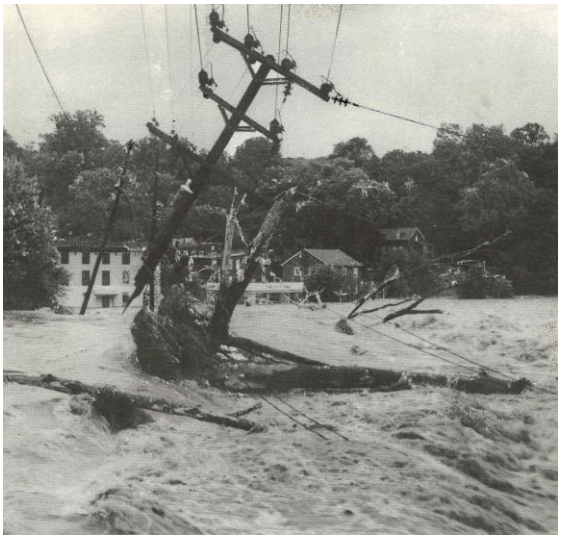
Flood Mitigation Plan
Howard County, Maryland



Prepared for:

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Acknowledgments

This Flood Hazard Mitigation Plan was prepared under the guidance of the County's Department of Public Works and the Flood Mitigation Plan Steering Committee. The members of the Steering Committee are listed in Chapter 1.

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CHAPTER 1: INTRODUCTION

Background

Floods are a common occurrence throughout the United States. In the Federal Emergency Management Agency (FEMA) document, "Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy," it is estimated that over 9 million households and $390 billion in property are at risk from flooding in the United States. Floods result from large-scale weather systems that generate rainfall or on-shore winds for prolonged periods. Other causes of flooding include local thunderstorms, snowmelt, ice jams, and dam failures. Flash-floods are characterized by high velocity waters that carry large amounts of debris.

Over the years, communities have taken proactive measures to reduce the impact of flooding and the damage caused by it to residents and structures. In March 2008, the Howard County Office of Emergency Management received funding from FEMA through the Flood Mitigation Assistance (FMA) grant for the development of a Flood Mitigation Plan for the County. The purpose of the Plan was to address flood hazards that threatened the health and welfare of Howard County and develop actions to mitigate the effects of flooding.

In June 2010, the County hired consultants Deepa Srinivasan, President of Vision Planning & Consulting, and Dr. Michael Scott, Director of the Eastern Shore Regional GIS Cooperative at Salisbury University to assist the County with the preparation of their Flood Mitigation Plan.

The Plan's overarching goal of this project was to *"develop a Flood Mitigation Plan for Howard County to improve resistance to floods by planning and undertaking hazard mitigation strategies before floods strike.*"

Study Area

Howard County is located in central Maryland approximately halfway between Washington, D.C. and Baltimore, Maryland. The County is the only one in the state that is surrounded by other Maryland counties, namely Frederick County, Carroll County, Baltimore County, Anne Arundel County, Prince George's County, and Montgomery County. There are no incorporated towns in the County. There are a number of identified communities and neighborhoods including Columbia, Elkridge, Ellicott City, Lisbon, Savage, and West Friendship. In 2000, the population of Howard County was 247,842[1], and the total number of households was 90,043.

Howard County has a generally mild climate with four distinct seasons, low humidity, and mild temperatures. On average, 45.3 inches of precipitation fall annually. Snowfall averages 20.9 inches annually. [2] The Maryland Piedmont region contains Howard County with the topography being consistently rolling hills. The entire county falls into either the Patapsco Watershed (to the north) or the Patuxent Watershed (to the south). The elevation ranges between 20 and 873 feet above sea level throughout the County.

[1] US 2000 Census of Population and Housing
[2] Maryland State Office of Climatology

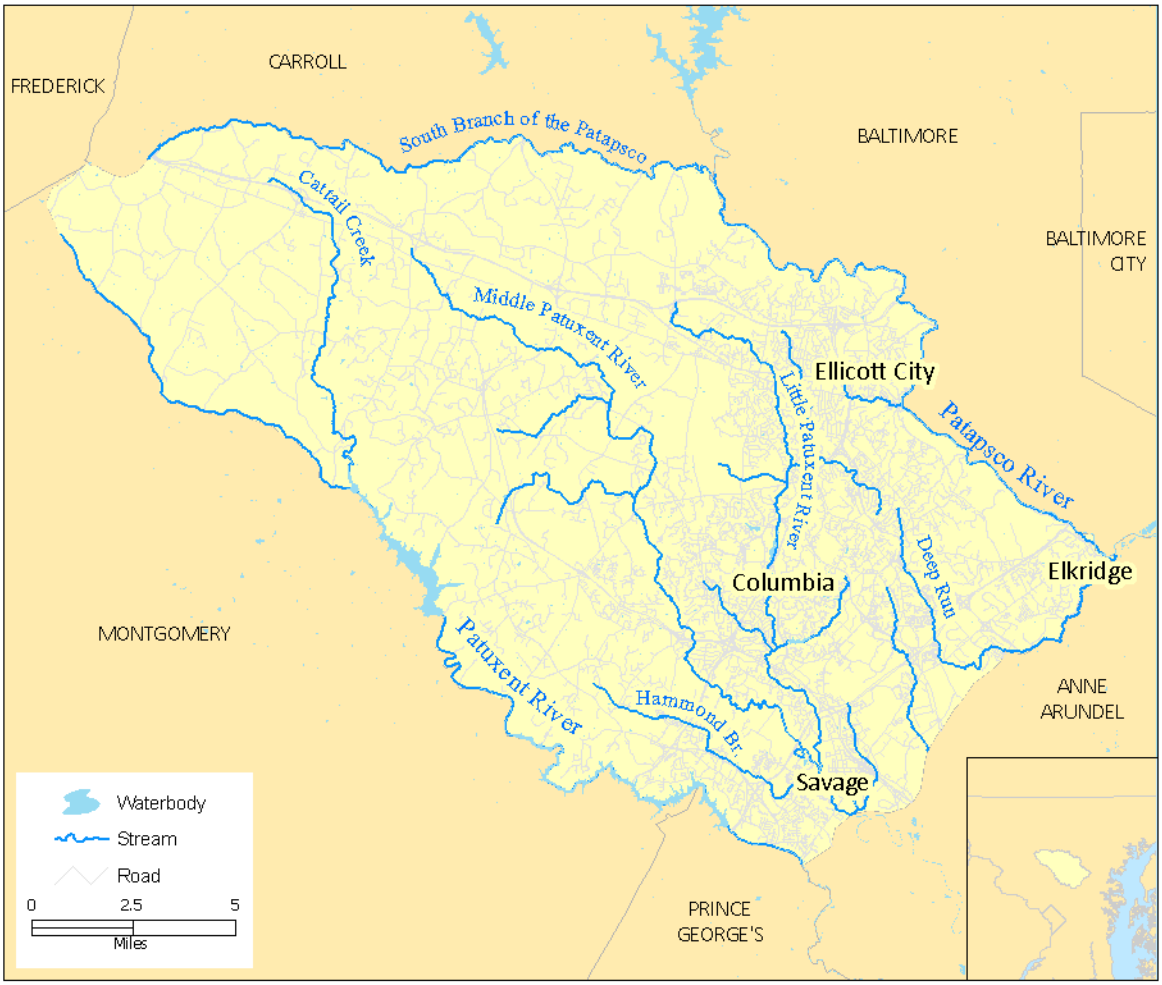
In Howard County, the flood origins consist of riverine flooding from the tributaries of the Patuxent River bordering Prince George's and Montgomery Counties to the southwest and the Patapsco River bordering Carroll and Baltimore County to the north and northeast, as well as many streams and rivers in between. These include the Little Patuxent River, the Middle Patuxent River, Cattail Creek, Deep Run, Dorsey Run, Bonnie Branch, Plumtree Branch, Guilford Branch, Hammond Branch, Clyde's Branch, Tiber-Hudson Branch, and many others (Figure 1.2).

Figure 1.1 Regional context of the study area

Flooding History

Howard County has had numerous incidents of flooding, including a couple major events such as Tropical Storm Agnes in 1972, Hurricane Eloise in 1975, and Hurricane Floyd in 1999. Most incidents are the result of tropical systems, nor'easters, and flash flooding from sudden, short-lived rainstorms. Many references were found for Howard County when researching the history of floods in the region, and it is reasonable to assume that this is just a selection of flood events. The sources for these flood history narratives include the Flood Insurance Study for Howard County and the National Climatic Data Center who maintains a national database of storm events, including flooding, from 1950 to 2008. A search of that database yielded 39 flood events in Howard County, beginning in 1996.

Figure 1.2 Flooding sources and study area context



March 5 – 7, 1965 – Snowstorm
1 to 2 inches of rain during the day followed by 5 inches of snow overnight caused the flooding of some roads and cellars.

July 22 – 23, 1969 – Thunderstorm
1.42 inches of rain flooded a quarter mile portion of Fells Lane in Ellicott City after overflowing drainage ditches. Several homes were evacuated and a hilltop housing project was flooded for the third time.

August 1 – 4, 1971 – Heavy Rain
Heavy rain flooded several areas causing the closing of numerous roads and damage to a number of homes. The Patuxent River rose 25 feet in 30 minutes and mud slides damaged roads and bridges. Roads 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 $110,000 in county property damage occurred.

