, completion of several mitigation actions or requirements for qualifying for specific funding. Minor revisions may be handled by addenda.

Major comprehensive review of and revisions to the Howard County NHMP will be considered on a five-year cycle. Anticipated adopted of the plan will be in September 2012, and the NHMP will enter its next review cycle in 2016, with adoption of revisions anticipated in early mid 2017. The NHMPSC will convene to conduct the comprehensive evaluation and revision to include the identification and prioritization of additional mitigation action items as required.

10.6 Continued Public Involvement

Upon adoption of the updated 2012 NHMP, the public will be notified of any substantial changes to the document prior to the next scheduled update on in mid 2017. Any changes proposed by the NHMPSC considered significant will be distributed to the list of stakeholders identified in Section 5, *Planning Process*. The NHMPSC will then review any/all suggested changes and make recommendations for revisions to the plan as deemed appropriate/necessary.

Appendix A
General Description of Natural Hazards

The following is a general description for each of the hazards listed below. The complete profile for each hazard can be found in Section 6 of the updated 2012 Hazard Mitigation Plan (NHMP).

General descriptions completed for the following natural hazards;

1. Floods
2. Severe Winter Storms
3. Wildfires
4. Hurricanes and Tropical Cyclones
5. Tornadoes and Wind Storms
6. Lightning
7. Earthquakes
8. Drought and Extreme Heat

1. Floods

Definition of Flood Hazard

Flooding is the accumulation of water within a water body (e.g., stream, river, lake, or reservoir) and the overflow of excess water onto adjacent floodplains. As illustrated in Figure A-1, floodplains are usually lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Nationwide, hundreds of floods occur each year, making them one of the most common hazards in the U.S.[1] There are a number of categories of floods in the U.S., including the following:

- Riverine flooding, (river channel, flash floods, alluvial fan floods, ice-jam floods, dam breaks)
- Local drainage or high groundwater levels
- Fluctuating lake levels
- Coastal flooding, including storm surges
- Debris flows
- Subsidence

Characteristics of Floods

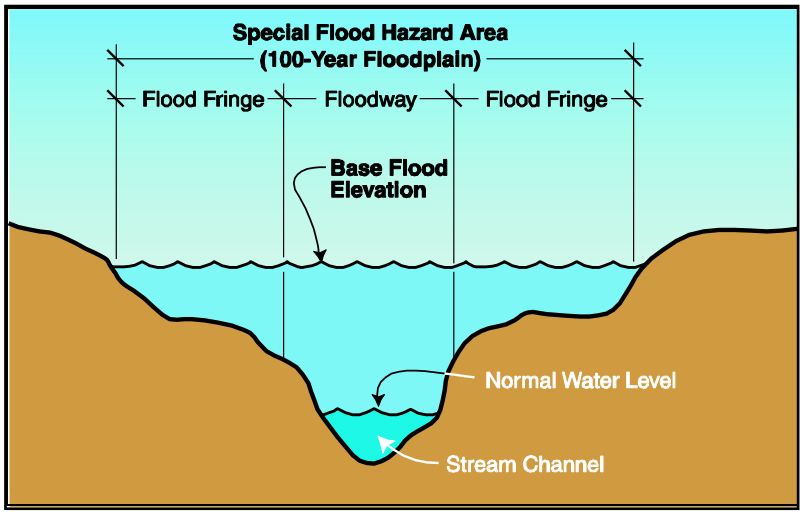
While there is no sharp distinction between riverine floods, flash floods, alluvial fan floods, ice jam floods, and dam-break floods, these types of floods are widely recognized and may be helpful in considering the range of flood risk and appropriate responses.

The most common kind of flooding event is riverine flooding, also known as overbank flooding. Riverine floodplains range from narrow, confined channels in the steep valleys of mountainous and hilly regions, to

[1] FEMA, 1997

wide, flat areas in plains and coastal regions. The amount of water in the floodplain is a function of the size and topography of the contributing watershed, the regional and local climate, and land use characteristics. In steep valleys, flooding is usually rapid and deep, but of short duration, while flooding in flat areas is typically slow, relatively shallow, and may last for long periods of time.

Figure A-1
Floodplain Definition
(Source: FEMA, August 2001)



When rainfall runoff collects in rivers, creeks, and streams and exceeds the capacity of channels, floodwaters overflow onto adjacent lands. Floods result from rain events, whether short and intense or long and gentle. Flood hazards are categorized as follows:

- **Flash floods** involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the tearing out of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding.
- **Alluvial fan floods** occur in the deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in the pattern of a fan. Alluvial fan floods often cause greater damage than overbank flooding due to the high velocity of the flow, amount of debris, and broad area affected. Human activities may exacerbate flooding and erosion on alluvial fans via increased velocity along roadways acting as temporary drainage channels or changes to natural drainage channels from fill, grading, and structures.
- **Ice jam flood** occur when an upstream part of a river thaws first (possibly because it flows away from the equator), and the ice gets carried downstream into the still-frozen part. Masses of ice can become lodged under bridges and other wiers, causing an ice dam, flooding areas upstream of the jam. After the ice dam breaks apart, the sudden surge of water that breaks through the dam can then flood areas downstream of the jam. While this usually occurs in spring, it can happen as

winter sets in when the downstream part becomes frozen first. Dam-break floods may occur due to structural failures (e.g., progressive erosion), overtopping or breach from flooding, or earthquakes.

- **Local drainage floods** may occur outside of recognized drainage channels or delineated floodplains for a variety of reasons, including concentrated local precipitation, a lack of infiltration, inadequate facilities for drainage and stormwater conveyance, and/or increased surface runoff. Such events often occur in flat areas, particularly during winter and spring where the ground is frozen. Drainage floods are found also in urbanized areas with large impermeable surfaces. High groundwater flooding is a seasonal occurrence in some areas, but may occur in other areas after prolonged periods of above-average precipitation.
- **Flash floods** not only occur suddenly, but also involve more forceful flows that can destroy buildings and bridges, uproot trees, and scour out new channels. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or heavy rains from hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urban areas, where much of the ground is covered by impervious surfaces and drainageways are designed for smaller flows. Flood Insurance Rate Maps typically show the 1%-annual-chance (100-year) floodplain for waterways with at least 1 square mile of drainage area. The flood hazard area for waterways with less than one square mile of drainage area typically are not shown.
- **Riverine floods** are a function of precipitation levels and water runoff volumes, and occur when water rises out of the banks of the waterway. Flooding along waterways that drain larger watersheds often can be predicted in advance. It usually takes more than 24 hours for the flood crest (maximum depth of flooding) to pass. In Texarkana, most riverine flooding is caused by large rainfall systems and thunderstorm activity associated with seasonal cold fronts. These systems can take as long as a day to pass, giving ample opportunity for large amounts of rain to fall over large areas. The Flood Insurance Rate Maps show the 1%-annual-chance floodplains of riverine systems.
- **Urban flooding** occurs where development has altered hydrology through changes in the ground surface and modification of natural drainageways. Urbanization increases the magnitude and frequency of floods by increasing impervious surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and, occasionally, overwhelming sewer systems. Localized urban flooding is not usually shown on the Flood Insurance Rate Maps in areas with less than one square mile of contributing drainage area.
- **Dam failure flooding** occurs when a dam fails and releases impounded water. The sudden release of large volumes of water most often occurs when rainfall is already causing high water levels. If a dam is in poor condition, dam failure can occur under “sunny day” conditions. Areas predicted to flood if a dam fails may have been approximated on a map if an Emergency Action Plan (EAP) has been prepared; typically, only dams classified as “high hazard” have EAPs.

2. Severe Winter Storms

Definition of Winter Storm Hazards

A winter storm is a type of precipitation in which the dominant varieties of precipitation are forms that only occur at cold temperatures, such as snow or sleet, or a rainstorm where ground temperatures are cold enough to allow ice form (i.e. freezing rain). In temperate continental climates, these storms are not restricted to the winter season, and may occur in the late autumn and early spring. Also, there are very rare occasions when they form in summer, although it would have to be an abnormally cold summer, such as the summer of 1816 in the Northeast U.S. In many locations in the Northern Hemisphere, the most powerful winter storms usually occur in March and, in regions where temperatures are cold enough.

Figure A-2
Split Tree Caused by Ice Storm
(Source: FEMA)

Characteristics of Winter Storms

Winter storms typically form along a front generally following the meandering path of the jet stream. These storms, called mid-latitude cyclones or extra-tropical cyclones, differ from hurricanes, in that they move from west to east as opposed to east to west. These weather patterns carry cold air from Canada and the Rockies into the southern U.S. The origins of the weather patterns that cause winter storms in Texas are affected by differences in temperature and pressure, moisture availability, and wind direction as well as weather systems in the Atlantic Ocean and Gulf of Mexico.

Winter storms vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death. Severe winter and ice

storms can cause unusually heavy rain or snowfall, high winds, extreme cold, and ice storms throughout the continental United States.

NOAA describes the jet streams that carry storm systems across the United States as narrow bands of strong wind in the upper atmosphere that follow the boundaries between hot and cold air masses. These boundaries are most pronounced during the winter months, when the jet streams travel to their southernmost position over the United States and surrounding water.

In the last 11 winters, no region in the United States has escaped flooding during the winter months. The Southeastern and Gulf Coast States (regularly hit by autumn hurricanes) experience damaging floods in the winter months, too. No region is immune. Global warming threatens to disrupt weather patterns around the world and may increase the frequency of winter flooding.

Another weather phenomenon, El Niño, can have a significant effect on precipitation in the United States. Named by Peruvian fishermen who noticed the periodic appearance of warming surface temperatures in the Pacific Ocean around Christmas, El Niño is now understood to be the warm phase of a temperature oscillation in the Pacific Basin's water and atmosphere. The cool phase of the oscillation is nicknamed La Niña. During the warm phase, heat and moisture are released into the upper atmosphere, creating precipitation. El Niño alters the course of the jet stream - pushing it farther south than usual.

According to NOAA, El Niño winters tend to be wetter than normal in the Southeastern United States, as well, and contribute to flooding along the Gulf Coast. Storms that spin up in the Gulf of Mexico typically track northeast on the southern jet stream, bringing rain as well as ice and even snow to the Gulf States.

Winter storm occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs and heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. As a result of severe ice storms, telecommunications and power can be disrupted for days. Such storms can also cause exceptionally high rainfall that persists for days, resulting in heavy flooding.

3. Wildfire

Definition of the Wildfire Hazard

A wildfire, also known as a forest fire, vegetation fire, grass fire, brush fire, or hill fire, is an uncontrolled fire often occurring in wildland areas, which can also consume houses or agricultural resources. Common causes include lightning, human carelessness, and arson. Wildfires are fueled by naturally occurring or non-native species of trees, brush, and grasses. Topography, fuel, and weather are the three principal factors that impact wildfire hazards and behavior.

Figure A-3
Brush Fire
(Source: FEMA)

Characteristics of the Wildfire Hazard

Wildfires often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may fill the area for miles around. As mentioned, wildfires can be human-caused through acts such as arson or campfires, or can be caused by natural events such as lightning. Wildfires can be categorized into three types:

1. Wildland fires occur in very rural areas and are fueled primarily by natural vegetation.
2. Interface fires occur in areas where homes or other structures are endangered by the wildfires. The fires are fueled by both natural vegetation and man-made structures. These are often referred to as Wildland Urban Interface fires.
3. Firestorms occur during extreme weather (e.g., high temperatures, low humidity, and high winds) with such intensity that fire suppression is virtually impossible. These events typically burn until the conditions change or the fuel is exhausted.

The following three factors contribute significantly to wildfire behavior:

Fuel: The type of fuel and the fuel loading (measured in tons of vegetative matter per acre) have a direct impact on fire behavior. Fuel types vary from light fuels (grass) to moderate fuels (Southern Rough) to heavy fuels (slash). The type of fuel and the fuel load determines the potential intensity of the wildfire and how much effort must be expended to contain and control it.

Weather: The most variable factor affecting wildfire behavior is weather. Important weather variables are precipitation, humidity, and wind. Weather events ranging in scale from localized thunderstorms to large

cold fronts can have major effects on wildfire occurrence and behavior. Extreme weather, such as extended drought and low humidity can lead to extreme wildfire activity.

Topography: The movement of air over the terrain tends to direct a fire's course. Topography can have a powerful influence on wildfire behavior.

4. Hurricanes and Tropical Cyclones

Definition of Hurricanes and Tropical Cyclones

Hurricanes, tropical storms, and typhoons, collectively known as tropical cyclones, are among the most devastating naturally occurring hazards in the United States. They present flooding, storm surge, and high wind hazards to the communities that they impact.

A hurricane is defined as a low-pressure area of closed circulation winds that originates over tropical waters. A hurricane begins as a tropical depression with wind speeds below 39 mph. As it intensifies, it may develop into a tropical storm, with further development producing a hurricane. Table A-3 below identifies the criteria for each stage of development.

Table A-4
Classification of Tropical Storms and Hurricanes

Stage of Development	Criteria
Tropical Depression (development)	Maximum sustained surface wind speed is < 39 mph
Tropical Storm	Maximum sustained wind speed ranges 39 - <74 mph
Hurricane	Maximum sustained surface wind speed 74 mph+
Tropical Depression (dissipation)	Decaying stages of a cyclone in which maximum sustained surface wind speed has dropped below 39 mph

Hurricane and tropical storm winds blow in a large spiral around a relative calm center known as the "eye." The "eye," the storms core, is an area of low barometric pressure and is generally 20 to 30 miles wide. The storm may extend outward 100 - 400 miles in diameter. As a hurricane or tropical storm approaches, the skies will begin to darken and winds will grow in strength. As the hurricane (or tropical storm) nears land, it can bring torrential rains, high winds, storm surges, and severe flooding. The storm system weakens as it moves inland and areas 300 – 350 miles from the coast such as northeastern Texas can experience tropical storm force winds, flooding and heavy rains.

A single hurricane can last for more than two weeks over open waters and can run a path across the entire length of the eastern seaboard. August and September are peak months during the hurricane season that lasts from June 1 through November 30.

Characteristics of Tropical Storms and Tropical Cyclones

Hurricanes and tropical storms are categorized based on their wind speed. Both bring strong winds and are characterized by torrential rain that often results in widespread damage. Tropical storms can produce both moderate winds speeds and heavy rains. Tropical storms are most often associated with heavy rains that have the potential to produce severe flooding.

High winds from tropical storms although not as fierce as hurricane force winds are still capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above the ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, velocity of windborne debris

Proper design and construction of residential structures, particularly those close to water or near the coast, demand that every factor mentioned above be addressed. Failure to do so may result in building damage or destruction by wind.

5. Tornadoes and Wind Storms

Tornadoes

Definition of the Tornado Hazard

A tornado is a rapidly rotating funnel (or vortex) of air that extends toward the ground from a cumulonimbus cloud. Most tornadoes do not touch the ground, but when the lower tip of a tornado touches the earth, it can cause extensive damage. Tornadoes often form in convective cells such as thunderstorms or at the front of hurricanes. Tornadoes may also result from earthquake induced fires, wildfires, or atomic bombs (FEMA, 1997).

Characteristics of Tornadoes

Tornadoes are nature's most unpredictable and violent storms, formed when cold air overrides a warmer air mass, such as commonly occurs in the Texarkana area, typically with greater frequency, in the early spring and late fall. Like oil and water, the two air masses are incompatible and cannot mix. Cold air falls, because of its heavier weight, while warmer and lighter air rushes upward and polarized walls, or a squall line, are

created between the air masses. The air moving in the boundary between the two masses begins to rotate, violently, (according to most investigators, the developing cloud rotates, initially, at speeds in excess of 100 mph) and, eventually, extrudes below base cloud level to form a tornado, or "twister." When a tornado makes contact with the earth, the results can be devastating. Tornadoes have been estimated to rotate at speeds exceeding 300 mph --- a violent force that can make missiles of automobiles and splinters of well-constructed houses.