September 11 – 12, 1971 – Heavy Rain
Heavy rain caused an estimated $150,000 in damage to county property, blocked roads in 39 places, damaged seven bridges, and damaged numerous private properties. The most severe damage was along the Patapsco River. To this point, the county had received 49.22 inches of rainfall for the year, 16.92 inches over the average annual precipitation for the area with 3 months still to go.

June 21 – 23, 1972 – Tropical Storm Agnes
Tropical storm Agnes struck the area with nine inches of rain causing flash floods all over the county. Massive flooding caused at least 3 deaths and bodies were still being found days later. Extensive personal and government property damage occurred as well as the complete flooding of Elkridge and Ellicott City, which had to be evacuated in the middle of the night by boat. Several commercial enterprises including trucking firms, paper producers, chemical plants, and others were completely washed away along the Patapsco River. Howard County became what was called a "veritable island" as bridges were washed away on the Patapsco and Patuxent Rivers. This disaster was so complete that the financial damage could not be estimated in some instances due to the total removal of all traces of property. Many businesses simply did not attempt to reopen.

Figure 1.3 The raging Patapsco River in Ellicott City, June 26, 1972 (source: The Times Newspapers, 1972)

August 19, 1974 – Flash Flood
Afternoon storms dropped 2.2 inches of precipitation on the county causing flash floods and traffic disruption.

September 22 – 26, 1975 – Hurricane Eloise
The remnants of Hurricane Eloise coupled with snow from a previous blizzard totaled over 12 inches of rain in four days. This caused the Patuxent and Patapsco Rivers to overflow up to 24 feet above normal. Much of Ellicott City and Elkridge was again flooded as some businesses had just reopened after recovering from extensive damage from Agnes. The county was declared a disaster zone, mud and debris covered the landscape, and homes and businesses were condemned.

December 31, 1975 – Rain and Melting Snow
The new year turned what had been snow into rain. The combination of melting snow and heavy precipitation caused streams and rivers to overflow flooding roads and homes. The Weather Service reported 2.37 inches of rain overnight.

January 26, 1978 – Melting Snow
A storm dumped 1.3 inches of precipitation while warm temperatures melted snow. Some minor road flooding occurred, basements flooded, and storm drains were clogged.

February 24, 1979 – Rain
Steady rain over a period of 48 hours combined with melting snow cause the flooding of some waterways and road closures. Rain measurements ranged from 1.5 to 2 inches.

January 19 – 22, 1996 – Melting Snow
Precipitation occurred and snow and ice quickly melted as temperatures rose into the 60's. Flooding occurred that caused the closing of 24 roads in Howard County including U.S. 29 near Columbia Town Center.

June 19, 1996 – Storms
Storms dumped 5.5 inches of rain on the area flooding roads, bridges, and properties. Seneca Creek and Bennett Creek overflowed their banks and several roads were temporarily closed. Two deaths occurred when a couple rafting in the Patapsco was swept over a dam in the raging current. $60,000 in property damage was reported.

July 30, 1996 – Heavy Rain
Torrential rain flooded Highway 1 near Elkridge washing away parts of the shoulder.

September 6, 1996 – Hurricane Fran
The remnants of Hurricane Fran dumped up to 5 inches of rain on parts of the area and caused damage with 40 mph sustained winds. Minor flooding occurred, 36,300 residents of Howard County lost power, and $25,000 of property damage was recorded.

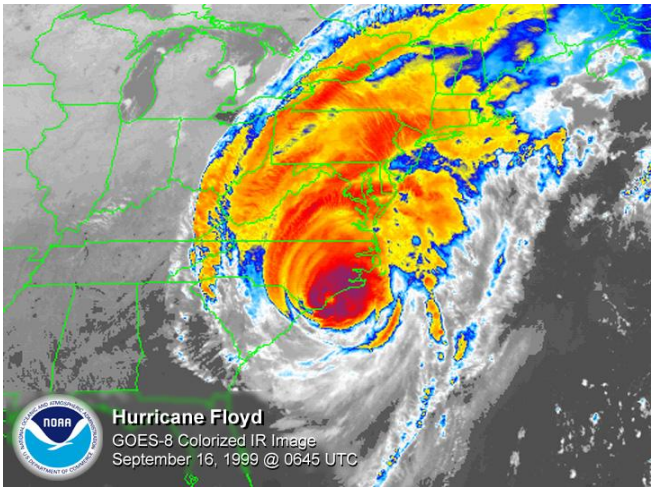
November 8, 1996 – Heavy Rain
A cold front pushed tropical moisture in front of it causing 1.5 – 3 inches of precipitation. Sporadic flash flooding occurred in low lying areas when creeks and streams overflowed. Several roads were closed in western Howard County including Highway 1 in Beltsville.

December 13, 1996 – Heavy Rain
Several days of rainfall, including 2.66 inches on this day, led to overflowing streams, flooded roads, and power outages. This was the third wettest year for Maryland since 1871 with a total of 57.52 inches to this point in time. $10,000 of property damage was reported.

September 9, 1999 – Thunderstorms
Thunderstorms moved through the area producing damaging winds and heavy rainfall across the county. Flooding occurred in Ellicott City, Dorsey, Columbia, and Elkridge. Portions of Highway 1 flooded and cars were stuck in hood depth water. Homes near Columbia and Dorsey were surrounded by water. Precipitation measurements included 7.39 inches near Columbia and 5.98 inches near Elkridge.

September 16, 1999 – Hurricane Floyd
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 that overflowed its banks in Ellicott City. Rainfall measurements of 2 to 5 inches were reported for the day. County officials reported 350 flooded basements, 2 rescues, and the country fair was shut down for the first time in its 47 year history. In addition, 17 homes reported major damage, 26 reported minor damage.

Figure 1.4 Hurricane Floyd; September 1999 (Source: NOAA)



June 22, 2001 – Thunderstorms
Thunderstorms developed east of the Appalachian Mountains and moved very slowly east. Rainfall measurements around 5 inches were recorded in the area. Flash flooding occurred in many roadways as streams overflowed and drivers had to be evacuated from their cars. North Trotter Road was washed out and a mudslide damaged Marriottsville Road in Ellicott City.

August 11, 2001 – Thunderstorms
Flooding was caused by heavy rain from thunderstorms moving through the area. Parts of Route 29, six roads in the Elkridge area, and three roads in the Ellicott City area were closed as streams flooded and motorists became stranded in rising water.

August 30, 2001 – Thunderstorms
In an unusual weather event, precipitation hovered over western Maryland causing 3 inches of rain in an hour. The Patapsco River overflowed causing the temporary closing of U.S. 1 and other roads. Seven basements flooded.

February 22, 2003 – Melting Snow
Widespread flooding was caused by melting snow from the snowstorm of February 14 – 18th and 1.5 to 3 inches of rain on the 22nd. Several roads were closed including Route 108, Race Road, Furnace Avenue, Triadelphia Mill Road, and Toll House Road. 30 basements were flooded.

June 7 - 20, 2003 – Rain
Roads and waterways flooded off and on for nearly two weeks as precipitation systems constantly moved across the region. River and stream levels remained 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.

September 23, 2003 – Rain
After dodging a flooding bullet from Hurricane Isabel days before, 2.5 inches of rain in one day caused some flooding as the already soaked ground could not absorb it.

November 19, 2003 – Thunderstorms
Several roads were closed due to flooding when a line of severe thunderstorms moved across the area. Rainfall measurements ranged from 2 to 4 inches.

December 11, 2003 – Rain
Heavy overnight rainfall averaging 2 to 3 inches fell on snow covered grounds and caused melting. This led to heightening of rivers and streams and closing of roads due to rising water.

February 6, 2004 – Rain and Snow
Freezing rain accumulated on the ground until a warm front moved in during the afternoon. As the warm front moved in, frozen rain on the ground warmed and flooded the streams and rivers of the county.

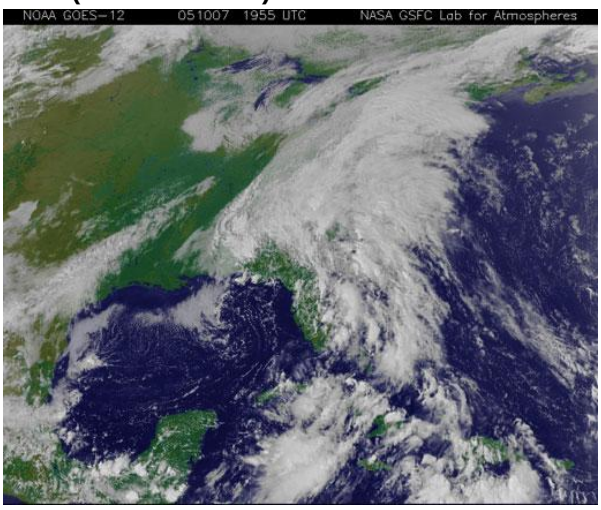
August 12, 2004 – Hurricane Charley
Though the storm was downgraded from tropical storm status as it moved into the area, many streets and roads were closed due to flooding.

April 2, 2005 – Thunderstorms
A cold front brought downpours from severe thunderstorms that flooded rivers, streams, and roadways.

June 9, 2005 – Thunderstorm
Downpour from a thunderstorm produced flash flooding at the intersection of Florence Road and Shaffersville Road along Cabin Branch. Roads near Lisbon were closed and a water rescue took place.

July 7, 2005 – Tropical Storm Cindy
Remnants of Tropical Storm Cindy moved across the region causing flash flooding and road closures. Rainfall estimates ranged from 2 to 4 inches.

Figure 1.5 Tropical Storm Tammy; October 7, 2005 (Source: NASA)



October 8, 2005 – Tropical Storm Tammy
Remnants of Tropical Storm Tammy caused prolonged heavy rainfall that measured 7 inches in two days. This broke the two day record for the region and totaled more than the average for the whole month of October. Ten roads in the county were flooded, two homes were flooded with mud, and a water rescue was needed in Ellicott City.

June 23 – 26, 2006 – Storm System
A storm system from the south caused torrential rain that continued for four days. The ground was saturated and low lying areas flooded as the area received more than 10 inches of rain. A storm surge of 2 to 3 feet combined with the flooding to wash away part of Vollmerhausen Road Bridge and forced the closing of minor roads. Main Street in Ellicott City flooded and a sewer line broke.

November 16, 2006 - Rain
A strong cold front passed across the region bringing heavy rainfall and thunderstorms. Route 32, River Road, and other minor roads were closed as waterways rose out of their banks.

April 15, 2007 – Nor'easter

A Nor'easter impacted the area bringing heavy rain that caused flooding in the evening and afternoon. Brock Ridge Road flooded southeast of Savage as the Little Patuxent River flowed over its banks.

May 12, 2008 – Thunderstorms
A potent storm system moved across the region bringing thunderstorms and widespread heavy rain. Stoney Run overflowed leaving Furnace Avenue under 2 feet of water.

July 23, 2008 – Rain
A slow moving cold front produced waves of heavy showers in the afternoon and evening. Flash flooding occurred causing several road closures including I-95 near Elkridge.

March 13, 2010 – Rain
A slow moving southerly low pressure system produced heavy rainfall. 2 to 4 inches of rainfall combined with already saturated conditions from snowmelt to produce flooding that closed some roads.

Plan Objectives

This Flood Mitigation Plan for the County fulfills the following objectives:

- It is consistent with the requirements of the 44 Code of Federal Regulations part 78.5 - Flood Mitigation Plan Development in accordance with the National Flood Insurance Act of 1968 (42 U.S.C. 4104c et seq.);
- It conforms to all pertinent criteria and regulations, including those found in applicable state and local ordinances and NFIP requirements;
- It identifies risks from flood and mitigation strategies for Howard County and its two municipalities;
- It helps reduce the risk of loss of life, personal injury and property damage to the County's residences and businesses; and
- It will be submitted to MEMA and FEMA for approval, opening the way for future federal funding of flood mitigation projects.

Planning Approach

The Flood Mitigation Plan for Howard County has been developed in compliance by the 44 Code of Federal Regulations (CFR) 78.5 Flood Mitigation Plan Requirements. This Plan:

- Describes the planning process;
- Describes public involvement;
- Includes existing flood risk;
- Includes the number of estimated structures in floodplain;
- Identifies repetitive loss structures;
- Identifies the extent of flood depth and damage potential;
- Discusses floodplain management goals;
- Identifies and evaluates feasible mitigation actions;
- Presents a strategy for reducing flood risks;
- Provides a strategy for continued compliance with NFIP;
- Describes procedures for ensuring implementation, reviewing progress, and making revisions; and
- Provides documentation of Plan by legal authority.

Flood Mitigation Plan Participants

The planning process involved a number of entities at the local, state, and Federal level:

- Hazard Mitigation Steering Committee members (Howard County staff and residents) – attendance at meetings and review of plan materials;
- Consultants – Vision Planning and Consulting, and Eastern Shore Regional GIS Cooperative – assessment of flood risk, development of mitigation actions, plan preparation and meeting facilitation;
- Public – plan input
- Maryland Emergency Management Agency (MEMA) – plan review and approval
- Federal Emergency Management Agency (FEMA) – project funding and plan review and approval.

Hazard Mitigation Steering Committee

A Hazard Mitigation Steering Committee (HMSC) was formed to serve as the committee for this planning process. The HMSC members participated in all committee meetings, and provided input on the issues to the consultants. Table 1.1 lists the members of the Hazard Mitigation Steering Committee and the agencies they represent.

Table 1.1 Hazard Mitigation Steering Committee members

Name	Agency
Lindsay DeMarzo	Planning and Zoning/ OES
Chad Edmondson	Planning and Zoning/ DED
Jessica James	Rockburn Institute
Brad Killian	Planning and Zoning/DCCP
Jim Koehnlein	Wilkins- Rogers Inc.
Ed Lilley	Tourism
Bill Malone	Public Works
Dustin Mariman	Wilkins- Rogers Inc.
Betsy McMillion	Patapsco Heritage Greenway
Tom McNeal	Emergency Management
Gene Mellin	Emergency Management
Robin Melton	MDDNR - Patapsco
Don Mock	Inspections, Licenses, and Permits
Angela Morales	Public Works
Samuel H Rogers	Wilkins- Rogers Inc.
Howard Saltzman	Public Works
Diane Schwarzman	Public Works
Dale Schumacher	Rockburn Institute
Ed Schilling	Fire and Rescue
Michael Scott	Consultant - ESRGC/Salisbury Univ.
John Seefried	Public Works, CID

Deepa Srinivasan	Consultant - Vision Planning
Bryan Yanchetz	Resident

Planning Process

The planning process comprised of four main steps: 1) organizing work group and process; 2) assessing the flood hazard, vulnerability, and mitigation capability; 3) developing a mitigation plan; and 4) implementing the plan. These steps are elaborated in the sections below.

Step 1 – Organize work group and process

A Hazard Mitigation Steering Committee was formed by the County's Department of Public Works that included staff representatives from various County agencies, and stakeholders from the flood-prone areas. The Consultants worked closely with the Hazard Mitigation Steering Committee and met with them four times during the planning process.

The first Steering Committee meeting was held on 22 June 2010 at the County Gateway Building in Columbia. At this meeting, the planning process, key elements of the Plan, schedule, and deliverables were discussed. A mitigation capability assessment questionnaire was also distributed to the Steering Committee for input on plans and ordinances and the County's capabilities with respect to flood mitigation.

Figure 1.6 Howard County Flood Mitigation Steering Committee Meeting

The second Steering Committee meeting was held on 21 July 2010 at the County Gateway Building in Columbia. At this meeting, the data on the flood hazard identification was presented; input on the flood risk was solicited; and the data from the hazard vulnerability and risk assessment was discussed.

At the third Steering Committee meeting held on 11 August 2010 at the County Gateway Building in Columbia, the highlights of the mitigation capability assessment were presented and an exercise to develop goals and objectives was conducted. At this meeting, a range of mitigation actions were examined that addressed the Plan's goals. Mitigation alternatives were discussed and prioritized, along with an implementation strategy for each action. A plan maintenance schedule was also developed at this meeting.

Public Involvement

In this planning process, public involvement assumed various forms. First, county residents were encouraged to provide input through representatives on the Steering Committee. Residents in flood-prone areas were also invited to attend meetings and provide their comments and concerns.

Second, public input was solicited at two public meetings during the planning process. The first public meeting was held on 21 July 2010 at the County Gateway Building in Columbia. At this meeting, the planning process and the results of the hazard identification were presented to the public to solicit comment. The group discussed the community's risk to flooding in specific areas

and offered suggestions for mitigation actions. A public notice was published in the *Howard County Times* and the Columbia Flier. Invitation letters were also sent to residents in the floodplain. The meeting included over 50 county residents who provided valuable input on the flood hazard in the county.

The second Public Meeting was held on 11 August 2010 at the County Gateway Building in Columbia. At this meeting, mitigation goals and objectives along with actions were presented to the public for review and discussion. A public notice of this meeting was published in the two local newspapers, the *Howard County Times* and the *Columbia Flier*. Copies of the draft plan were available for review during this meeting. Letters were sent to those residents who attended the July public meeting. The meeting included over 40 County residents who provided valuable comments on the proposed goals and flood mitigation actions for the county.

Figure 1.7 Members of the public in Howard County listen to a presentation by Ms. Srinivasan regarding potential flood mitigation actions

Third, a mitigation capability questionnaire was developed and distributed to the Hazard Mitigation Steering Committee members. The purpose of the questionnaire was to solicit input on critical facilities, existing plans and ordinances and flood-related policies, and mitigation projects that have been implemented in the past as well as the county's technical and staffing capability.

Step 2 – Assess hazards, risks, vulnerability, and mitigation capability

In this step, information on past flood events in the County was gathered and areas where flooding is an issue, were identified. This step also involved a literature review of publications addressing historical flood events, an internet search for data related to historic events, and an inventory and review of the existing GIS layers and other documentation pertinent to the County. The vulnerability analysis 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 Mitigation Capability Assessment included a review and analysis of the County's plans, ordinances, programs, and policies in light of flood mitigation and floodplain management. The flood risk assessment is documented in detail in the next chapter of this report.

Step 3 – Develop a mitigation plan

Based on flood hazard data and the vulnerability and capability assessments, mitigation goals and objectives were developed. These goals were aimed at protecting the community from long-term vulnerability to the identified flood hazards. A comprehensive range of specific mitigation actions and projects to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure, were developed in this step.