Tornadoes almost always form in conjunction with a powerful thunderstorm that may also contain intense lightning, excessive rainwater and damaging hail, conditions that greatly increase the danger quotient of nature's most feared weather phenomenon. The formation of tornadoes from thunderstorms is explained in Figure A-5.

The tornado's fearsome reputation is also enhanced by its unpredictability. While the storms tend to travel in a southwest to northeasterly direction, that is not always the case. Tornadoes have been known to travel in every direction, to move forward then backtrack and to skip along the ground, recede into a cloud, then appear, again, miles away. The average path of a tornado is four miles, but tornadic storms have tracked over 200 miles. In addition, the average width of a tornado is 300 to 400 yards. But, again, the exception is often the rule with these erratic and unpredictable storms. Some tornadoes have been as small as a few yards and others, while rare, as wide as two miles. According to tornado experts, the size of a tornado is not necessarily an indication of strength. A small tornado may be extremely violent, while a large one may be relatively weak. And, to add to the mystique, tornadoes can occur in any month of the year, at any time of the day or night, may form singularly or in groups and may occur anywhere in the world. Tornado experts estimate that, in the month of May of each year, three out of every four days a tornado occurs somewhere in the continental United States.

Tornadoes in the dissipating stage can appear like narrow tubes, or ropes, twisting into all manner of curls, twists, and s-shapes. Multiple-vortex tornadoes can appear as a family of swirls circling a common center, or may be completely obscured by condensation, dust, and debris, appearing to be a single funnel. In addition to these appearances, tornadoes may be obscured completely by rain or dust. These tornadoes are especially dangerous, as even experienced meteorologists might not spot them. As shown in the following table, tornadoes are measured by the Fujita Scale, an empirical system that determines the severity by observed damages (last column).

Table A-5
The Fujita Tornado Scale
(Source: FEMA 1997)

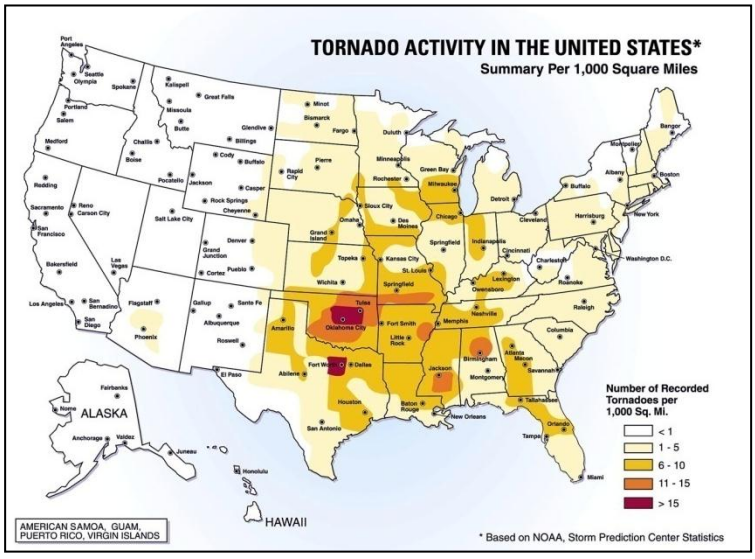
Category	Wind Speed	Description of Damage
F0	40-72 mph	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
F1	73-112 mph	Moderate damage. The lower limit is the beginning of hurricane speed. Roof surfaces peeled off; mobile homes pushed off foundations or overturned; moving autos pushed off roads.

Appendix A
General Description of Natural Hazards

Category	Wind Speed	Description of Damage
F2	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	158-206 mph	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	207-260 mph	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	261-318 mph	Incredible devastating damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100-yards; trees debarked.

Figure A-2 illustrates the frequency of tornado strikes in the U.S. per 1,000 square miles. While tornadoes can occur in any month and at all hours of the day or night, they occur with greatest frequency during the late spring and early summer months during late afternoon and early evening hours.

Figure A-6
Historic Tornado Activity in the United States,
Summary per 1,000 Square Miles



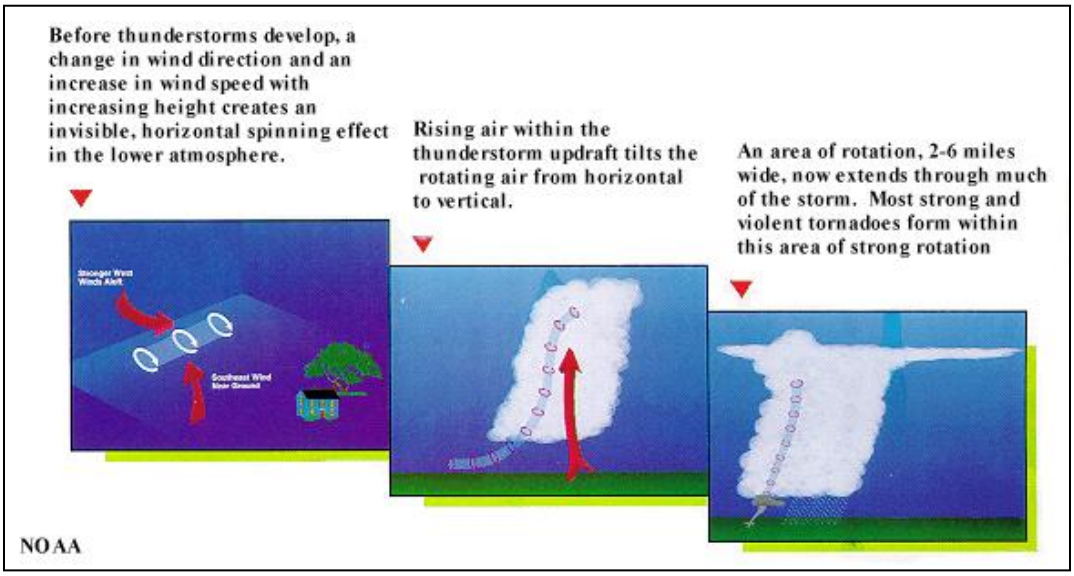
The severity and duration of tornadoes is a function of several factors, including weather conditions, topography and the F class of the event. As noted earlier, tornado severity is measured with the Fujita scale, an empirical system that classifies events after they occur. In some cases there are anomalous

patterns for various reasons (including the reliability and completeness of reporting), but generally speaking smaller events are more probable, larger (more severe) ones are less likely.

Tornado duration is usually relatively short, varying from a matter of seconds to several minutes on the ground, although in rare cases they can last significantly longer. The path width of a single tornado generally is less than 0.6 miles. The path length of a single tornado can range from a few hundred yards to miles. A tornado typically moves at speeds between 30 and 125 mph and can generate internal winds exceeding 300 mph.

Most tornadoes take on the traditional appearance of a narrow funnel, a few hundred yards across, with a small cloud of debris near the ground. Tornadoes can appear, however, in all manner of shapes and sizes.

Figure A-7
Formation of Tornadoes
(Source: NOAA)



Small, relatively weak landspouts might only be visible as a small swirl of dust on the ground. While the condensation funnel may not extend all the way to the ground, if associated surface winds are greater than 40 mph (64 km/h), it is considered a tornado. Large single-vortex twisters, often violent, can look like a large wedge stuck into the ground, and are known as *wedge tornadoes* or *wedges*. Wedges can be so wide that they appear to be a block of dark clouds. Even experienced storm observers may not be able to tell the difference between a low-hanging cloud and a wedge tornado from a distance.

Wind Storms

Definition of the Wind Storm Hazard

Wind is the uneven horizontal movement of air resulting from the irregular heating of the earth's surface. It can range from local breezes produced by heat from land surfaces and lasting tens of minutes to powerful

global winds resulting from solar heating of the earth. Severe winds typically result from hurricanes, nor'easters, tropical storms, tornadoes, thunderstorms, or winter storms.

Characteristics of High Winds during Wind Storms

High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above the ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, velocity of windborne debris

Figure A-8
Strong Wind Effects
(Source: FEMA)

Proper design and construction of residential structures, particularly those close to water or near the coast, demand that every factor mentioned above be addressed. Failure to do so may result in building damage or destruction by wind.

6. Lightning

Definition of Lightning Hazard

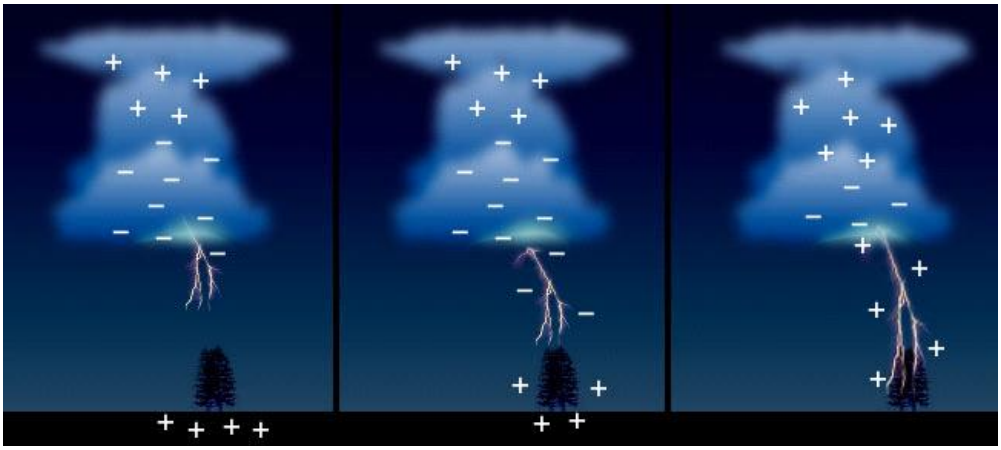
Lightning is a powerful natural electrostatic discharge produced during a thunderstorm. This abrupt electric discharge is accompanied by the emission of visible light and other forms of electromagnetic radiation. The electric current passing through the discharge rapidly channels heat and expands the air into plasma producing acoustic shock waves (thunder) in the atmosphere.

Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees F. The rapid heating and cooling of the air near the channel causes a shock wave, which produces thunder.

Characteristics of Lightning

Lightning typically occurs as a by-product of a thunderstorm. The action of rising and descending air in a thunderstorm separates positive and negative charges, with lightning the result of the buildup and discharge of energy between positive and negative charge areas. Water and ice particles may also affect the distribution of the electrical charge. In only a few millionths of a second, the air near a lightning strike is heated to 50,000°F, a temperature hotter than the surface of the sun. Thunder is the result of the very rapid heating and cooling of air near the lightning that causes a shock wave.

Figure A-9
Formation of Lightning
Source: University Corporation for Atmospheric Research (UCAR)



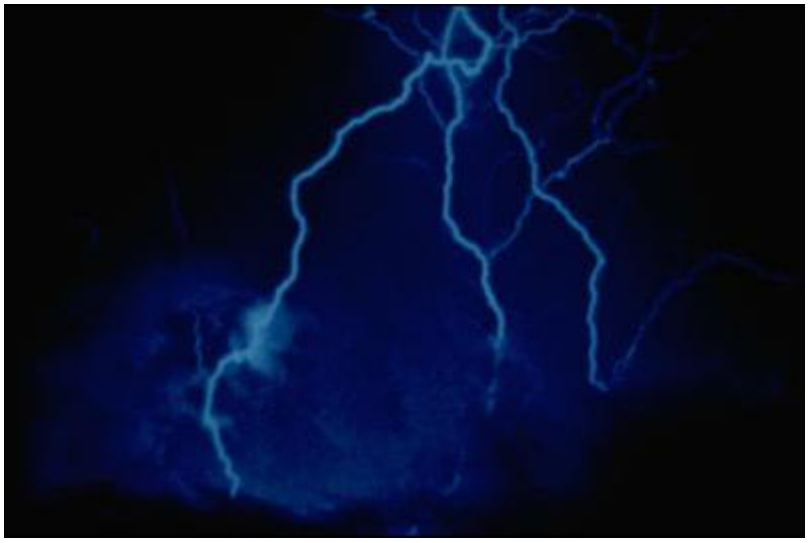
The hazard posed by lightning is significantly underrated. High winds, rainfall, and a darkening cloud cover are the warning signs for possible cloud-to-ground lightning strikes. While many lightning casualties happen at the beginning of an approaching storm, more than half of lightning deaths occur after a thunderstorm has passed. The lightning threat diminishes after the last sound of thunder, but may persist for more than 30

minutes. When thunderstorms are in the area, but not overhead, the lightning threat continues to exist. Lightning has been known to strike more than 10 miles from the storm in an area with clear sky above.

Lightning is the most dangerous and frequently encountered weather hazard that most people in the United States experience annually. Lightning is the second most frequent killer in the U.S., behind flash floods, with nearly 100 deaths and 500 injuries annually. These numbers are likely to underestimate the actual number of casualties because of the under reporting of suspected lightning deaths and injuries. Cloud-to-ground lightning can kill or injure people by either direct or indirect means.

According to the National Oceanic and Atmospheric Administration (NOAA), an average of 20 million cloud-to-ground flashes have been detected every year in the continental United States. About half of all flashes have more than one ground strike point, so at least 30 million points on the ground are struck on average each year. In addition, there are roughly 5 to 10 times as many cloud-to-cloud flashes as there are cloud-to-ground flashes (NOAA, July 7, 2003).

Figure A-10
Lightning Bolt in Night Sky
Source: FEMA



Cloud-to-ground lightning is nearly always associated with thunderstorms and related weather phenomena. Thunderstorms occur in most warm and hot months, and occasionally at other times as well. The entire planning area is subject to the lightning hazard. While the duration of individual lightning strikes is only milliseconds, the duration of thunderstorms that create the lightning ranges from very short periods (15 minutes or less) to long periods when the storms are relatively stationary.

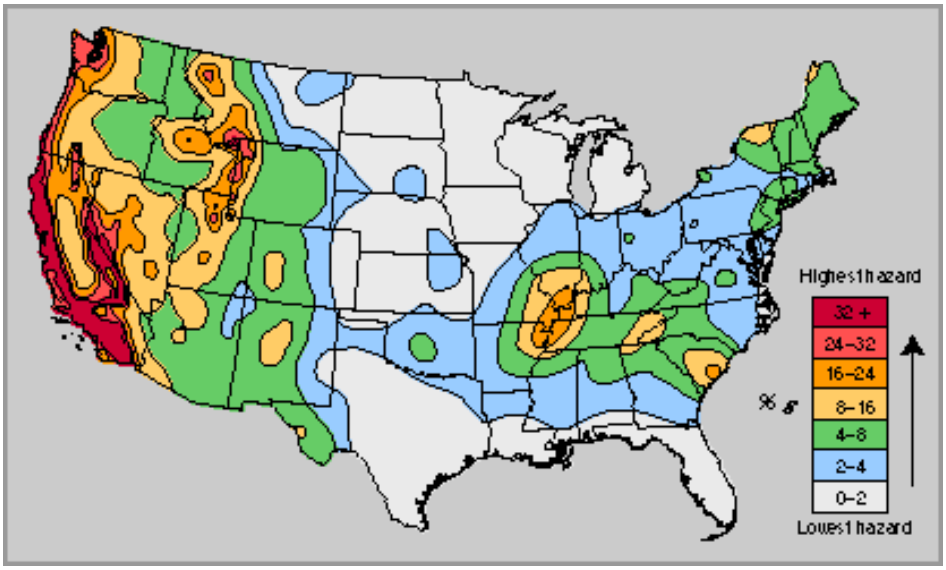
Damages from lightning hazards are generally limited to those related to power surges and contact with electrical equipment. In some cases ungrounded structures are hit by lightning and experience damage, either as a direct result of the lightning or via fires secondary to the hazard. There are also reports of brushfires being started by lightning, although these are usually relatively small and quickly contained. No reliable database or information exists to determine the cost of recovery from lightning.

7. Earthquakes

Definition of Earthquake Hazard

An earthquake is "…a sudden motion or trembling caused by an abrupt release of accumulated strain in the tectonic plates that comprise the earth's crust." These rigid plates, known as tectonic plates, are some 50 to 60 miles in thickness and move slowly and continuously over the earth's interior. The plates meet along their edges, where they move away from or pass under each other at rates varying from less than a fraction of an inch up to five inches per year. While this sounds small, at a rate of two inches per year, a distance of 30 miles would be covered in approximately one million years.[2] Figure A-11 shows a USGS seismic probability map for the continental U.S.

Figure A-11
United States Earthquake Zones



Characteristics of Earthquakes

The vibration or shaking of the ground during an earthquake is described by ground motion. Severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. The following are the two kinds of seismic waves:

P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion), with particle motion in the same direction as wave travel. They move through the earth at approximately 15,000 mph.

[2] FEMA, 1997

S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side-to-side (horizontal motion) due to particle motion at right-angles to the direction of wave travel. Unreinforced buildings are more easily damaged by S waves.

Earthquakes are often relatively short duration, but there may be aftershocks and other effects (such as liquefaction) that prolong and exacerbate their effects. The potential for either of these effects depends on local conditions and other technical factors that are not discussed in this NHMP.

There is some potential for seismic activity virtually anywhere on the earth. Locations that are close to tectonic faults, however, are much more likely to be impacted by earthquakes than other places. The United States Geologic Survey and other organizations develop maps to indicate the relatively probability of earthquakes in particular areas.

Figure A-12
Earthquake Damage
(Source: FEMA)

8. Drought / Extreme Heat

Definition of Drought Hazard

Drought is generally defined as a condition of climatic dryness severe enough to reduce soil moisture and water supplies below the requirements necessary to sustain normal plant, animal, and human life. In Texas, drought is often defined in terms of agricultural and hydrologic drought:

- **Agricultural drought** is considered a dry period of sufficient duration and intensity that crop and animal agriculture are markedly affected.
- **Hydrologic drought** is considered a long-term condition of abnormally dry weather that ultimately leads to the depletion of surface and ground water supplies. During hydrologic drought, a significant reduction in flow of rivers, streams, and springs is notable.

Appendix A
General Description of Natural Hazards

Drought is the result of a decline in the expected precipitation over an extended period of time, typically one or more seasons in length. *Meteorological drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.* Hydrological drought is related to the effects of precipitation shortfalls on streamflows and reservoir, lake, and groundwater levels. *Agricultural drought is defined principally in terms of soil moisture deficiencies relative to water demands of plant life, usually crops.* Socioeconomic drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. This may also be called a water management drought.

Characteristics of Drought

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs.

Drought is a normal part of virtually every climate on the planet, including areas of both high and low normal rainfall. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity (FEMA, 1997). A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering effects of an event. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Droughts may cause a shortage of water for human and industrial consumption and cause a decrease in hydroelectric power. Water quality may also decline while the number and severity of wildfires may increase. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and higher unemployment.

Extreme Heat

Definition of Extreme Heat Hazard

Extreme summer heat is the combination of very high temperatures and exceptionally humid conditions. If such conditions persist for an extended period of time, it is called a heat wave (FEMA, 1997). Heat stress can be indexed by combining the effects of temperature and humidity, as shown in Table D.6.1-1. The index estimates the relationship between dry bulb temperatures (at different humidity) and the skin's resistance to heat and moisture transfer. The higher the temperature or humidity, the higher the apparent temperature.

Table D.6.1-1
Heat Index and Disorders
(Sources: FEMA, 1997; NWS, 1997)

Danger Category		*Heat Disorders*	*Apparent Temperatures (°F)*
IV	*Extreme Danger*	*Heatstroke or sunstroke imminent.*	*>130*
III	*Danger*	*Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.*	*105-130*
II	*Extreme Caution*	*Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.*	*90-105*
I	*Caution*	*Fatigue possible with prolonged exposure and physical activity.*	*89-90*

In the northeastern U.S. periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years or so where maximum daily temperatures exceed 100 degrees Fahrenheit for an extended period of time. The passing of a cold front usually moderates temperatures after a few days to a week.

Characteristics of Extreme Heat

The main impact of extreme heat is its affect on the human body. In a very hot environment, the most serious concern is heat stroke. In absence of immediate medical attention, heat stroke could be fatal. Heat stroke fatalities do occur every summer. Heat exhaustion and fainting (syncope) are less serious types of illnesses which are not fatal but interfere with a person's ability to work.

The major human risks associated with extreme heat can be summarized as follows.

- **Heatstroke:** Considered a medical emergency, heatstroke is often fatal. It occurs when the body's responses to heat stress are insufficient to prevent a substantial rise in the body's core temperature. While no standard diagnosis exists, a medical heatstroke condition is usually diagnosed when the body's temperature exceeds 105°F due to environmental temperatures. Rapid cooling is necessary to prevent death, with an average fatality rate of 15 percent even with treatment.

- **Heat Exhaustion:** While much less serious than heatstroke, heat exhaustion victims may complain of dizziness, weakness, or fatigue. Body temperatures may be normal or slightly to moderately elevated. The prognosis is usually good with fluid treatment.

- **Heat Syncope:** This refers to sudden loss of consciousness and is typically associated with people exercising who are not acclimated to warm temperatures. Causes little or no harm to the individual.

- **Heat Cramps:** May occur in people unaccustomed to exercising in the heat and generally ceases to be a problem after acclimatization.

Appendix B
Natural Hazards Mitigation Plan Steering Committee - Meeting Agendas

Meeting #1
November 2010

Natural Hazards Mitigation Plan Revision
First Steering Committee Meeting
November 8, 2010 - 1330 to 1530 hours
Columbia Gateway Building - 4th Floor Conference Room

Invited Attendees: William Mackey (DPZ), Kris Singleton (DPW), Colleen Clary (OEM), Dan Cornwell (OEM), Bob Frances (DILP), Gene Mellin (OEM), Angela Morales (DPW SWM)

Agenda

- Introductions
- Planning Process
  - Updated Demographics
  - Updated Risk and Vulnerability Assessments
  - Development of the Mitigation Strategy
  - Identify and Analyze Mitigation Actions (Old and New)
  - Develop Mitigation Implementation Plan
  - Plan Maintenance Process
  - Integration with Comprehensive Plan
  - Public Involvement is **Required**
- Timeline
- Availability of Grant Funds
- Potential Contractor Involvement – All or Part of the Plan
- Going Forward

Appendix B
Natural Hazards Mitigation Plan Steering Committee - Meeting Agendas

Meeting # 2
March 2011

Natural Hazards Mitigation Plan Revision
Second Steering Committee Meeting
March 8, 2011 - 1000 to 1200 hours
George Howard Building - Clarksville Room (3rd floor)

Invited Attendees: Michael Sharpe (DFRS), Brad Killian (DPZ), Donald Mock (DILP), Bob Frances (DILP), Manesh Pillai (DTCS GIS), Robert Slivinsky (DTCS GIS), Angela Morales (DPW SWM), Bill Anuszewski (DFRS), Gene Mellin (OEM), Chris Singleton (DPW), Dan Cornwell (OEM), Colleen Clary (OEM), Angelique So (OEM), Steve Pardue (Vissering Pardue and Associates)

Agenda

- Welcome and Introductions
- Review Purpose and History of the Mitigation Plan
- Review Planning Process, Timeline, and Grant Funding
- Review the Steering Committee structure, members and responsibilities
- Review the Work Group structure, members and responsibilities
- Review the Decision Making Process
- Review current Hazards and Identify any new Hazards since the 2004 plan was created
- Identify any other vested agencies/stakeholders that should be involved in the planning process
- Review the Task Matrix
- Briefly review the current 2004 plan
    - Likes/dislikes
    - Format/structure of the plan
    - Inclusion/exclusion of sections
- Solidify the Timeline
- Discuss the next proposed steering committee meeting date – April 19, 2011
- Review process to track “in-kind” time
- Conclusion

Appendix B
Natural Hazards Mitigation Plan Steering Committee - Meeting Agendas

Meeting # 3
June 2011

Natural Hazards Mitigation Plan Revision
Third Steering Committee Meeting
June 14, 2011 - 1000 to 1200 hours
Columbia Gateway Building – 4th Floor Conference Room

Invited Attendees: Michael Sharpe (DFRS), Brad Killian (DPZ), Donald Mock (DILP), Bob Frances (DILP), Manesh Pillai (DTCS GIS), Robert Slivinsky (DTCS GIS), Angela Morales (DPW SWM), Bill Anuszewski (DFRS), Kris Singleton (DPW), Mike Price (HCPD), Dan McNamara (DRP), Kevin Enright (PIO), Nancy Gray (RM), Virginia Peterman (DTCS), Ron Miller (HCPS), Gene Mellin (OEM), Dan Cornwell (OEM), Colleen Clary (OEM), Angelique So (OEM), Greg Vernon (DPW), Steve Pardue (Vissering Pardue and Associates), Deepa Srinivasan (Vision Planning and Consulting, LLC)

Agenda

- Welcome and Introductions
- Review Purpose of Meeting (third/final)
- Review Planning Process, Timeline, and Grant Funding
- Review the Stakeholder and Public input/feedback process
- Introduce the State Hazard Mitigation Officer – Mr. Mark James
- Review the Hazard Identification and Risk Analysis (HIRA) and Vulnerability Assessment and Loss Estimation (VALE) – Mr. Steve Pardue
- Discuss the 2004 Mitigation Actions Outcomes – metrics
- Review and prioritize the new proposed Mitigation Actions – Ms. Deepa Srinivasan
- Review the HMP Integration Strategy – Ms. Deepa Srinivasan
- Conclusion

Appendix B
Natural Hazards Mitigation Plan Steering Committee - Meeting Agendas

Meeting # 4
October 2011

Natural Hazards Mitigation Plan Revision
Fourth Steering Committee Meeting
October 20, 2011 - 1400 to 1600 hours
Ligon Building – Policy Room

Invited Attendees: Michael Sharpe (DFRS), Brad Killian (DPZ), Donald Mock (DILP), Bob Frances (DILP), Manesh Pillai (DTCS GIS), Robert Slivinsky (DTCS GIS), Angela Morales (DPW SWM), Bill Anuszewski (DFRS), Kris Singleton (DPW), Mike Price (HCPD), Dan McNamara (DRP), Kevin Enright (PIO), Nancy Gray (RM), Virginia Peterman (DTCS), Ron Miller (HCPS), Gene Mellin (OEM), Dan Cornwell (OEM), Colleen Clary (OEM), Angelique So (OEM), Greg Vernon (DPW), Steve Pardue (Vissering Pardue and Associates), Deepa Srinivasan (Vision Planning and Consulting, LLC)

Agenda

- Welcome and review purpose of meeting
- Review the current draft NHMP Goal and Objectives
- Review current list of draft NHMP Actions
- Brainstorm new NHMP Mitigation Action Items based on recent natural hazards
- Conclusion

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Meeting # 1
November 2010

Natural Hazards Mitigation Plan Review Steering Committee Meeting

November 8, 2010

NAME	DEPARTMENT	
Bill Mackey	DPZ	
Bob Frances	DILP	2 hrs total (w/ travel)
Angela Morales	DPW	
Dan Cornwell	OEM	
Kris Singleton	DPW	1 hour
Colleen Clary	OEM	

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Meeting # 2
March 8, 2011

2011 NATURAL HAZARDS MITIGATION STEERING COMMITTEE MEETING
March 8, 2011

NAME	DEPARTMENT	SIGNATURE
MICHAEL SHARPE	FIRE + RESCUE	
BRAD KILLIAN	DPZ	
Angelique So	OEM	
Donald Mock	DILP	
BOB FRANCES	D.I.L.P.	
steven Pardue	VPA (consultant)	
MANESH PILLAI	DTCS	
Robert Slivinsky	DTCS	
Angela Morales	SCDM	
Colleen Cleary	OEM	
Bill Anuszewski	DFRS	
Gene Mellin	OEM	

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Work Session # 1
May 2011

Hazard Mitigation Plan Revision
Work Session
May 16, 2011
1 pm – 4 pm

SIGN IN SHEET

Name	Signature
Donald L. Mock DILP	
Rocco Sovero HCPD	
Dale Jackson DCS	
Edgar Shilling HCFR	
Brad Killian DPZ	
Dan McMahon	
Gene Mellin	
Michael Sharpe HCFR	
Wm. A. Mackey, Jr DPZ	

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Work Session # 2
May 2011

Howard County
ALL HAZARDS MITIGATION PLAN UPDATE

Mitigation Workshop
26 May 2011
8:30am-9:30am
Sign-in Sheet

Print Name	Sign Name	Department
Ron Lapson		DPW
Diane Schwarzman		DPW
KRIS SINGLETON		DPW
DAN CORNWELL		OEM
Evelyn Tomlin		DPW
MARK DeLuca		DPW
KAREN BECKER		DPW
JIM IRVIN		DPW
Michael Giovanniello		DPW
STEVE GERLOIN		DPW

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Meeting # 3
June 2011

Natural Hazards Mitigation Plan Revision

Third Steering Committee Meeting
14 June 2011
10am-12pm
Gateway Building – Room 401
Sign-in Sheet

Print Name	Sign Name	Department
Robert Slivinsky		Tech Com
Rocco Sovero		HCPD
Nathan Stone		DFRS
Angela Morales	Angela Morales	DPW
Kris Singleton		DPW
Bill Mackey	W.A. Mackey Jr.	DPZ
steve Pardue		VPA consultant
Greg Vernon		DPZ
Angelique So.		OEM.
Donald C. Mock		ILP
BRAD KILLIAN		DPZ
DAN McMahon		

Appendix C

Natural Hazards Mitigation Plan Steering Committee - Meeting Sign-In Sheets

Meeting # 4
October 2011

Natural Hazards Mitigation Plan
Fourth Steering Committee Meeting
October 18, 2011 – EOC Policy Room, Ligon Building
1400 – 1600

Name	Signature	Department
KRIS SINGLETON		DPW
MICHAEL SHARPE		FIRE + RESCUE
Angela Morales	Angela Morales	Storm Cdr. DPW
DONALD MOCK		DILP
Angelique So	Angelique So	OEM.
John Marshall		Rec + Parks
SEAN Hasbrough		Col. Assoc.
BRAD KILLIAN		DPZ
DAN Connell		OEM
Katrina Hein		OEM

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Meeting # 1
March 8, 2010

Natural Hazards Mitigation Plan Update
First Steering Committee Meeting
November 8, 2010 - 1330 to 1530 hours
Columbia Gateway Building - 4th Floor Conference Room

Date of Meeting	November 8, 2010
Subject	First Steering Committee
In Attendance	Steering Committee • William Mackey (DPZ) • Kris Singleton (DPW) • Bob Frances (DILP) • Angela Morales (DPW SWM) Working Group Members • Gene Mellin (OEM) • Dan Cornwell (OEM) • Colleen Clary (OEM)
Summary prepared by	Gene Mellin

Agenda

- Review Purpose of Meeting
- Review Background of Hazard Mitigation Planning
- Review how Steering Committee members were selected
- Discuss the Planning Process:
  - Review 2004 plan
  - Review MEMA/FEMA Crosswalk
  - Discuss the possibility of using an outside consultant/contractor to complete the plan revision
- Develop the Work Plan and timelines
- Assignment of Tasks
- Review how work hours will be tracked
- Conclusion/Wrap-up

Gene Mellin of the Office of Emergency Management started the meeting by passing out the Natural Hazards Mitigation Plan. He then spent substantial time providing background information on hazard mitigation planning process and emphasized that mitigation grant funds were contingent on updating this natural hazards mitigation plan. He then discussed the review process, developed and discussed the work plan, and assigned tasks to steering committee members.