The Plan included the following categories for mitigation actions:

- Preventive measures – e.g., zoning, floodplain management, storm water, and other ordinances;
- Structural projects – e.g., levees, reservoirs, channel improvements;
- Property protection measures – e.g., relocation, flood-proofing, flood insurance;
- Emergency services – e.g., warning, event response, evacuation;
- Natural resource protection – e.g., wetlands protection, best management practices; and
- Public information – e.g., outreach projects, technical assistance

Each of these categories is discussed in detail in Chapters 3 through 8 in the report.

Step 4 – Implement the Plan

An Action Plan was developed that described how the mitigation strategies and activities identified would be prioritized, implemented, funded, and administered.

Cost estimates for the recommended projects, where available, and funding sources to implement recommended projects were identified. A description of the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle and also ways to incorporate community participation into the plan maintenance process was included in the final section of the Plan.

Organization of the Report

The Howard County Flood Mitigation Plan is comprised of 10 chapters. Chapter 2 identifies the sources of flooding and assesses the County's vulnerability to flooding; Chapter 3 elaborates on preventive measures; Chapter 4 focuses on property protection techniques; Chapter 5 discusses emergency services; Chapter 6 identifies structural projects; Chapter 7 examines natural resources protection techniques; Chapter 8 identifies options for public outreach. Chapter 9 includes goals and objectives for the plan and includes actions to mitigate the flood hazard. The final chapter determines the ranking and identifies the actions that are of top priority to the County.

CHAPTER 2: PROBLEM DESCRIPTION

Flooding occurs when rivers, creeks, streams, ditches, or other water bodies receive more water that they can handle from rain or snowmelt. The excess water flows over adjacent banks into the adjacent floodplain. As many as 85 percent of the natural hazard disasters across the United States have been attributed to flooding.

This Chapter outlines the scope of Howard County's flooding problems including the sources of flooding, the 100-year flood levels in each of Howard County's waterways, the hazards that could be expected from a flood, and the type and degree of damage a flood could cause. However, the primary focus of this Chapter is to present the results of the flood vulnerability assessment including potential damage amounts, probable locations of flooding in a 100-year event, and an accounting of the critical facilities exposed to the flood hazard.

Sources of Flooding

In Howard County, the flood origins consist of riverine flooding from the tributaries of the Patuxent River bordering Prince George's and Montgomery Counties to the southwest and the Patapsco River bordering Carroll and Baltimore County to the north and northeast, as well as many streams and rivers in between. These include the Little Patuxent River, the Middle Patuxent River, Cattail Creek, Deep Run, Dorsey Run, Bonnie Branch, Plumtree Branch, Guilford Branch, Hammond Branch, Clyde's Branch, Tiber-Hudson Branch, and many others.

Riverine Flooding

The following map (Figure 2.1) depicts the 100-year floodplains within Howard County, as designated by FEMA on the Flood Insurance Rate Maps or FIRMs. The 100-year flood is a flood which has a 1 percent chance of being equaled or exceeded in any given year (MDE, *Maryland Floodplain Manager's Handbook*). Howard County can experience riverine flooding as a result of excessive rainfall in a matter of hours, such as from a severe thunderstorm. Additionally, some soils can become saturated over a longer period of time and reduce their absorption potential. Riverine flooding can affect any of the rivers and streams in the County.

It is evident (Figure 2.1) that the floodplains impact many parts of Howard County. In fact, 6.4 percent of the County's land area is in the 100-year floodplain. The floodplain is defined as the area adjoining a river or stream that has been or may be covered by floodwater (Figure 2.2). This is different than the floodway, defined as the channel of a river or stream and the parts of the floodplain adjoining the channel that are reasonably required to efficiently carry and discharge the floodwater or flood flow of a river or stream. Encroachments in the floodway cause increased flood elevation, both upstream and downstream. Unfortunately, the FIRMs do not depict the floodway as a separate area.

In addition, the review of past flood events showed than many of the streams in Howard County carry a flash flood threat. A flash flood is defined as a rapid flooding event that generally starts, peaks, and passes in less than six hours (National Weather Service, 2010). The small basins and incised nature of the streams in the County suggest a degree of "flashiness" to the flood threat.

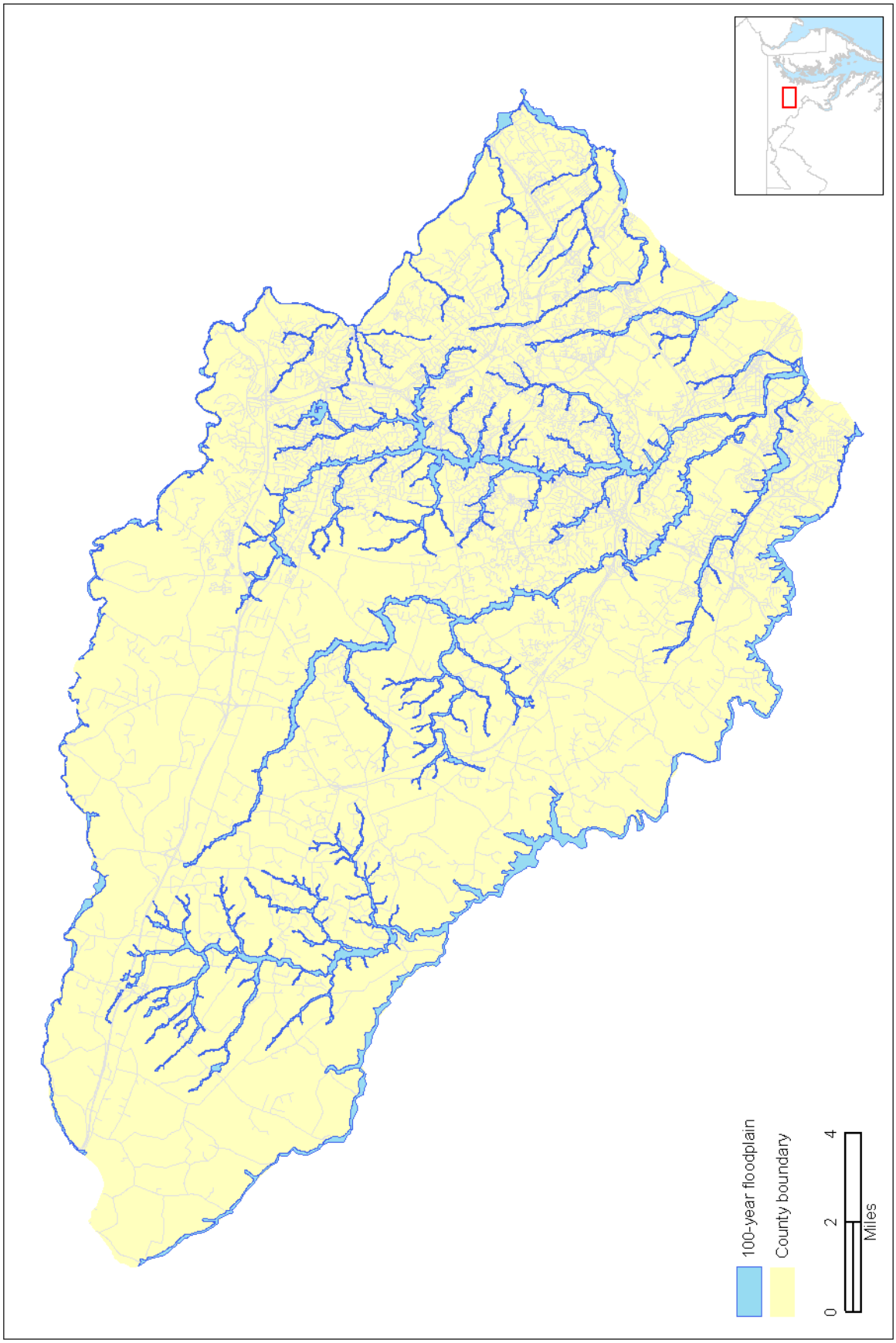
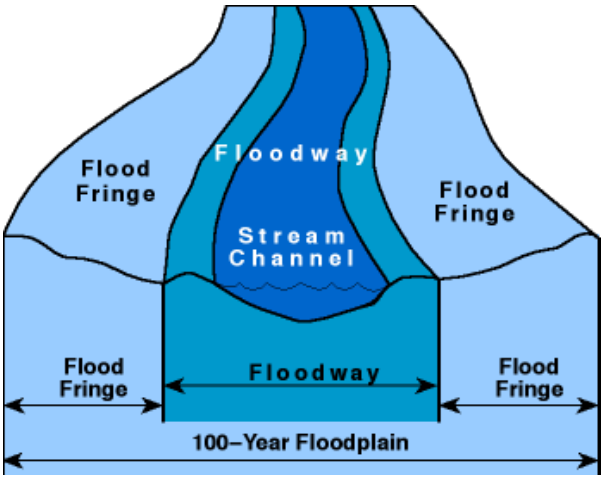


Figure 2.1 Howard County 100-year floodplain from dFIRMs

Dam Failure

Dams are water storage, control, or diversion barriers that impound water upstream in reservoirs. Dam failure is a collapse or breach of the structure. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage volumes can cause significant flooding.

Figure 2.2 Schematic of a floodplain (Source: Ohio Dept of Natural Resources)



Most of the dams in Howard County are relatively small earthen impoundments that were created for either flood control or recreation. All but three are privately-owned. Two dams, the Columbia Gateway Dam and the Centennial Park Dam, are rated as being a high hazard. A high hazard dam is one where failure or mis-operation will probably cause the loss of human life while a significant hazard dam is one where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage or other concerns.