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Meeting # 2
March 2011

Natural Hazards Mitigation Plan Update
Second Steering Committee Meeting
March 8, 2011 - 1000 to 1200 hours
Howard Building - Clarksville Room (3rd Floor)

HMP STEERING COMMITTEE MEETING MINUTES

Date of Meeting	March 8, 2011
Subject	Second Steering Committee
In Attendance	Steering Committee • Michael Sharpe (DFRS) • Brad Killian (DPZ) • Donald Mock (DILP) • Bob Frances (DILP) • Manesh Pillai (DTCS) • Robert Slivinsky (DTCS) • Angela Morales (DPW - SWM) • Bill Anuszewski (DFRS) • Gene Mellin (OEM) • Kris Singleton (DPW) Working Group Members • Dan Cornwell (OEM) • Colleen Clary (OEM) • Angelique So (OEM) • Steve Pardue (Vissering & Pardue)
Summary prepared by	Angelique So

Agenda

- Welcome and Introductions
- Review Purpose and History of the Mitigation Plan
- Review Planning Process, Timeline, and Grant Funding
- Reviewing Steering Committee structure, members and responsibilities
- Review Decision Making Process
- Review Current Hazards and Identify any new Hazards since the 2004 plan was created
- Identify any other vested agencies / stakeholders that should be involved in the planning process
- Review the Task Matrix and proposed “Table of Contents” for the updated plan
- Briefly review the current 2004 plan

- Like / dislikes
- Format / structure of the plan
- Inclusion / exclusion of the sections

Introduction

- Steering Committee signed in
- Dan Cornwell introduced the Working Group Members, including one of the subject matter expert, Steve Pardue
- Handouts passed out
  - Agenda
  - Timeline
  - Scope of Work
  - FEMA's Hazard Mitigation Basics
  - A sample Table of Content

Purpose and History of the Mitigation Plan

- Dan Cornwell provided a brief overview on what was covered during the first steering committee meeting.

Planning Process, Timeline and Grant Funding

- Dan Cornwell discussed the timeline. DPW representative thought the timeline is over-ambitious. While a two week timetable is reasonable for review of the current mitigation actions, it is difficult to also then assess future mitigation actions. DPW representative would like additional time for that aspect of the review.
- Dan Cornwell and Angelique So will revisit the timetable and adjust it accordingly.

Reviewing Steering Committee structure, members and responsibilities

- Scope of Work worksheet was reviewed by the Steering Committee.
- The Subject Matter Expert provided a brief background on his work in hazards mitigation.
- Dan Cornwell emphasized that the Office of Emergency Management will do most of the work, but Steering Committee should provide guidance, input and feedback.
- Angela Morales would like to open up the Steering Committee to more members to ensure that everyone who was involved in the 2004 plan can be involved in this revision. However, Dan Cornwell assured her that both the EMOG/EMAG members are kept abreast on the status of the plan.
- An action matrix will be sent out to those who participated in the 2004 plan where they will inform the Working Group the progress of the mitigation actions listed and future mitigation actions to consider. Emails will be sent to both the department's director and Steering Committee's representative for consideration.

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Review Decision Making Process

- Strive to reach consensus, however when consensus cannot be reached a majority vote will be taken.

Review Current Hazards and Identify any new Hazards since the 2004 plan was created

- The SME Steve Pardue emphasized that the flood mitigation portion has already been completed by SWM. Since floods consistently affects the region the most, the rest of the hazards should be relatively simple to address.
- DPW representative asked if the county should consider "diseases" and "manmade" hazards in the Hazards Mitigation Plan. The SME suggested that these two items would be much too technical for this revision and recommends that they are addresses in the next revision. No new hazards were added to the list.
- SME suggests the section titled "lightning and wildfires" be separated, since they are caused by different events. Steering Committee agreed.

Identify any other vested agencies/stakeholders that should be involved in the planning process

- Several agencies were identified by the Steering Committee, including the EDA, Columbia Association, MDE, DNR, Baltimore Metro Council.
- OEM will contact surrounding counties such as Montgomery, Prince George's, Anne Arundel, Carroll, Baltimore, and Frederick, to gather their input on this project.
- The Working Group will work closely with MEMA's State Hazard Mitigation Officer, Mark James.

Review the Task Matrix and proposed "Table of Contents" for the updated plan

- Instead of reviewing the task matrix, Dan Cornwell reiterated that most of the revision work will be conducted by the Working Group.
- The group thought the sample Table of Contents was satisfactory. The Working Group will use that as their basis for their draft revision.

Review of 2004 Plan

- The SME thought the 2004 plan was an average plan for that era, but noted that the plan reviewers are now much more technical / detailed in their review.
- Ms. Morales from Stormwater Management (SWM) thought the plan could be improved with the inclusion of tabs for ease of reference.

Conclusion

- Ms. Morales was concerned over the inclusion of the Flood Mitigation Plan into the Natural Hazards Mitigation Plan. This will be considered by the Working Group and the SME.
- Dan Cornwell thanked everyone for attending. He also reminded all representatives to keep close track of the hours worked for grant funding purposes.

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Meeting # 3
June 2011

Natural Hazards Mitigation Plan Update
Third Steering Committee Meeting
June 14, 2011 - 1000 to 1200 hours
Gateway Building - Room 401

NHMP UPDATE STEERING COMMITTEE MEETING MINUTES

Date of Meeting	June 14, 2011
Subject	Third Steering Committee
In Attendance	Steering Committee • Robert Silvinsky (DTCS) • Rocco Sovero (HCPD) • Nathan Stone (DFRS) • Angela Morales (DPW – SWM) • Kris Singleton (DPW) • Bill Mackey (DPZ) • Donald Mock (DILP) • Brad Killian (DPZ) • Dan McNamara (Rec & Park) Working Group Members • Dan Cornwell (OEM) • Angelique So (OEM) • Greg Vernon (DPZ) • Steve Pardue (Vissering & Pardue)
Summary prepared by	Angelique So

Agenda

- Welcome and Introductions
- Review Purpose of Meeting (third / final)
- Review Planning Process, Timeline, and Grant Funding
- Review the Stakeholder and Public input/feedback process
- Introduce the State Hazard Mitigation Officer – Mr. Mark James
- Review the Hazard Identification and Risk Analysis (HIRA) and Vulnerability Assessment and Loss Estimation (VALE) – Mr. Steve Pardue
- Discuss the 2004 Mitigation Actions Outcome
- Review and prioritize the new proposed Mitigation Actions – Ms. Deepa Srinivasan
- Review the HMP Integration Strategy – Ms. Deepa Srinivasan
- Conclusion

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Introduction

- Steering Committee / Working Group signed in
- Dan Cornwell (DC) asked everyone to reintroduce themselves
- Handout packets were passed out
    - Agenda
    - Plan Goals
    - Summary of Howard County 2011 Hazard Mitigation Plan Update
    - Hazards Mitigation Plan Actions and Metrics
    - Prioritization Criteria
    - 2011 NHMP's New Actions Chart

Purpose and History of the Mitigation Plan

- Dan Cornwell provided a brief overview on what was covered during the first and second steering committee meetings.

Planning Process, Timeline and Grant Funding

- The Working Group has been on scheduled regarding the revision process. The next step will be the Public Meeting – which will be held on June 28, 2011 (Tuesday) from 6:00 to 8:00 PM. A press release has already been distributed and announcement flyers will be distributed to libraries for posting purposes.

Review the Stakeholder and Public input/feedback process

- A list has been generated in terms of who will be considered a stakeholder for this process. This list includes: -
    - All Departments on EMAG (Emergency Management Advisory Group)
    - Howard County Public School System
    - CERN
    - Office of Law
    - Economic Development Authority
    - All surrounding county's Office's of Emergency Management
    - Columbia Association

Introduce the State Hazard Mitigation Officer – Mr. Mark James

- Mr. Mark James was invited to the meeting, but unfortunately could not attend.

Review the Hazard Identification and Risk Analysis (HIRA) and Vulnerability Assessment and Loss Estimation (VALE) – Mr. Steve Pardue (SP)

- SP summarized Sections 6 & 7 of the plan for the benefit of the group. This new plan will consider eight different natural hazards, including floods, hurricane and tropical storm winds, winter storms, tornadoes, wildfires, lightning, earthquakes and drought/extreme heat.

- As Howard County is a relatively low-risk area, as well as good practices mandated by the county, there are less events that affect the region overall.
- DPW asked if the increased frequency of the various hazards affecting the county has been taken into account in the new plan. The SME responded that language reflecting this will be included into the plan.
- DPW's representative suggested that the inclusion of data points from areas outside the county should be considered. DPZ made the counter-argument that the over-inclusion of data outside the county may dilute the usefulness of the plan itself, since it is no longer county-specific.
- The plan goals were revisited and members of the Steering Committee wanted to change the goals that were created during the work session to having one main goal, namely: "Strive to save lives and protect property within Howard County" and the rest of the goals changed to objectives.

Discuss the 2004 Mitigation Actions Outcome

- DC reviewed the metrics handout with the group. A total of 92 actions from the previous 2004 plan was reviewed, and of those 92 actions, a total of 24 (8 "in progress" items, and 16 "on-going" actions) will be utilized in this revision. Furthermore, a total of 25 new mitigation actions (excluding the 40+ flood mitigation actions covered in the flood mitigation plan) were created and will be included in the updated 2011 plan.
- The subject matter expert, Ms. Deepa Srinivasan, will review the list and provide input / feedback on the action items.
- This metric will be included into the 2011 plan.

Review and prioritize the new proposed Mitigation Actions

Our second Subject Matter Expert was unable to attend the meeting, so DC covered the prioritization methodology that will be utilized.

- The prioritization methodology is based on three considerations, namely: social (life/safety impact), administrative (administrative/technical assistance) and economic (project costs). Using these three criterion, the Work Group will prioritize the new proposed actions and then the Steering Committee will review and provide feedback.

Review the HMP Integration Strategy

DC mentioned that the integration section of the plan (Section 9) has been completed and ready for review by senior members of the Office of Emergency Management.

Conclusion

- Again, DC invited the Steering Committee to the Public Meeting on June 24 and extended the invitation to respective departments' members who may be interested in the process.

Appendix D

Natural Hazards Mitigation Plan Steering Committee - Meeting Minutes

Meeting # 4
October 2011

Date of Meeting	October 18, 2011
Subject	Fourth Steering Committee Meeting
In Attendance	Steering Committee • Kris Singleton (DPW) • Michael Sharpe (HFRS) • Angela Morales (DPW – SWM) • Donald Mock (DILP) • John Marshall (Rec & Park) • Sean Harbaugh (Columbia Association) • Brad Killian (DPZ) Working Group Members • Dan Cornwell (OEM) • Angelique So (OEM) • Katrina Hein (OEM) • Deepa Srinivasan (Vision Consulting)
Summary prepared by	Angelique So

- Welcome and review purpose of meeting
- Review the current draft NHMP Goal and Objectives
- Review current list of draft NHMP Actions
- Brainstorm new NHMP Mitigation Action Items based on recent natural hazards
- Conclusion

<u>Welcome and review purpose of meeting</u>

- Dan Cornwell (DC)
    - Several hazards have hit Howard County the last few months
        - Earthquake
        - Hurricane Irene
        - Tropical Storm Lee
    - As part of FEMA's mandate, the steering committee should reconvene to discuss possible changes to the natural hazards mitigation plan (NHMP) (specifically the new hazard mitigation actions discussed during the third steering committee and the work sessions)
    - Status update
        - The draft has been written, but with the advent of the new hazards, now awaiting the subject-matter experts, Steve Pardue and Deepa Srinivasan (DS), to re-write parts of the plans (sections 6,7 and 8)
    - Quick introduction around the table, as well as introduce the subject matter expert, Deepa.

  - Good representation of the department
- DS
  - She worked intimately with Department of Public Works, Stormwater Management, in drafting the flood mitigation plan (FMP)
  - She will also serve as a reviewer of the draft NHMP prior to submission to MEMA / FEMA
    - As one of the individuals assisting FEMA with the creation of a new review system, she has a clear understanding on what they will be looking for when assessing the plan

Review the current draft NHMP Goal and Objectives

- The group reviewed the goal and objectives list critically
- DC - our county goals and objectives were modeled after Maryland's state hazard mitigation plan.
- AM
  - Objective No. 2: based on recent events, we should incorporate ways on focusing on what individual citizens can do to better prepare for natural hazards
  - DC: Howard County did a good job on preparing, really good job on dealing with response, but we need to do a better job on recovery
  - MS: other states have better models for recovery process (utilization of standard forms, for example)
    - DC: We do not have a standardized process, per se, but we are just getting started on establishing a county-wide recovery process
  - DS: the state of Florida has long-term recovery plans, which is built into their comprehensive plans. However, in many East Coast states' plans, they have piece-meal recovery plans, but nothing comprehensive.
  - DC / DS: instead of adding it into objectives, we should establish the creation of a comprehensive recovery plan as part of our mitigation action items.
  - BK: we must be careful not to be over-comprehensive or be over-inclusive of actions that are merely recovery in nature
  - DS: this can be considered an outreach action, which is a huge component of hazard mitigation
  - KS: we need to do a better job managing expectations during an emergency and giving them to PIO during call centers
  - SH: need to provide people manning the call center a tip sheet on who is responsible for what
- Objectives
  - Combine
    - Improve preparedness response, recovery and mitigation functions to reduce vulnerabilities within the County

- DS went over the six different mitigation objectives

Review current list of draft NHMP Actions

- As a group, went through each individual new actions and figured out estimated cost for specific new mitigation actions
- Already examined these before during previous steering committees and work sessions, but a quick review to see if they still make sense given the recent natural hazards
- AM: FMP needs to be updated based on CRS (and NFIP insurance rate)
    - DS: FEMA requires the plan to be revisited every year by providing a status report
    - DC: the NHMP team should reconvene with Stormwater Management annually for status updates of both plans
- No. 6
    - Stakeholders… on how to prevent, prepare and recovery from natural hazards
- No. 5
    - Devise process to protect critical health care supplies during extended power outages caused by natural hazards, as well as a back-up storage
- Difference between nos. 9/18
    - DS will word-smith
    - Split
        - ID existing class four and put them into sheltering policy
        - Create policy for creating new class four
- No. 10 – Develop an Emergency Preparedness Training and Exercise Plan including an annual and 3-year plan and an annual budget
- No. 13 – continue to incorporate state and local for progressive storm water techniques into all development plans (DS will reword)

Brainstorm new NHMP Mitigation Action Items based on recent natural hazards

- Based on the month of August hazards
    - Earthquake, Hurricane Irene, Tropical Storm Lee
- Good idea to reconvene the steering committee to brainstorm new actions
- New Mitigation Plan Action Items
    - Coordinate with SWM to synchronize update of plans (NHMP + SWM)
    - Re-evaluate and review the existing code for retaining walls (under debate)
    - Identify and classify all county-owned retaining walls to see if they need to be reinforced (Tech & Comm / DPW)
    - Developing a GIS layer for retaining walls (Tech & Comm)
    - Pedestrian footbridge
        - DPW plans on removing it from the channel

        - Already identified as project and has already begun work on the structure
        - "replace damaged footbridge in parking lot in historic EC"
    - Waste management facility in Elkridge
        - KS needs to talk to Steve Irwin regarding the Little Patuxent waste water treatment plant
    - Dam (Sewells Orchards)
        - Not an issue to explore right now
    - Waverly Mansion (owned by County)
        - Cracked from earthquake, and needs repair and paint
        - Cost estimate = zero
    - Adopt and implement National Grid Coordinates to adopt into county system and computer aided dispatch system (water valves, and critical structures) (DTCS and DPW)