Table 2.1 High and Significant Hazard Dams in Howard County, Maryland (National Inventory of Dams, 2010)

Dam Name	Waterway	Owner
Wilde Lake Dam	Tributary of Little Patuxent River	Columbia Assoc
Columbia Gateway Dam	Tributary of Dorsey Run	General Growth Properties
Lake Elkhorn (L-4)	Tributary of Little Patuxent River	Columbia Assoc
Centennial Park Dam	Tributary of Little Patuxent River	Howard County Parks Dept
Wyndemere SWM Pond	Tributary of Patuxent River	Howard County
North Laurel Park SWM Pond	Tributary of Patuxent River	Howard County

Stormwater Flooding

Another source of flooding in Howard County is storm water system overflow, resulting from a large amount of precipitation in a short period of time. This type of flooding occurs much more often than riverine flooding, but the impacts are often localized and minimal. Most of these more-frequently flooded locations are within the built-up areas and known to the county and municipal staff.

Flood Measurement

There are only two active US Geological Survey gauging stations and no National Weather Service hydrographs within the County. (Table 2.1). According to the USGS, data collection at the Savage station will be discontinued on October 1, 2010 unless new funding partners are

found. The measurements of stream discharge, river stage, and expected flood height are critical to the prediction of flood events.

Table 2.2 Gauging stations in Howard County

Agency	ID Number	Station Name	Real-Time or Daily
USGS	01593500	Little Patuxent River at Guilford	Real-time
USGS	01594000	Little Patuxent River at Savage	Real-time

Flood Levels

Using the 1986 Flood Insurance Study (FIS) of Howard County, the following table (Tables 2.3) report the drainage areas and discharge amounts for the key flooding sources.

Table 2.3 Peak discharges for a 100-year riverine event

Flooding Source	Drainage Area (sq mi)	100-year Peak Discharge (CFS)
Patapsco River	315.47	43,900
South Branch Patapsco River	64.39	24,400
Deep Run	17.82	11,900
Stream DR-1	5.12	4,150
Stream DR-2	1.00	1,100
Stream DR-3	1.88	2,000
Stream DR-4	0.87	950
Stream DR-5	2.75	2,400
Bonnie Branch	1.55	2,498
Tributary to Bonnie Branch	0.50	909
Patuxent River	524.2	66,000
Little Patuxent River	39.67	10,218
Guilford Branch	1.26	961
Hammond Branch	5.40	2,709
Middle Patuxent River	57.82	7,915
Sanner Road Tributary	2.42	1,389
Clyde's Branch	8.69	5,504
Stream CB-1	2.22	1,498
Stream CB-4	0.56	462
Stream CB-5	1.83	1,408
Stream CB-10	1.04	816
Stream CB-16	0.58	633
Benson Branch	2.90	1,330

(All tributaries with a drainage area greater than 0.5 sq miles are included; see the Howard County FIS for more information)

Hazards from Floods

Flooding causes $6 billion in average annual losses in the United States annually and account for an average of 140 casualties annually (USGS, "Flood Hazards – A National Threat," 2006). While most people's vision of the threat from flooding may include being swept away or buildings being structurally impacted, there are actually a number of hazards associated with flooding that occur both during and after an event.

During the Flood

While a flood event is underway, citizens will be faced with a number of threats. The hydraulic power of water is significant and walking through as little as 6 inches of moving water is

dangerous because of the possibility of losing stable footing. Driving through flood water is the cause of many flood deaths each year. As little as one foot of water can float many cars and two feet of rushing water can carry away most vehicles including SUVs. That fact, combined with an inability for drivers to judge the depth of flood water, as well as the potential for flood waters to rise quickly without warning, making driving through flood water a very unwise action.

In addition to being swept away, flood water itself is to be avoided. Because of leaking industrial containers, household chemicals, and gas stations, it is not healthy to even touch the flood water without protective equipment and clothing. Downed power lines, flooded electric breaker panels, and other sources of electricity are a significant threat during a flood. One should also be prepared for the outbreak of fire. Electric sparks often cause fire to erupt and because of the inability of fire fighting personnel to respond, a fire can quickly burn out of control.

After the Flood

Cleaning up after a flood can also expose citizens to a number of threats. For example, electrical circuits or electrical equipment could pose a danger, particularly if the ground is wet. Buildings that have been exposed to floodwater may exhibit structural instability of walkways, stairs, floors, and possibly roofs. Flood waters often dislodge and carry hazardous material containers such as tanks, pipes, and drums. They may be leaking or simply very heavy and unstable. The combination of chemical contamination and the likely release of untreated sewage (necessary when the sewage treatment plant is overwhelmed with flood-swelled effluent) mean that drinking water supplies can be unusable. Fire continues to be a very real threat after a flood. First-responders could be occupied with more pressing emergencies and traditional fire suppression equipment may be inoperable, but there may be mobility problems that keep fire-fighting equipment to reach an outbreak. Finally, there is the mental toll of being involved in a disaster. Continued long hours of work, combined with emotional and physical exhaustion and losses from damaged homes and temporary job layoffs, can create a highly stressful situation for citizens. People exposed to these stressful conditions have an increased risk of injury and emotional crisis, and are more vulnerable to stress-induced illnesses and disease.

Impact to Buildings

Fortunately, the number of people killed or injured during floods each year is relatively small. The built environment within the floodplain, however, is likely to bear the brunt of a flood's impact. Whether the water is moving or standing, the exposure of buildings to flood water could cause a great deal of damage. If the water is moving, the differing hydraulic pressure inside the building vs. outside can cause the walls and foundation to buckle and fail. If the water is standing for any length of time, even materials above the flood height will become saturated with flood water as the flood water is absorbed (known as wicking). Certainly, most of the contents of flooded buildings that were located at or below the flood height will need to be discarded. This includes carpet, furniture, electronic equipment, and other household or commercial items. In most cases it is not simply the fact that the objects have become wet but since the flood water brings with it sediment and chemicals, it makes it nearly impossible to recover all but the most precious/heirloom items.

Vulnerability Assessment

The goal of mitigation is to increase the flood resistance of a community, so that the residents and businesses will become less susceptible to future exposures to flooding, thereby resulting in fewer losses. A key component to reducing future losses is to first have a clear understanding of the current threats, the current probability that those threats would occur, and the potential for loss from those threats. The Vulnerability Assessment is a crucial first step in the process as it is an organized and coordinated process of assessing potential hazards, their risk of occurring, and the possible impact of an event.

Methodology

The Vulnerability Assessment was conducted using HAZUS-MH MR4, FEMA's loss estimation software, to assess the County's built environment and critical facilities' vulnerability to flooding. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations that have been developed by hazard and information technology experts to provide credible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards, including floods, hurricane winds and earthquakes. The methodology supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

The primary input to any vulnerability assessment is a "depth of flood" grid. This flood depth grid was created using an elevation grid derived from LiDAR measurements with a 2 m spatial resolution. By incorporating the polygons of the 100-year floodplain from the FIRMs, the flood elevations from the preliminary dFIRM study cross-sections for 189 stream reaches, as well as the current elevation grid, HAZUS-MH was able to create a flood depth grid with a reasonable precision.

Once this flood depth grid was created, Howard County's address points were digitally overlaid and those points that intersect the floodplain were selected. The height to the first finished floor of each building in the floodplain was determined by field inspection. The height to the first finished floor was then compared with the predicted flood depth to estimate the potential depth of water for each building. For each level of water depth, there is a corresponding "percent damaged" metric. The 2009 assessed value of the building was then adjusted based on a formula to account for the value of the contents of the building. The total value was multiplied by the percent damaged metric to calculate an estimate of damage from the 100-year flood event.

Results

The results of the analysis indicate that there are 198 buildings within the 100-year floodplain in Howard County (Table 2.4). When the flood depth grid (Figure 2.3) is intersected with the height of the foundations of each of these buildings, five of them show minimal damage. The maximum amount of damage predicted is 100% percent; 26 buildings in Howard County could possibly sustain a severe degree of damage (50% or more). The total value of both the structures and their contents is over $106 million. The total potential damage from flooding is nearly $29 million. This number represents 27.1 percent of the total assessed value. When standardized per building, it is important to note that the most valuable buildings (average of $628,937) are those predicted to be damaged moderately (20% - 30%). Unfortunately, those buildings expected to sustain significant damage (40% - 50%) are the least valuable buildings.

The plurality of the potential damage to flooding (46.5%) is likely to be to those 92 buildings damaged between 10 and 30 percent.

Table 2.4 Potential damage to structures/contents from a 100-year flood event by degree of damage category

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%

Note: All dollar values are from 2009 tax assessments.

When the potential damage was also examined with respect to building use, it was found that the majority all of buildings in the 100-year floodplain in Howard County were residential (Table 2.5). The second largest category was commercial buildings. While commercial buildings account for 36.8% of the buildings impacted, its potential damage is nearly twice as large (67.1%). This suggests that mitigating commercial structures is an important opportunity for reducing future flood losses.

Table 2.5 Potential damage to structures/contents from a 100-year flood event by general occupancy type

General Occupancy Type	Building Count	% of Total	Value of Structure and Contents	Total Damage	% of Total
Residential	121	61.1	$52,233,195	$7,994,627	27.7
Commercial	73	36.8	$47,568,550	$19,361,170	67.1
Educational	1	0.5	$3,691,000	$313,404	1.1
Government	2	1.0	$2,376,400	$1,012,371	3.5
Industry	1	0.5	$704,750	$166,459	0.6
Total	198	100%	$106,573,895	$28,848,031	100%

Note: All dollar values are from 2009 tax assessments.

When the specific occupancies of each of the buildings in the 100-year floodplain were examined, a similar pattern emerged (Table 2.6). The majority of the structures damaged were single family residential (116 or 58.5% of the total). The occupancy types that were likely to suffer the greatest damage, besides single family dwellings, were: retail trade businesses, professional services businesses, and entertainment & recreation businesses.

Table 2.6 Potential damage to structures/contents from a 100-year flood event by specific occupancy type

Specific Occupancy Type	Building Count	Value of Structure and Contents	Value per Building	Total Damage	Damage per Building
Retail Trade	68	$30,685,000	$451,250	$14,459,830	$212,644
Parking	1	$733,950	$733,950	$454,925	$454,925
Professional Services	1	$10,391,000	$10,391,000	$2,331,981	$2,331,981
Entertainment & Recreation	3	$5,758,600	$1,919,533	$2,114,434	$704,811
Schools	1	$3,691,000	$3,691,000	$313,404	$313,404
General Government Services	1	$1,423,200	$1,423,200	$879,151	$879,151
Emergency Response	1	$953,200	$953,200	$133,220	$133,220
Light Industrial	1	$704,750	$704,750	$166,459	$166,459
Single Family Dwelling	116	$47,950,251	$413,364	$7,744,911	$66,766
Multi-Family Dwelling	5	$4,282,944	$856,588	$249,716	$49,943

Note: All dollar values are from 2009 tax assessments.

Critical Facilities

In addition to the general building stock, critical facilities were also examined as part of the vulnerability assessment. Specifically, the locations of wastewater treatment facilities, fire stations, police stations, schools, government buildings, senior centers, assisted housing, hospitals, nursing homes, and libraries were compared to the flood depth grid. There were only four critical facilities in the modeled flooded area (Table 2.7). The government "building" is actually a pavilion in Centennial Park and was deemed to be "not critical."

Table 2.7 Critical facilities within the modeled flood zone

Type	Name
WWTP	Little Patuxent Water Reclamation Plant
Fire Station	Lisbon, Station 4, Woodbine
School	High Road Academy
Government Building	Pavilion H in Centennial Park

Spatial Distribution of Flooding

The geography of the flood vulnerability can best be described as "dispersed" and "infrequent." With the exception of historic Ellicott City and Elkridge, the County has very few legacy structures that are vulnerable to flooding. Most of the other more recently constructed vulnerable structures are located in groups of just a few along one of the County's many streams, creeks, and rivers. They just happen to be the part of a planned development that was located closest to a water source. The overall pattern suggests that the County's restrictions on floodplain development have achieved the desired effect in most cases.

Areas of significant or moderate flood vulnerability in the county comprise the following areas, each of which is elaborated below.

- Ellicott City (77 structures)
- Columbia near Clarksville Pike & Columbia Road (39 structures)
- Elkridge (10 structures)

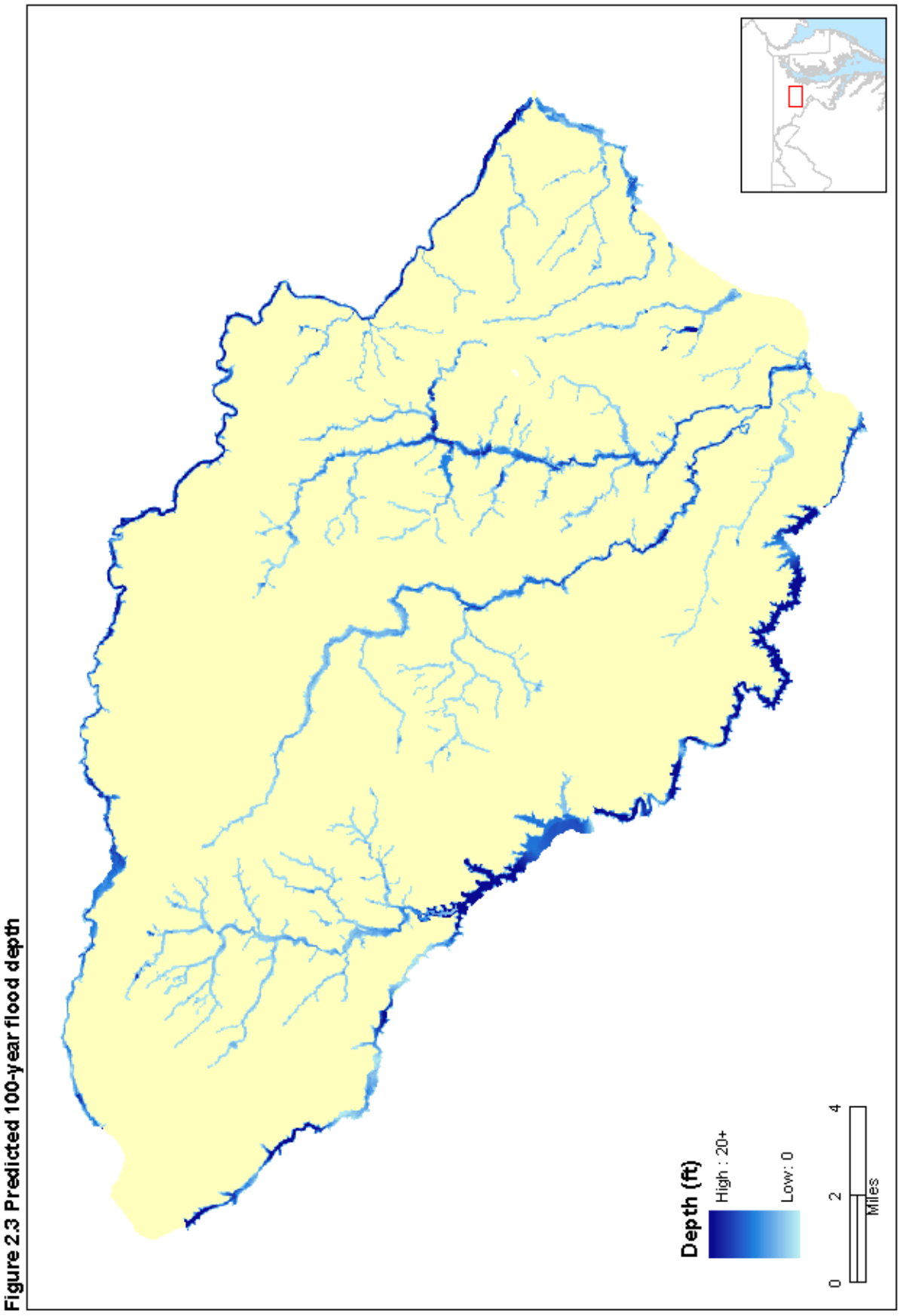


Figure 2.3 Predicted 100-year flood depth

Figure 2.4 The Tiber-Hudson Branch flows underneath the railroad bridge in Old Ellicott City. A flood depth marker denotes significant floods of the past.

The (Old) Ellicott City area will potentially be one of the most impacted during a 100-year flood event on the Patapsco River. This area was devastated in 1972 during the flood event after the torrential rainfall delivered by the remnants of Hurricane Agnes. During that historical event, the Patapsco River crested at 14.5 ft with a flood volume of 80,600 cubic feet per second. Nearly all structures (77) in the area may suffer flooding damage to their buildings and contents. Many are likely to be impacted significantly or severely. In addition to flooding from the Patapsco River, the (Old) Ellicott City area is also impacted by the Tiber Hudson Branch, Cat Rock Run, Autumn Hill Branch, and New Cut Branch. There are many businesses in the (Old) Ellicott City area, making both the buildings and their valuable contents vulnerable to flooding.

Columbia near Clarksville Pike & Columbia Road (Figure 2.5 & 2.7)

A significant (39) number of buildings are vulnerable to the 100-year riverine flood from the Little Patuxent River in the Columbia area near Clarksville Pike and Columbia Road. Specifically, it is a number of residential apartments on the west side of the River on Brook Way, Ten Mills Road, Whetstone Road, and Woodland Road that are vulnerable to loss from flooding. The combination of physical proximity to the water and the lack of elevation of structures equal a significant degree of vulnerability.