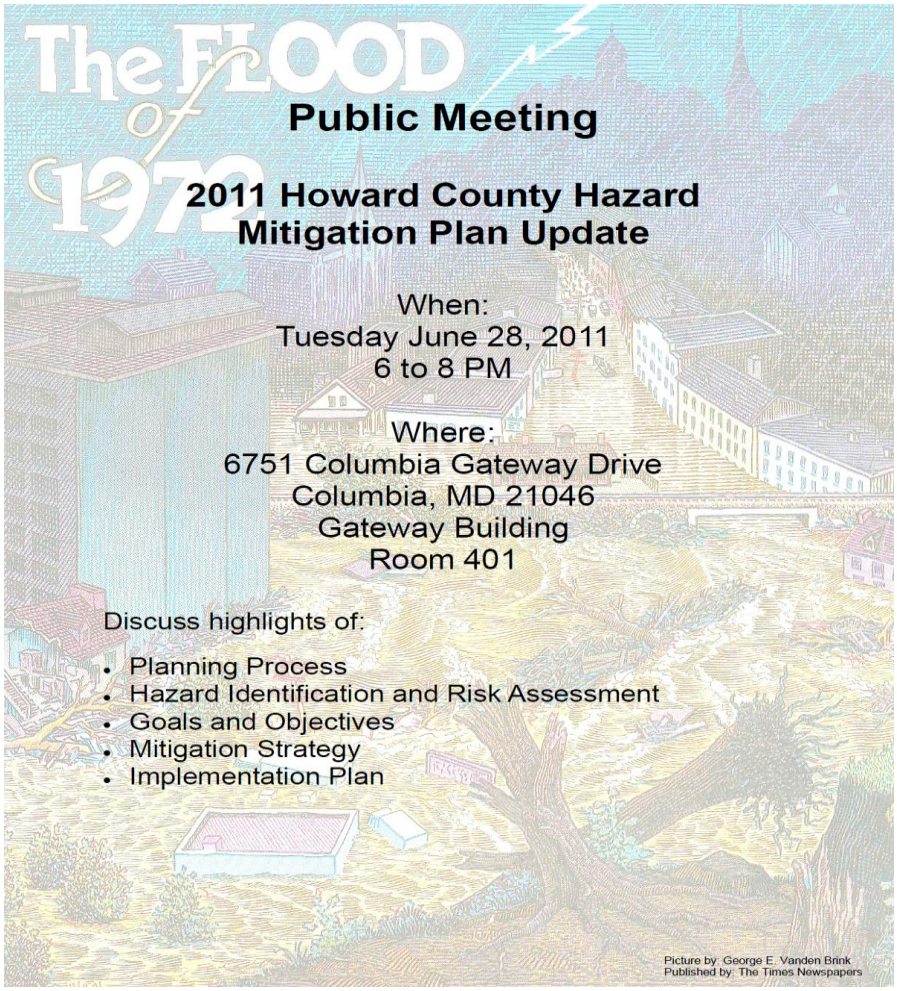
Conclusion

- Once changes are made, DC will circulate it around with the steering committee group again for group approval
- Based on these unforeseeable events (and the resulting draft changes), the new NHMP will be ready by the beginning of next year.

Appendix E

Public Meeting Documents

Public Meeting Announcement Flyer



Appendix E

Public Meeting Documents

Press Release

June 17, 2011

Howard County Office of Emergency Management request's public participation in developing the County's Updated Natural Hazards Mitigation Plan

The Howard County Office of Emergency Management is in the process of updating the County's Natural Hazards Mitigation Plan, a long-term strategic plan designed to reduce or eliminate the loss of life and property due to natural disasters. Howard County and all local governments are required to periodically update their plans to be eligible for certain types of non-emergency disaster assistance from the Federal Emergency Management Agency (FEMA).

The Office of Emergency management will be conducting a public meeting on Tuesday, June 28 at 6:00 PM, to brief the general public on the plan update, including the process, timeline, and the research conducted thus far. In addition, this meeting will also provide an opportunity for public commit on the plan. The location of the meeting will be at the Department of Fire and Rescue Services Headquarters, 6751 Columbia Gateway Drive, Room 401, in Columbia.

If you plan on attending, please RSVP so that we can ensure we have enough handouts, seating and refreshments at oem@howardcountymd.gov or by contacting 410-313-5911.

Comments may also be submitted by e-mail to oem@howardcountymd.gov.

The updated Natural Hazards Mitigation Plan is expected to be complete by December 2011.

Point of Contact:
Dan Cornwell, Emergency Management Specialist II
Howard County Office of Emergency Management
410-313-5911 (work)
dcornwell@howardcountymd.gov

Appendix E

Public Meeting Documents

Agenda

Natural Hazards Mitigation Plan Revision
Public Meeting
June 28, 2011 - 1800 to 2200 hours
Columbia Gateway Building - 4th Floor Conference Room

Agenda

- Welcome and Introductions
- Opening Remarks
- Review Planning Process
- Review Plan Goals and Objectives
- Review Hazard Identification and Risk Assessment
- Review Mitigation Development Strategy and Actions
- Questions and Answers

Appendix E

Public Meeting Documents

Sign In Sheet

2011 NATURAL HAZARDS MITIGATION PLAN (NHMP) REVISION PUBLIC MEETING

JUNE 28, 2011

NAME	EMAIL	SIGNATURE
Bruce Altschuler	cobalt-research@starpower.net	BA
Ruth Altschuler	ruthaltschuler@yahoo.com	RAltschuler
Mary Bogusław	mbogus1@umbc.edu	Mary Bogusław
RYAN MILLER	RAMILLER@HOWARDCOUNTYMD.GOV	
BRAD KILLIAN		

Appendix E

Public Meeting Documents

Powerpoint Presentation

2011 Natural Hazards Mitigation Plan (NHMP) Revision Public Meeting

Agenda

- Welcome and Introductions
- Opening Remarks
- Review Planning Process
- Review Plan Goals and Objectives
- Review Hazard Identification and Risk Assessment
- Review Mitigation Development Strategy and Actions
- Questions and Answers

What is Hazard Mitigation?

- **Sustained action** taken to reduce or eliminate long-term risk to people and property from hazards

- **Hazard Mitigation is NOT…**
  - Preparedness for an impending event
  - Immediate response to an event
  - Short-term recovery from an event

Appendix E

Public Meeting Documents

Why is Hazard Mitigation Planning Important?

- Disaster Mitigation Act of 2000 (DMA2k) requires all local jurisdictions to develop a natural hazard mitigation plan
- The plan establishes eligibility for
  - Pre-Disaster Mitigation (PDM) funding
  - Hazard Mitigation Grant Program (HMGP) funding

Mitigation Planning Process

Step 1: Organize Resources

Step 2: Assess Risks

Step 3: Develop a Mitigation Plan

Step 4: Implement Plan and Monitor Progress

Appendix E

Public Meeting Documents

2011 Natural Hazard Mitigation Plan "Goal"

Strive to save lives and protect property within Howard County

2011 Natural Hazard Mitigation Plan "Objectives"

- Enhance mitigation efforts to reduce vulnerabilities to future natural hazards
- Improve preparedness, response, recovery, and mitigation functions within the County
- Continue to pursue available mitigation funding opportunities for future projects
- Continue to engage and educate the public on mitigation natural hazards
- Ensure continual implementation of mitigation actions

Appendix E

Public Meeting Documents

Table of Contents

Planning Work Group

- **Dan Cornwell** - Emergency Management Specialist II,
  Office of Emergency Management
- **Angelique So** - Law & Policy Analyst,
  Office of Emergency Management
- **Greg Vernon** - Mitigation Planner,
  Department of Planning and Zoning
- **Steve Pardue** - Mitigation Planning SME,
  Vissering Pardue & Associates, Inc.
  - Overall guidance of planning process
  - Hazard Identification / Risk Assessment Section
- **Deepa Srinivasan** - Mitigation Planning SME,
  Vision Planning & Consulting, LLC
  - Mitigation Strategy Section
  - Integration Section

Appendix E

Public Meeting Documents

Stakeholders

- **Emergency Management Advisory Group (EMAG)**
  - Department of Fire and Rescue Services
  - Howard County Police Department
  - Department of Inspection, Licensing and Permits
  - Department of Planning and Zoning
  - Department of Public Works
  - Department of Technology and Communication Services
  - Department of Recreation and Parks
  - Department of Health
  - Department of Citizen Services
  - Sherriff's Office
  - Risk Management
  - Public Information Office
- **Community Representatives**
  - Community Emergency Response Network (CERN)
  - Howard County Public School System
  - Howard County Community College
  - Economic Development Authority
  - Office of Law
  - Columbia Association
  - Baltimore, Carroll, Frederick, Anne Arundel, Prince George's, and Montgomery County OEMs

Plan Update - Status

- Planning resources have been identified
- Hazard Identification / Risk Assessment Completed
- Currently drafting plan
  - Website developed: http://www.howardcountymd.gov/FAR/FAR_oemhazards.htm
  - Comprehensive Research / Writing / Review

Hazard Identification

- **Eight Natural Hazards have been identified**
  - Floods
  - Winter Storms
  - Tornadoes
  - Hurricane and Tropical Storm Winds
  - Wildfires
  - Lightning
  - Earthquakes
  - Drought & Extreme Heat

Vulnerability Assessment Loss Estimation

- Vulnerability – tendency to be damaged by hazards
- Loss estimation – projected money losses
  - direct damage
  - Injuries
  - lost function
- Various techniques based on data available

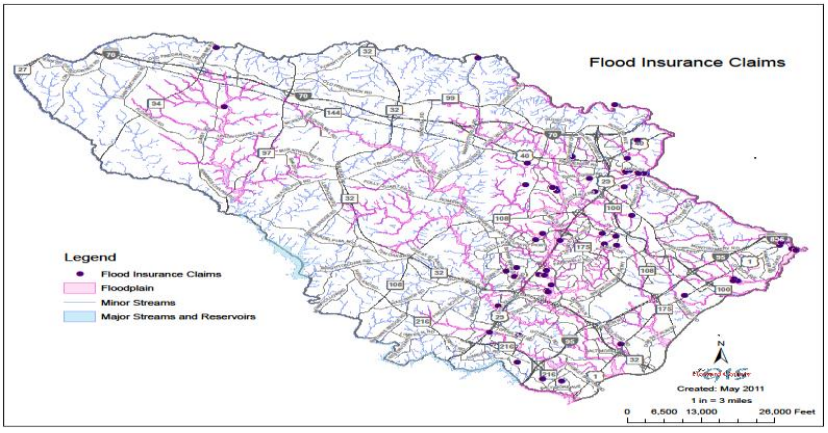
Appendix E

Public Meeting Documents

Highlights from the HIRA

- Due to good practices and conditions, Howard County is considered a relatively low-risk area
- FEMA requires discussion of
  - Location
  - Extent
  - Severity
  - Probability
  - History
- Various sources of data

Flood Insurance Claims



Appendix E

Public Meeting Documents

Mitigation Actions Metrics 2004

2004 NHMP Actions	Number	%
In Progress	6	7%
On-Going	14	15%
Not Applicable (N/A)	23	25%
Completed	33	36%
Cancelled	16	17%
Total Mitigation Actions Reviewed	92	100%

Mitigation Actions Metrics 2011

2011 NHMP Proposed Actions	Number	%
In Progress	6	14%
On-Going	14	32
New	24	54%
Total New Mitigation Actions	44	100%

Appendix E

Public Meeting Documents

Mitigation Actions

- Highlight high priority actions
  - Designate and train EOC/DOC representatives to allow continuous EOC/DOC staffing through a protracted disaster.
  - Install transfer switches at all designated shelters.
  - Develop a County-wide Emergency Water Resource Plan.
  - Devise a robust public outreach program to educate the general public and stakeholders regarding natural hazards.
  - Continue to conduct a snow emergency coordination meeting every year in the fall with County staff involved in snow emergency response.
- Exhibits
- Actions in Flood Mitigation Plan

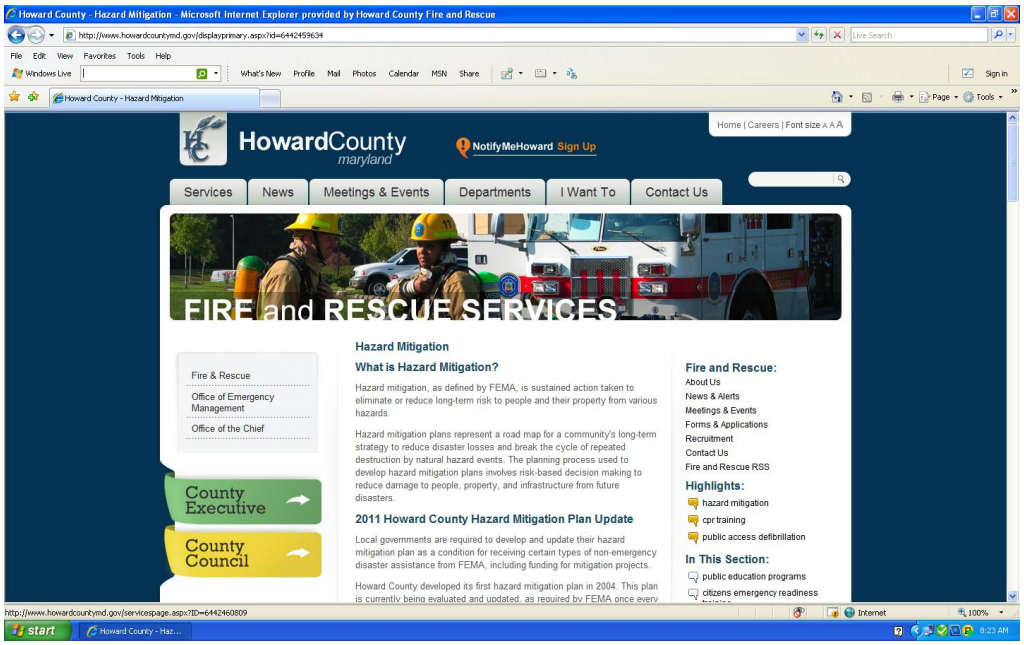
Additional Resources

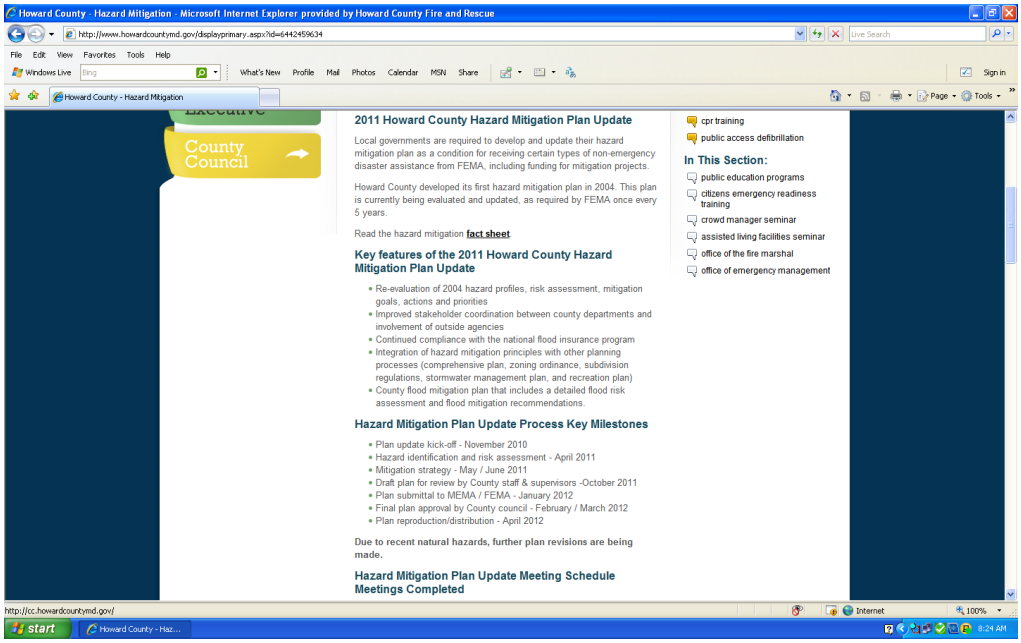
- Federal Emergency Management Agency website on hazard mitigation: www.fema.gov/plan/mitplanning
- Maryland Emergency Management Agency website on hazard mitigation: http://www.mema.state.md.us/MEMA/content_page.jsp?TOPICID=mitigation