Figure 2.5 Apartment buildings along Brook Way in Columbia. Notice the ground floor is located below grade

Figure 2.6 Potential flooding and building damage in (Old) Ellicott City

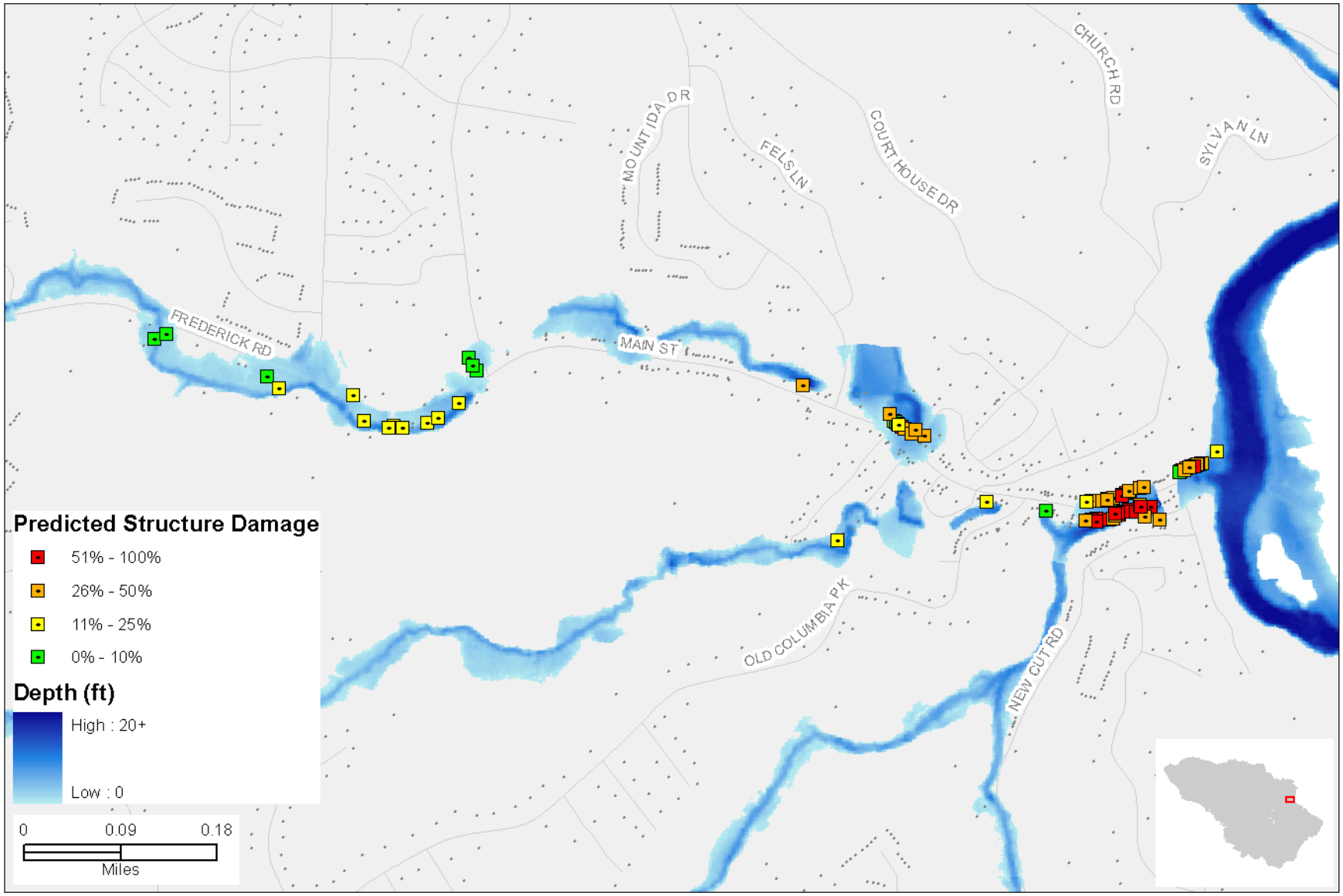
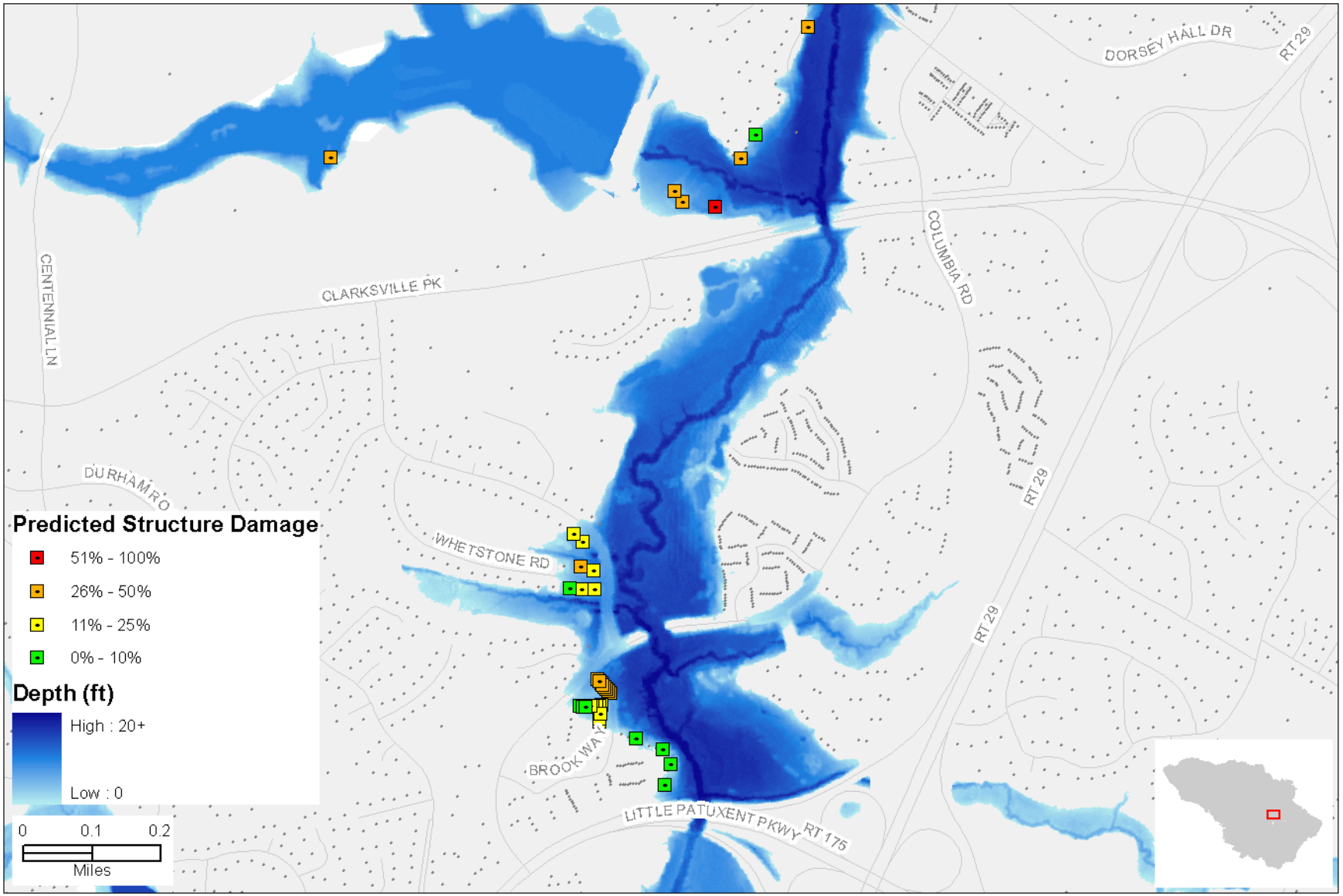


Figure 2.7 Potential flooding and building damage in Columbia near Clarksville Pike and Columbia Road



Elkridge (Figures 2.8 & 2.9)
The Elkridge area is at the extreme southeastern corner of Howard County on either side of the Harbor Tunnel Throughway (I-895). It lies along the Patapsco River and is also near the Thomas Viaduct. This area was also significantly impacted in the Flood of 1972 created by the remnants of Hurricane Agnes. A number of businesses were impacted during that 1972 flood including restaurants, gas stations, tire stores, and car dealerships. In the scenario of potential 100-year flooding, only 10 structures are predicted to be damaged from flooding. However, these structures are some of the most significantly damaged in the county. The HAZUS model is predicting 15 feet of flood water along the Patapsco River near Elkridge.

Figure 2.8 The Patapsco River flows underneath the Thomas Viaduct just upstream from Elkridge. If the bridge openings become blocked during a flood event, it could exacerbate the threat.

Repetitive Loss Properties

A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Structures that flood frequently strain the National Flood Insurance Fund. Repetitive loss properties not only increase the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the repetitive loss problem because residents' lives are disrupted and may be threatened by the continual flooding.

According to the Maryland Department of the Environment as of July 2010, Howard County has no unmitigated repetitive loss properties.

Economic Impact

Businesses

Floods cause other problems that are not as easy to identify as damage to buildings and critical facilities. Businesses that are disrupted by floods often have to be closed, often for long stretches of time. Inventories are lost, businesses cannot be accessed by customers, and employees are often busy protecting or cleaning up their flooded homes.