Appendix F

Natural Hazards Mitigation Plan - Website

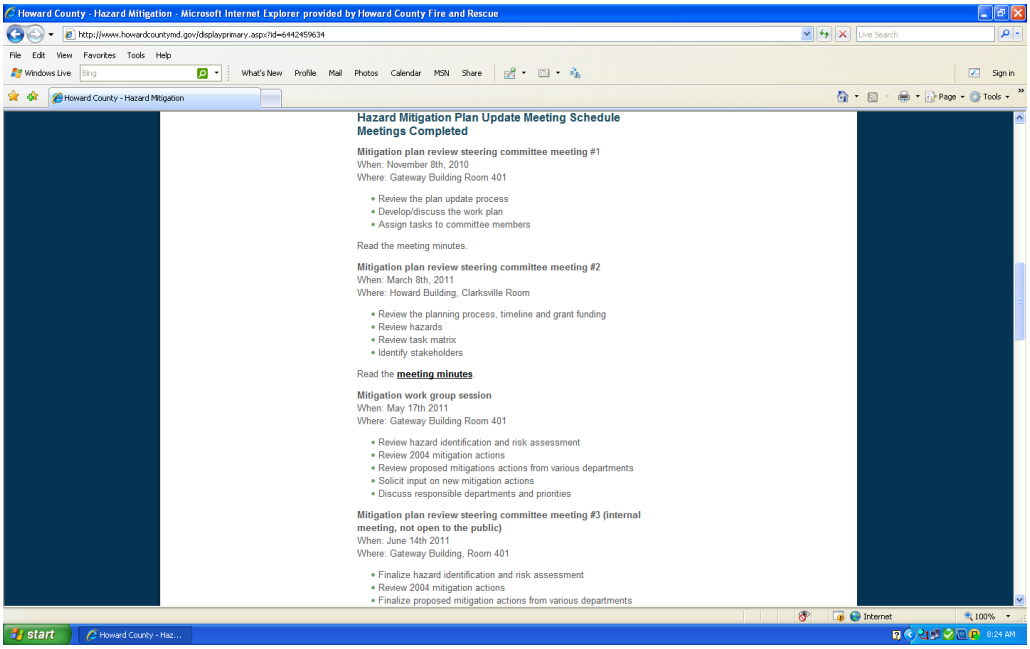
In an effort to leverage technology, in a very technological advanced jurisdiction, the Steering Committee choose to place all draft mitigation planning information on the DFRS OEM website so the general public could easily review the draft information and provide feedback throughout the planning process. A press release was also distributed advising the general public about the planning effort and the website address.

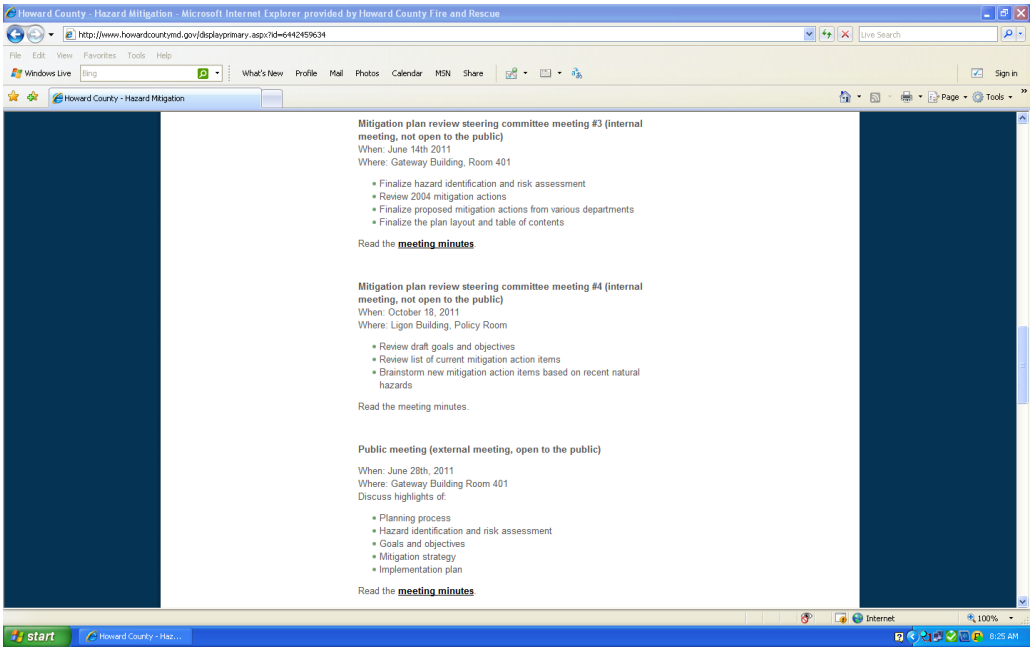




Appendix F

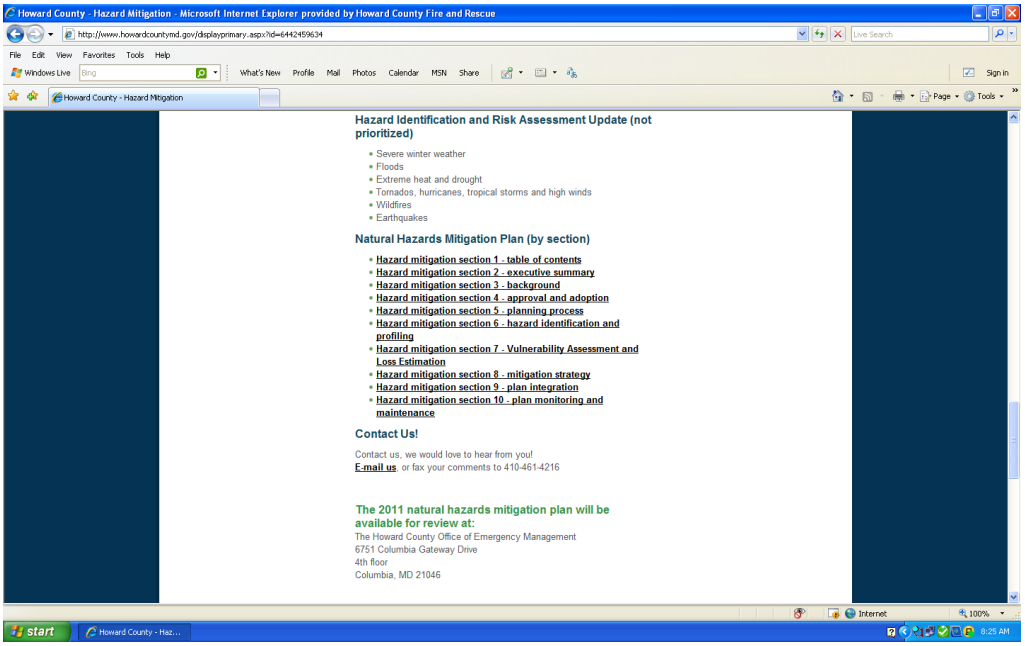
Natural Hazards Mitigation Plan - Website

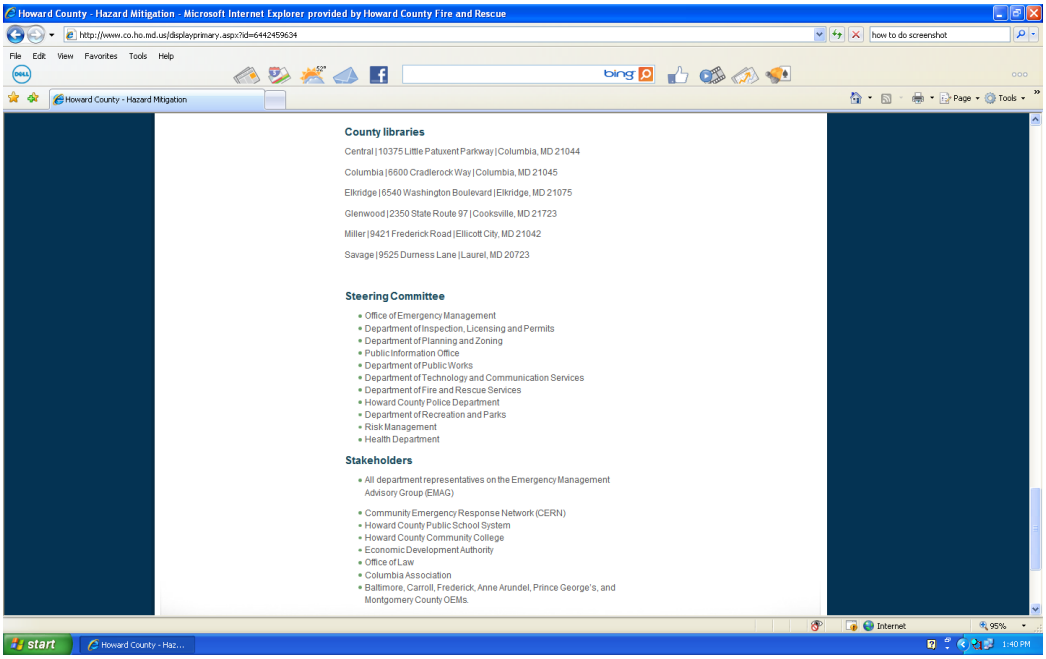




Appendix F

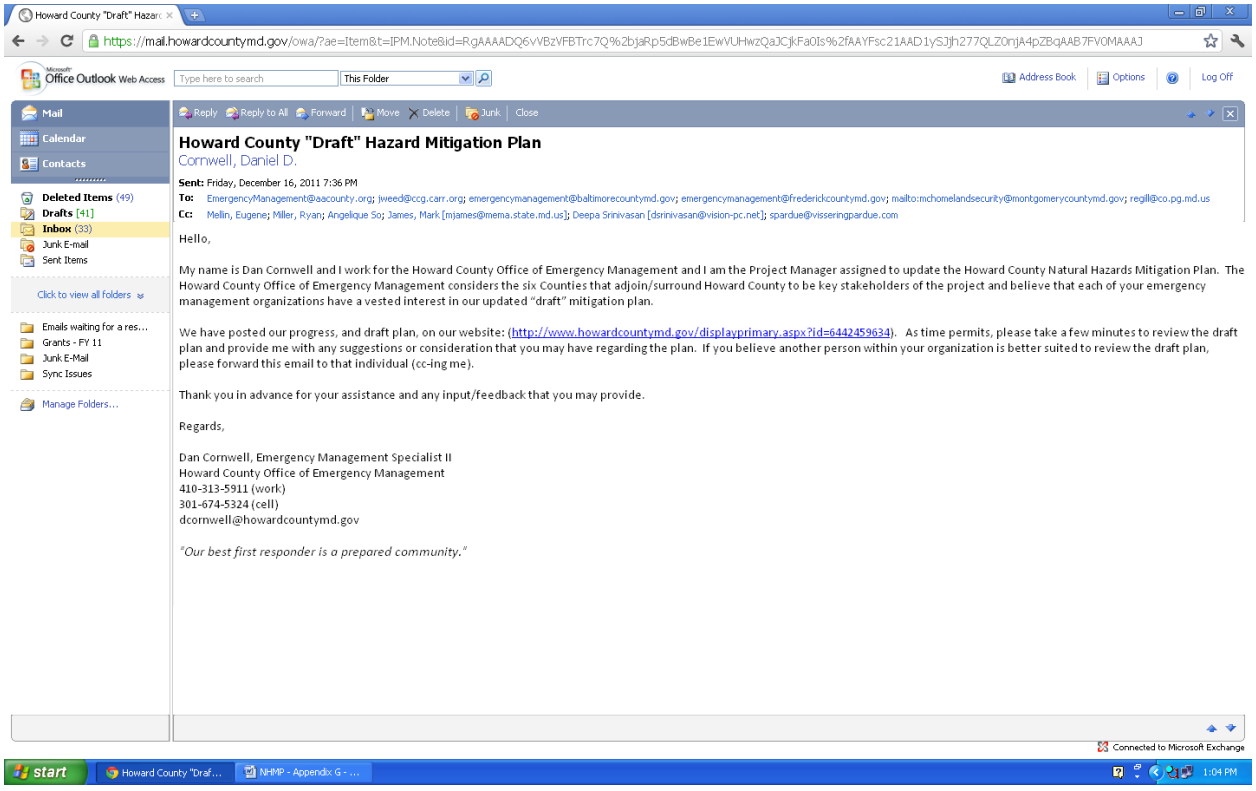
Natural Hazards Mitigation Plan - Website





Appendix G

Engaging Stakeholders



Howard County "Draft" Hazard Mitigation Plan

Cornwell, Daniel D.

Sent: Friday, December 16, 2011 7:36 PM
To: EmergencyManagement@aacounty.org; jweed@ccg.carr.org; emergencymanagement@baltimorecountymd.gov; emergencymanagement@frederickcountymd.gov; mailto:mchomelandsecurity@montgomerycountymd.gov; regill@co.pg.md.us
Cc: Mellin, Eugene; Miller, Ryan; Angelique So; James, Mark [mjames@mema.state.md.us]; Deepa Srinivasan [dsrinivasan@vision-pc.net]; spardue@visseringpardue.com

Hello,

My name is Dan Cornwell and I work for the Howard County Office of Emergency Management and I am the Project Manager assigned to update the Howard County Natural Hazards Mitigation Plan. The Howard County Office of Emergency Management considers the six Counties that adjoin/surround Howard County to be key stakeholders of the project and believe that each of your emergency management organizations have a vested interest in our updated "draft" mitigation plan.

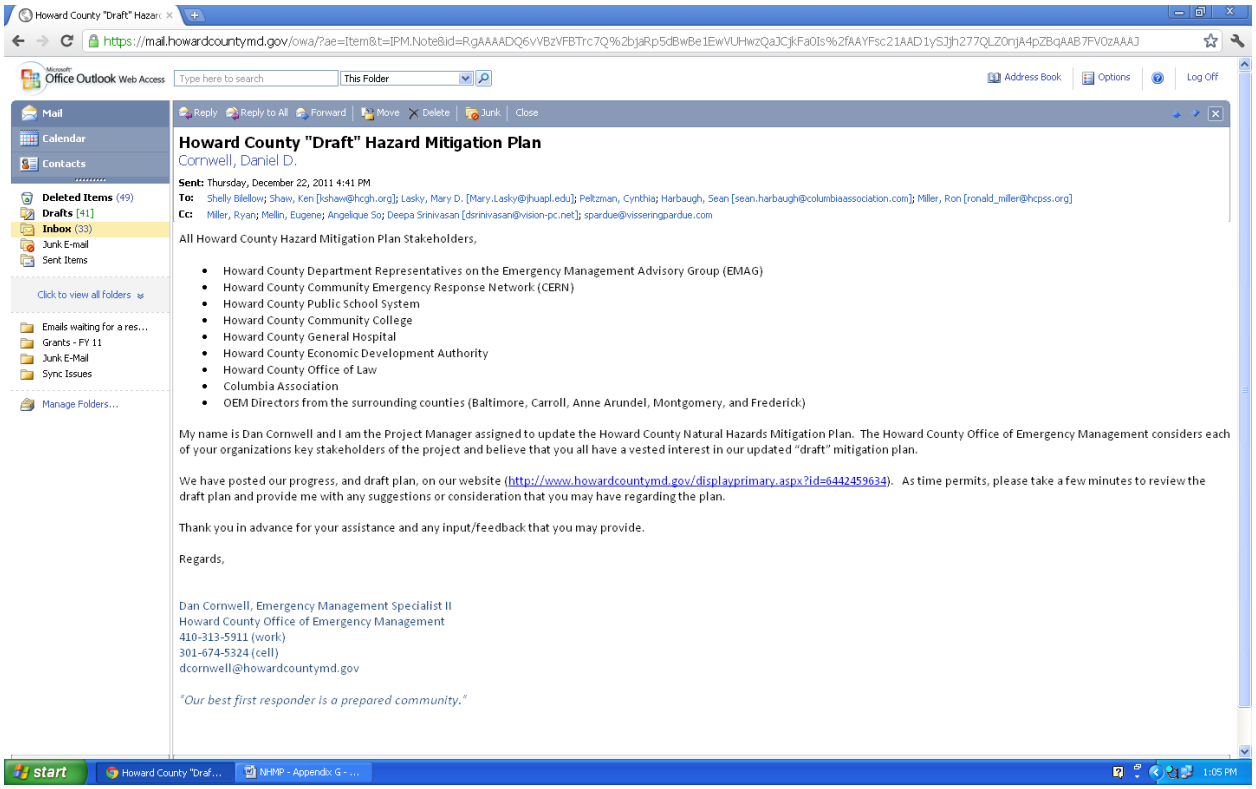
We have posted our progress, and draft plan, on our website: (http://www.howardcountymd.gov/displayprimary.aspx?id=6442459634). As time permits, please take a few minutes to review the draft plan and provide me with any suggestions or consideration that you may have regarding the plan. If you believe another person within your organization is better suited to review the draft plan, please forward this email to that individual (cc-ing me).

Thank you in advance for your assistance and any input/feedback that you may provide.

Regards,

Dan Cornwell, Emergency Management Specialist II
Howard County Office of Emergency Management
410-313-5911 (work)
301-674-5324 (cell)
dcornwell@howardcountymd.gov

"Our best first responder is a prepared community."



Howard County "Draft" Hazard Mitigation Plan

Cornwell, Daniel D.

Sent: Thursday, December 22, 2011 4:41 PM
To: Shelly Bilellow; Shaw, Ken [kshaw@hcgh.org]; Lasky, Mary D. [Mary.Lasky@jhuapl.edu]; Peltzman, Cynthia; Harbaugh, Sean [sean.harbaugh@columbiaassociation.com]; Miller, Ron [ronald_miller@hcpss.org]
Cc: Miller, Ryan; Mellin, Eugene; Angelique So; Deepa Srinivasan [dsrinivasan@vision-pc.net]; spardue@visseringpardue.com

All Howard County Hazard Mitigation Plan Stakeholders,

- Howard County Department Representatives on the Emergency Management Advisory Group (EMAG)
- Howard County Community Emergency Response Network (CERN)
- Howard County Public School System
- Howard County Community College
- Howard County General Hospital
- Howard County Economic Development Authority
- Howard County Office of Law
- Columbia Association
- OEM Directors from the surrounding counties (Baltimore, Carroll, Anne Arundel, Montgomery, and Frederick)

My name is Dan Cornwell and I am the Project Manager assigned to update the Howard County Natural Hazards Mitigation Plan. The Howard County Office of Emergency Management considers each of your organizations key stakeholders of the project and believe that you all have a vested interest in our updated "draft" mitigation plan.

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Regards,

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410-313-5911 (work)
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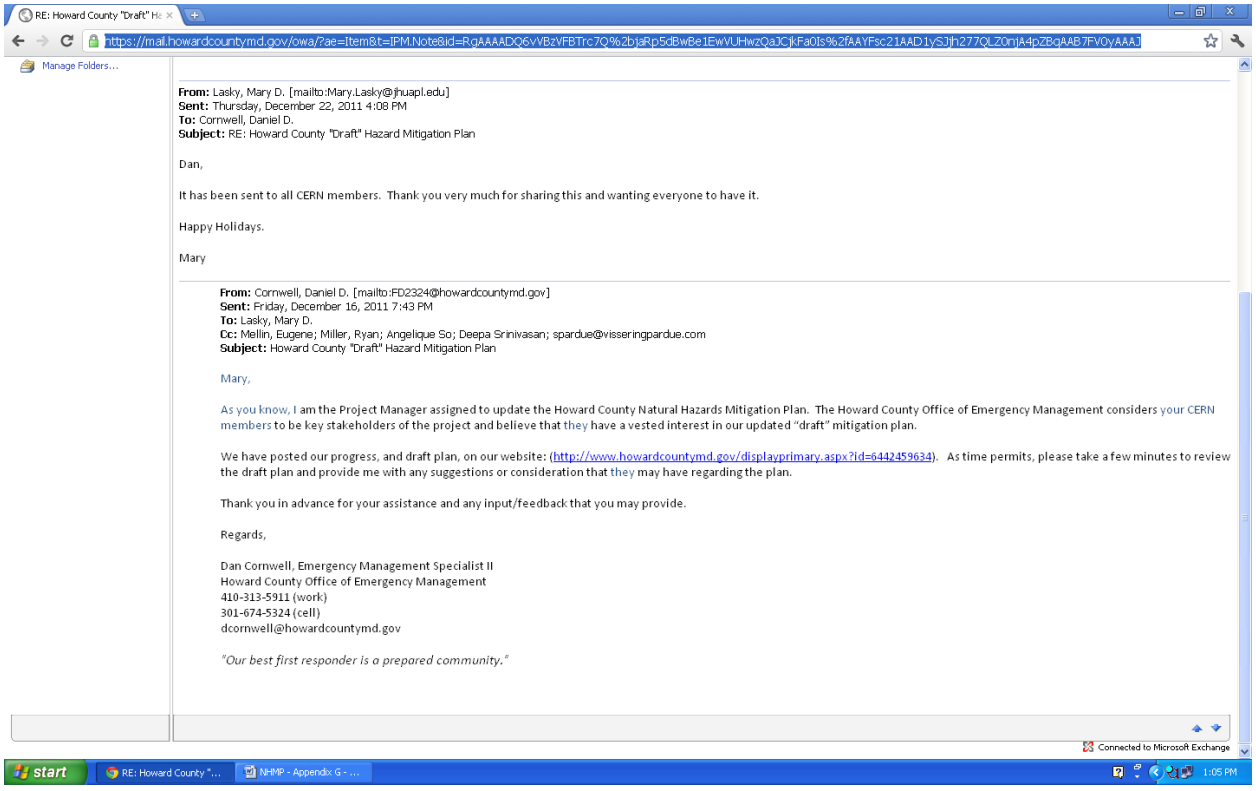
dcornwell@howardcountymd.gov

"Our best first responder is a prepared community."

Appendix G

Engaging Stakeholders



RE: Howard County "Draft" Hazard Mitigation Plan

https://mail.howardcountymd.gov/owa/?ae=Item&t=IPM.Note&id=RgAAAADQ6vVBzVFBTrc7Q%2bjaRp5dBwBe1EwVUHwzQaJCjkFa0Is%2fAAYFsc21AAD1ySJjh277QLZOnjA4pZBqAAB7FV0yAAAJ

Manage Folders...

From: Lasky, Mary D. [mailto:Mary.Lasky@jhuapl.edu]
Sent: Thursday, December 22, 2011 4:08 PM
To: Cornwell, Daniel D.
Subject: RE: Howard County "Draft" Hazard Mitigation Plan

Dan,

It has been sent to all CERN members. Thank you very much for sharing this and wanting everyone to have it.

Happy Holidays.

Mary

From: Cornwell, Daniel D. [mailto:FD2324@howardcountymd.gov]
Sent: Friday, December 16, 2011 7:43 PM
To: Lasky, Mary D.
Cc: Mellin, Eugene; Miller, Ryan; Angelique So; Deepa Srinivasan; spardue@visseringpardue.com
Subject: Howard County "Draft" Hazard Mitigation Plan

Mary,

As you know, I am the Project Manager assigned to update the Howard County Natural Hazards Mitigation Plan. The Howard County Office of Emergency Management considers your CERN members to be key stakeholders of the project and believe that they have a vested interest in our updated "draft" mitigation plan.

We have posted our progress, and draft plan, on our website: (http://www.howardcountymd.gov/displayprimary.aspx?id=6442459634). As time permits, please take a few minutes to review the draft plan and provide me with any suggestions or consideration that they may have regarding the plan.

Thank you in advance for your assistance and any input/feedback that you may provide.

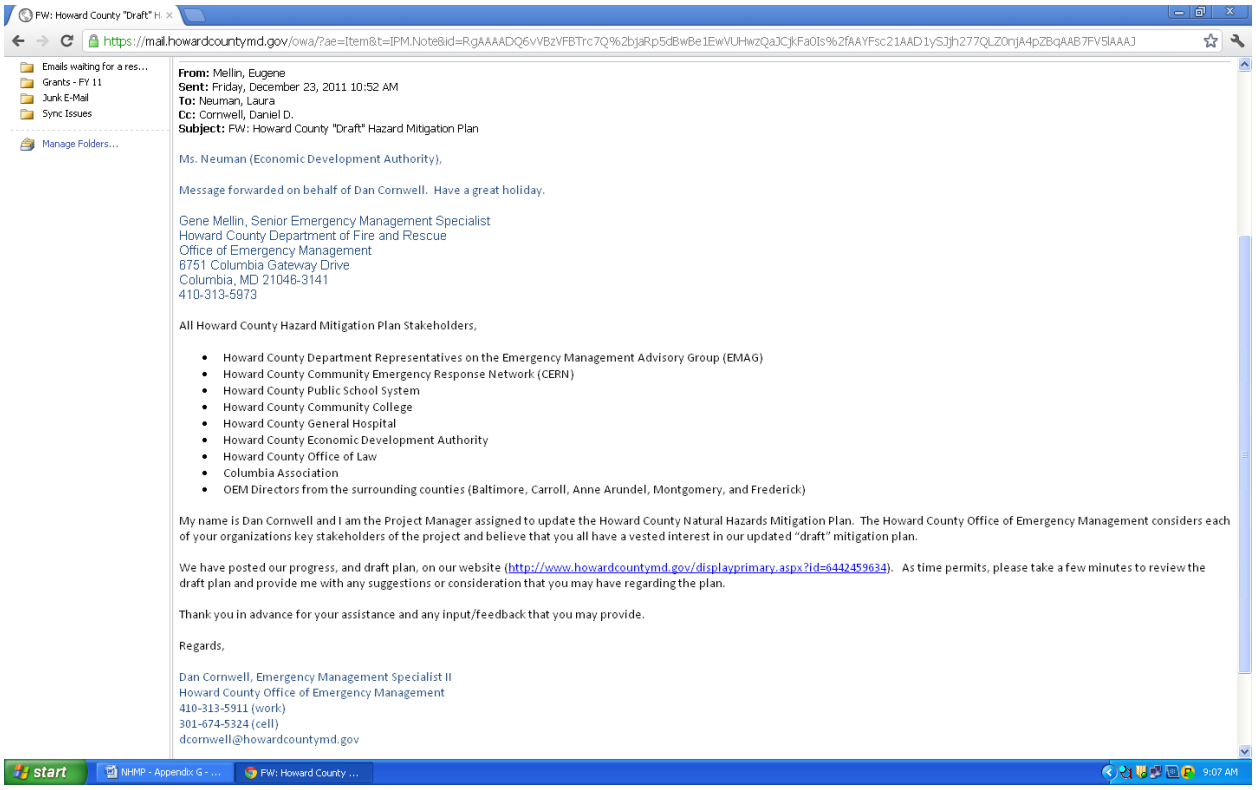
Regards,

Dan Cornwell, Emergency Management Specialist II
Howard County Office of Emergency Management
410-313-5911 (work)
301-674-5324 (cell)
dcornwell@howardcountymd.gov

"Our best first responder is a prepared community."

Connected to Microsoft Exchange

start | RE: Howard County "... | NHMP - Appendix G - ... | 1:05 PM



FW: Howard County "Draft" Hazard Mitigation Plan

https://mail.howardcountymd.gov/owa/?ae=Item&t=IPM.Note&id=RgAAAADQ6vVBzVFBTrc7Q%2bjaRp5dBwBe1EwVUHwzQaJCjkFa0Is%2fAAYFsc21AAD1ySJjh277QLZOnjA4pZBqAAB7FV5lAAAJ

Emails waiting for a res...
Grants - FY 11
Junk E-Mail
Sync Issues

Manage Folders...

From: Mellin, Eugene
Sent: Friday, December 23, 2011 10:52 AM
To: Neuman, Laura
Cc: Cornwell, Daniel D.
Subject: FW: Howard County "Draft" Hazard Mitigation Plan

Ms. Neuman (Economic Development Authority),

Message forwarded on behalf of Dan Cornwell. Have a great holiday.

Gene Mellin, Senior Emergency Management Specialist
Howard County Department of Fire and Rescue
Office of Emergency Management
6751 Columbia Gateway Drive
Columbia, MD 21046-3141
410-313-5973

All Howard County Hazard Mitigation Plan Stakeholders,

- Howard County Department Representatives on the Emergency Management Advisory Group (EMAG)
- Howard County Community Emergency Response Network (CERN)
- Howard County Public School System
- Howard County Community College
- Howard County General Hospital
- Howard County Economic Development Authority
- Howard County Office of Law
- Columbia Association
- OEM Directors from the surrounding counties (Baltimore, Carroll, Anne Arundel, Montgomery, and Frederick)

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Thank you in advance for your assistance and any input/feedback that you may provide.

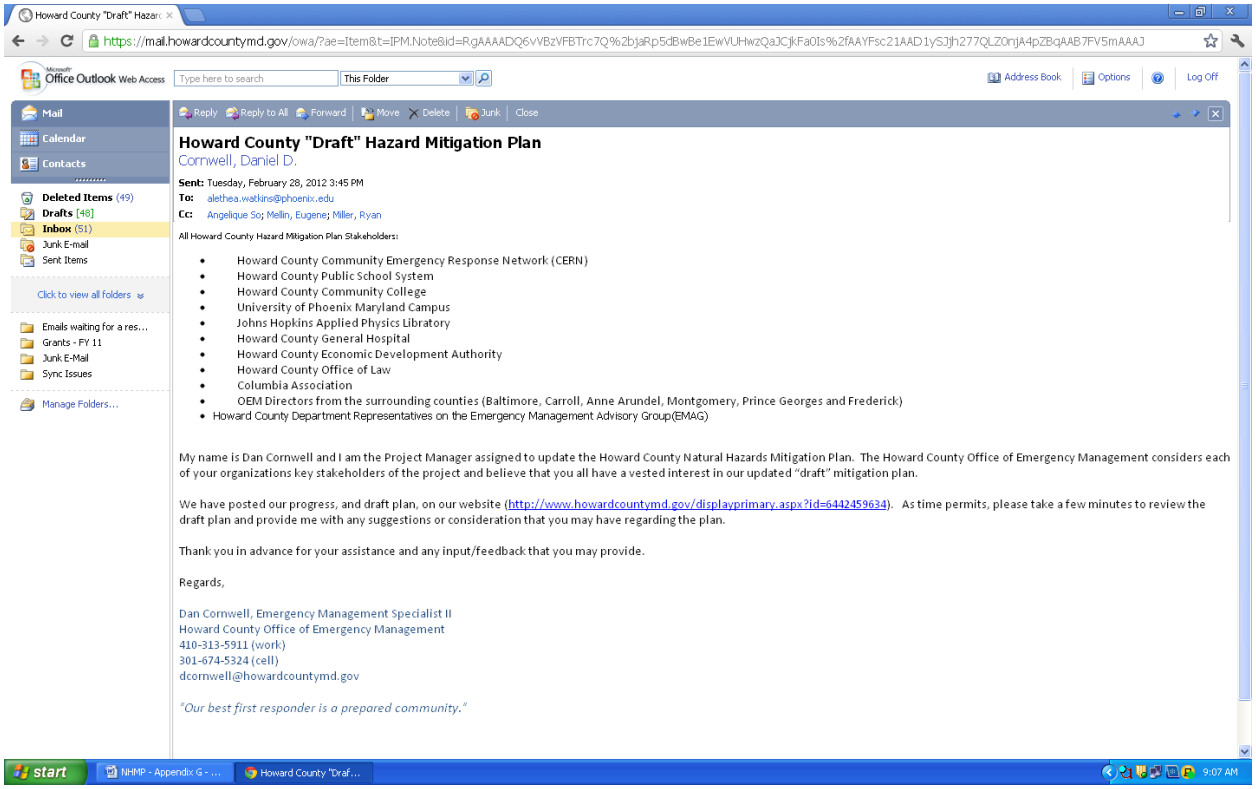
Regards,

Dan Cornwell, Emergency Management Specialist II
Howard County Office of Emergency Management
410-313-5911 (work)
301-674-5324 (cell)
dcornwell@howardcountymd.gov

start | NHMP - Appendix G - ... | FW: Howard County ... | 9:07 AM

Appendix G

Engaging Stakeholders



Howard County "Draft" Hazard Mitigation Plan

Cornwell, Daniel D.

Sent: Tuesday, February 28, 2012 3:45 PM
To: alethea.watkins@phoenix.edu
Cc: Angelique So; Mellin, Eugene; Miller, Ryan

All Howard County Hazard Mitigation Plan Stakeholders:

- Howard County Community Emergency Response Network (CERN)
- Howard County Public School System
- Howard County Community College
- University of Phoenix Maryland Campus
- Johns Hopkins Applied Physics Library
- Howard County General Hospital
- Howard County Economic Development Authority
- Howard County Office of Law
- Columbia Association
- OEM Directors from the surrounding counties (Baltimore, Carroll, Anne Arundel, Montgomery, Prince Georges and Frederick)
- Howard County Department Representatives on the Emergency Management Advisory Group(EMAG)

My name is Dan Cornwell and I am the Project Manager assigned to update the Howard County Natural Hazards Mitigation Plan. The Howard County Office of Emergency Management considers each of your organizations key stakeholders of the project and believe that you all have a vested interest in our updated "draft" mitigation plan.

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Thank you in advance for your assistance and any input/feedback that you may provide.

Regards,

Dan Cornwell, Emergency Management Specialist II
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301-674-5324 (cell)
dcornwell@howardcountymd.gov

"Our best first responder is a prepared community."

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
1	1a	Incorporate the results of any new flood studies into the new Digital Flood Insurance Rate Maps (DFIRMs).	5.3	3.4	5	13.7	Medium	1-2 years
2	1b	Reconcile the new DFIRM data with the flood data in this Flood Mitigation Plan.	5.3	3.4	4.6	13.3	Medium	1-2 years
3	1c	Prepare new hydrology and hydraulic studies for the Patuxent and Patapsco areas.	5.3	3.4	4.6	13.3	Medium	5-10 years
4	2	Consider integration of the comprehensive plan with flood and other all-hazard mitigation plans. During the next update of the comprehensive plan, encourage emergency planners and comprehensive planning staff from DPZ to work together to cross reference goals and objectives and actions between the Comprehensive Plan and the Flood Mitigation Plan to ensure that flood issues are addressed in the Comprehensive Plan.	4.6	3.8	5	13.4	Medium	1-2 years
5	3	Continue to encourage various land planning techniques such as cluster development and transfer of development rights to provide flexibility in design and conserve common open space.	4.3	3.8	5	13.1	Medium	1-2 years
6	4	Work with DPZ to examine 'inbuilding' within any area upstream that would contribute to additional flooding in a flood-prone neighborhood and clear cutting of trees on these properties in areas such as Columbia Hills at the Intersection of Routes 29 and 108 and the intersection of Sybert and Meadowbrook.	**5**	3.8	5	13.8	Medium	1-2 years

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
8	6a	Encourage the Flood Mitigation Steering Committee (comprised of staff from DPW, DPZ, OEM, Transportation, etc.) to meet on a quarterly basis to discuss growing concerns, upcoming plans, and issues as identified by the constituent groups.	3.8	4.2	5	13	Low	Continuous
9	6b	Encourage participation of representatives from the population centers at these quarterly meetings, particularly homeowners associations and Columbia Association so they deal with citizens' flood-related concerns and develop remedies and solutions.	3.3	4.2	5	12.5	Low	1-2 years
10	6c	Participate in regular regional meetings with Carroll and Baltimore Counties to address regional flood mitigation issues.	3.8	4.2	5	13	Low	1-2 years
11	7a	Identify the "at-risk" that are prone to damage during flooding and conduct a survey of these properties. Collect the following data for each "at-risk" property using the National Flood Mitigation Data Collection Tool, FEMA 497 (also referred to as the National Tool or NT): structure type and condition, foundation type, number of stories, building size, depth of flooding, occurrence of flash flooding, flood velocity, location of the structure in the floodway, and method of notification during a flood event.	8	3.8	3	14.8	Medium	3-5 years
12	7b	Develop a database of properties that have been relocated, acquired, elevated, or flood-proofed. Ensure that the database has up-to-date information on address, ownership, mitigation technique, date, and status.	6.3	4.2	5	15.5	High	1-2 years
13	8a	Develop appropriate mitigation solutions for High Road Academy School	8	3.4	5	16.4	High	3-5 years

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
15	9	Consider structural hardening of the facilities on higher ground so they can serve as shelters during flood and wind events.	7.6	2.2	1	10.8	Low	5-10 years
16	10a	Introduce a Community Notification System (phone, email, and self-registration) that encompasses the southeastern part of the county near the viaduct as well as residents in flood-prone areas.	8	3	3.4	14.4	Medium	1-2 years
17	10b	Consider replacing the Dialogic System with a better emergency notification system.	7.2	3	3	13.2	Medium	1-2 years
18	10c	Improve flood modeling system and capabilities to better predict crest height and timing.	6.5	2.6	1	10.1	Low	5-10 years
19	11a	Create a rating system to rate the degree of flashflood threat and enhance the current warning system based on the flashflood threat.	8	4.2	4.7	16.9	High	1-2 years
20	11b	Develop signage on roads that frequently flood to warn residents and commuters of the potential flood hazard.	6	5	3	14	Medium	1-2 years
21	12	Monitor an ongoing engineering study to identify mitigation alternatives such as elevation, barrier wall, elevating equipment, etc., for the wastewater treatment plant and pumping stations.	5.6	1.8	2.7	10.1	Low	1-2 years
22	13a	Continue to implement the dam inspection program for the regular maintenance of all dams in the county.	8.2	4.6	4.6	17.4	High	Continuous
23	13b	Coordinate with the Bureau of Engineering to assist with inspections of bridges and dams to ensure integrity is maintained in the event of a flood.	8.2	4.6	4.6	17.4	High	Continuous
24	14	Continue to support the study of non-functioning dams on Patapsco River and remove those that are non-functioning and restore the environment.	4	4.6	5	13.6	Medium	Continuous

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
26	16	Coordinate with the Public Works Department in Prince George's County to develop a mitigation solution.	4.5	4.3	5	13.8	Medium	1-2 years
27	17a	Continue to implement low impact development techniques , environmental site design, and best management practices to manage storm water to increase the amount of pervious surfaces by incorporating innovative methods including bio-retention areas, dry wells, infiltration trenches, filter/buffer strips, vegetated swales, where appropriate.	5.3	4.2	5	14.5	Medium	Continuous
28	17b	Develop incentives to promote green infrastructure concepts for storm water retention on private properties and promote the use of landscaping, rain gardens, rain barrels, etc., to retain water longer on properties.	5.3	3.8	5	14.1	Medium	1-2 years
29	18	Develop incentives to resolve storm water management issues at Old Columbia Road and other problem areas in the county and work with individual property owners to develop mitigation solutions.	5.7	3.8	4.7	14.2	Medium	1-2 years
30	19a	Continue to implement the County tree planting program, examine the stream network to identify areas for more opportunities to plant trees and explore the tree canopy goal.	4.4	5.8	5	15.2	High	Continuous
31	19b	Continue to enforce the Road Tree Law (to do no harm to existing trees on the boulevard).	4.4	5.8	5	15.2	High	Continuous
32	20a	Work with the Department of Natural Resources on watershed management issues and for periodic removal of debris.	5.3	3.4	5	13.7	Medium	1-2 years

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
34	21a	Continue to ensure that the libraries in the County are stocked with flood protection publications.	2.3	3.8	3.3	9.4	Low	Continuous
35	21b	Introduce natural hazards awareness programs in schools.	2.3	3.8	3.3	12.1	Low	Continuous
36	21c	Coordinate with OEM to make flood information available (via annual informational mailings to residents in the floodplain; pamphlet) to the citizens via the County's Public Information Officer to be utilized during flood events. Continue to distribute pamphlets in advance to inform citizens on how to prepare for potential flood events and to business owners on protecting inventory from flooding.	5	3.8	3.3	12.1	Low	Continuous
37	22a	Include the following information: flood and hazard data, safety precautions and emergency procedures, flood mitigation options, and sources of funding. Also include flood-related articles and success stories in the County newsletter.	4.8	3.8	5	13.6	Medium	1-2 years
38	22b	See http://www.fema.gov/plan/prevent/floodplain/publications.shtm for a detailed listing of flood-related publications and include this link on the County's webpage.	4.8	3.8	5	13.6	Medium	1-2 years
39	22c	Once they are completed, make DFIRMS available on the County's website that allows users to determine their flood zone and other property information as well as aerial photographs.	4.8	3.8	5	13.6	Medium	1-2 years

Appendix H

2011 Flood Mitigation Plan - Mitigation Actions

No.	Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Priority	Timeline
41	23b	Educate and make County staff available for on-site consultation as needed.	5	3.8	5	13.8	Medium	1-2 years
42	24	Continue to implement mitigation actions from the Flood Mitigation Plan and strive to move up to a Class 6 community where residents can obtain a 20 percent reduction in flood insurance premiums.	5.7	3.4	5	14.1	Medium	Continuous
43	25	When DFIRMs become available, provide training of the use of DFIRMs to stakeholder groups including planners, engineers, realtors, and community leaders.	2.5	3.8	5	11.3	Low	1-2 years
44	26a	Work with the Flood Mitigation Plan Steering Committee and members of the public who are interested in flood-related issues to implement this plan and review its progress.	6.2	4.2	5	15.4	High	Continuous
45	26b	Meet every six months to review projects that have been completed, altered, or are no longer applicable.	5.9	4.2	5	15.1	High	Continuous
46	26c	Update the Flood Mitigation Plan every five years and after a flood event.	5.9	4.2	5	15.1	High	Continuous
47	26d	Integrate this Plan into the All-Hazard Mitigation Plan as an annex.	6.2	4.2	5	15.4	High	Continuous

Appendix I

FEMA's Letter of Approvability

[Will Insert upon Receipt]

Appendix J

Adoption Resolution for Howard County

County Council Of Howard County, Maryland

2013 Legislative Session Legislative Day No. _____

Resolution No._____-2013

Introduced by: The Chairperson at the request of the County Executive

A RESOLUTION adopting the Howard County Natural Hazards Mitigation Plan.

Introduced and read first time _____, 2013.

By order _____
Stephen LeGendre, Administrator

Read for a second time at a public hearing on _____, 2013.

By order _____
Stephen LeGendre, Administrator

This Resolution was read the third time and was Adopted___, Adopted with amendments___, Failed___, Withdrawn___, by the County Council on _____, 2013.

Certified By _____
Stephen LeGendre, Administrator

NOTE: text in strike-out indicates deletions from existing law; TEXT IN SMALL CAPITALS indicates additions to existing law; Double strike-out indicates material deleted by amendment; Underlining indicates material added by amendment.

Appendix J

Adoption Resolution for Howard County

WHEREAS, the County Council of Howard County, Maryland, recognizes that natural hazards are common occurrences throughout the region and cause significant property damage and loss of life; and

WHEREAS, by passage of County Council Resolution No. 112-2004, the County took proactive measures to reduce the impact of these hazards by adopting the first Natural Hazards Mitigation Plan (NHMP); and

WHEREAS, the County remains committed to the mitigation of natural hazards through the concerted efforts of Howard County departments, government partners, and community members; and

WHEREAS, the Howard County Office of Emergency Management (OEM) received Federal Emergency Management Agency (FEMA) grant funds to revise the NHMP and that grant, along with in-kind grant funds from the County, enabled the County to complete the plan update; and

WHEREAS, OEM and the Natural Hazard Mitigation Update Steering Committee have updated the NHMP consistent with a federally mandated planning process; and

WHEREAS, the NHMP articulates a comprehensive strategy for implementing technically feasible mitigation activities for the area affected by natural hazards; and

WHEREAS, adoption of the NHMP will make the County eligible for future Federal and State grants to implement the NHMP's recommendations, if and when funds become available; and

WHEREAS, the County Executive recommends that the NHMP be adopted by the County Council.

Appendix J

Adoption Resolution for Howard County

NOW, THEREFORE, BE IT RESOLVED by the County Council of Howard County, Maryland this ____ day of _____ 2013 that the effort to become more disaster resistant is deemed worthy of support, and that the Howard County Natural Hazards Mitigation Plan prepared by the Howard County Office of Emergency Management, attached and incorporated by reference, is adopted.

Appendix K

FEMA's Final Letter of Approval

[Will Insert upon Receipt]

Appendix L

Key Terms

For the most part, terms used in the 2012 NHMP have the meanings that are commonly associated with them:

- **Disaster** means the occurrence of widespread or severe damage, injury, loss of life or property, or such severe economic or social disruption that supplemental disaster relief assistance is necessary for the affected political jurisdiction(s) to recover and to alleviate the damage, loss, hardship, or suffering caused thereby.
- **Federal Emergency Management Agency (FEMA)** coordinates the federal government's efforts to plan for, respond to, recover from, and mitigate the effects of natural and man-made hazards.
- **Flood Insurance Rate Map (FIRM)** is prepared by the Federal Emergency Management Agency to show Special Flood Hazard Areas.
- **Floodplain:** See "Special Flood Hazard Area (SFHA)" below.
- **Hazard** is defined as the natural or technological phenomenon, event, or physical condition that has the potential to cause property damage, infrastructure damage, other physical losses, and injuries and fatalities.
- **Mitigation** is defined as actions taken to reduce or eliminate the long-term risk to life and property from hazards. Mitigation actions are intended to reduce the *need* for emergency response – as opposed to improving the *ability* to respond.
- **National Flood Insurance Program (NFIP),** located within FEMA, is charged with preparing FIRMs, developing regulations to guide development, and providing insurance for flood damage.
- **Risk** is defined as the potential losses associated with a hazard. Ideally, risk is defined in terms of expected probability and frequency of the hazard occurring, people and property exposed, and potential consequences.
- **Special Flood Hazard Area (SFHA)** or **Floodplain** is the area adjoining a river, stream, shoreline, or other body of water that is subject to partial or complete inundation. The SFHA is the area predicted to flood during the 1% annual chance flood, commonly called the "100-year" flood.

Appendix M
Department Acronyms

The following department acronyms are used in the document:

- **DCS** – Department of Citizen Services
- **DFRS** – Department of Fire and Rescue Services
- **DILP** – Department of Inspection, Licenses and Permits
- **DPW** – Department of Public Works
- **DPZ**– Department of Planning and Zoning
- **DTCS** – Department of Technology and Communication Services
- **HD** – Health Department
- **OEM** – Office of Emergency Management
- **HCPD** – Police Department
- **PIO** – Public Information Office