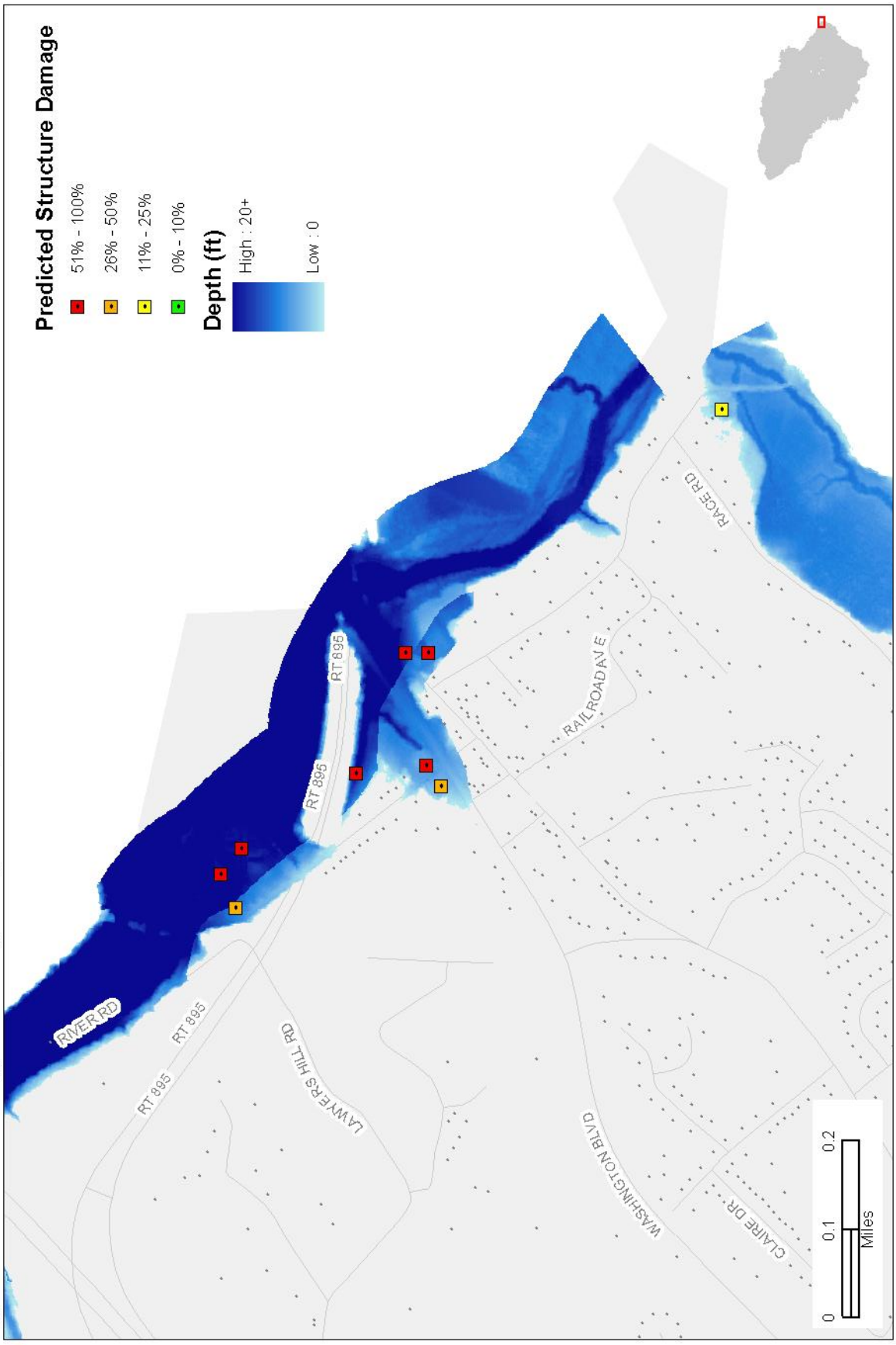


Figure 2.9 Potential flooding and building damage in Elkridge

Impact on taxes

Public expenditures on flood fighting, sandbags, fire department calls, clean up and repairs to damaged public property affect all residents of Howard County. While a state or federal disaster declaration may help reimburse the County, these handouts cannot be counted on in the future. Further, a recent law now requires that public agencies purchase insurance. The amount of insurance that should be carried will be deducted from disaster assistance payments. Despite Federal and state disaster assistance, public agencies incur many expenses that must be paid by local taxpayers.

Transportation

Loss of road access is a major flood impact that could affect the residents and businesses, not just those that own property in the floodplain. This can have an impact on not only the direct costs to fix the roads/bridges but also the value of lost time and productivity for the County's residents. As with taxes, these costs are borne by everyone, not just floodplain residents.

Other impacts

Finally, areas that are consistently prone to flooding will have a negative impact on property values, thereby encouraging neighborhood destabilization factors such as blight and crime to take over.

Future Trends

To date, Howard County been one of the fastest growing counties in Maryland. From 1970 to 2000, the population of the County has increased 300% (from 61,911 to 247,842). The pace of that growth will slow considerably over the next 30 years. The Maryland Department of Planning estimates that Howard County will grow its population at an average rate of about 1 percent per year with an expected population in 2030 of 324,100. This slow growth trend creates an opportunity with regard to flood vulnerability in the County. With a slower pace, it will be easier to continually monitor the collective vulnerability of Howard County's residents and businesses and suggest changes to policies as the years progress.

On the other hand, the southern/eastern portion of the County can be considered nearly fully developed. While there is some development capacity in the northern/western part of the County, there will be increasing pressure to develop land that was previous considered marginal, vulnerable, or otherwise not previously suitable. However, the fact that the County Code prohibits development within the floodplain will help maintain the relatively low vulnerability profile.

Conclusions

Several conclusions can be made regarding the question of flooding vulnerability in Howard County. First, given that Howard County has a number of streams and rivers that have significant floodplains and given that it contains more than 90,000 improved properties, the fact that only 198 (0.2%) are vulnerable to flooding is probably a result of strong land use regulations and the leadership and foresight to implement them (as well as a fortuitous geomorphology). Second, given the potential for increased development potential plus the "flashy" nature of many of the County's streams, the time to redouble the County's efforts to protect its citizens from

flooding is now. Third, even though the County is largely flood-resistant, there are certain areas that remain very vulnerable, such as Ellicott City and Elkridge, for which there is no easy answer. In the chapters that follow, a number of potential actions will be recommended. In the end, it will be incumbent upon the people of Howard County to reduce their personal vulnerability to flooding.

CHAPTER 3: PREVENTATIVE MEASURES

Introduction

Preventative measures are taken to ensure that future development does not increase the damage caused by a flood or other hazard thereby reducing its vulnerability. Preventive measures are put in place to keep the community's problem from occurring or exacerbating. These measures include language in planning, zoning, building codes, floodplain development regulations, storm water management techniques, and open space preservation and are usually administered by the planning, public works, and/or code enforcement departments.

Zoning ordinances address the issues of keeping damage-prone development out of the hazardous or sensitive areas, while building codes and floodplain development regulations impose construction standards on what is allowed to be built in the floodplain. They protect buildings, roads, and other projects from flood damage and prevent development in flood hazard areas, thereby preventing the flood problem from aggravating. Building codes are also very important in addressing the issue of mitigating the impact of non-flood hazards on new buildings. Storm water management addresses the runoff of storm water from new developments onto other properties.

The sections below include a review of Howard County's codes, plans, and ordinances and identify areas in these documents where flood mitigation principles are addressed.

County and State Plans

Howard County Natural Hazard Mitigation Plan – 2004

The County's Hazard Mitigation Plan, developed in 2004 and administered by the Office of Emergency Management, is currently in the process of being updated. The Plan identifies flooding as the most common natural disaster to impact Howard County, with the greatest threat during the spring and the summer. The Plan identified 231 structures greater than 500 square feet built in the floodplain and 730 buildings touching the floodplain.

New construction is not permitted in the 100-year floodplain and a freeboard of two-feet is required. The Plan identifies the following public properties within the 100-year floodplain: Centennial Park, Lisbon Fire Station #4, the County Wastewater Treatment Plan, and the Deep Run Waste Treatment Plan.

The following flood mitigation actions were listed in the Hazard Mitigation Plan. Those that have not been implemented will be included in the Flood Mitigation Plan:

- Update Standard Operating Procedures related to flood warning system operations and have them reviewed by OEM;
- Improve flood modeling system and capabilities to better predict crest height and timing.
- Improve the flood warning system;
- Increase training and functionality of the Diad System;
- Prepare pamphlets in advance to inform citizens about how to prepare for potential flood events;

- In coordination with OEM, make flood information available to the citizens via the County Public Information Officer to be used in anticipation of, and during, flood events;
- Determine the necessity to make floodplain maps available online for citizens;
- Develop pamphlets for business owners regarding protecting inventory from flooding; and
- Research frequently flooded roadways to determine whether roads/bridges/culverts need to be upgraded to lessen the frequency of flooding.

2000 Howard County General Plan

The following policies in the Master Plan speak directly or indirectly to flood mitigation issues, particularly in the areas of storm water management and natural resources:

- Develop maintenance and replacement programs to maintain the quality of County public facilities. Use the ten-year Capital Improvement Master Plan to prioritize and schedule maintenance, renovation and replacement to avoid the unnecessary disruption and expense caused by consecutive projects that disturb the same location.
- Plan for needed storm water management in developed areas that lack these facilities or need retrofitting of existing facilities. Seek solutions that enhance natural areas within existing communities.
- Seek grant funding to provide and improve public infrastructure and restore natural environments within existing communities.
- Public acquisition, easements and regulations are tools for protecting Howard County's river and stream valleys, wetlands, floodplains, steep slopes, forests and wildlife habitats. The natural resource protection policies of this Plan focus on water resources, forests and contiguous tracts of undisturbed natural environments.
- Restore natural resources. Many areas of the County were developed before current protections were in place, and much of the original streamside tree cover, wetlands and buffers were lost. Restoring these elements will do much to improve water quality and reestablish ecological continuity along these streams.
- Connect protected natural areas in a comprehensive greenway network. A greenway network can sustain critical ecosystem functions and link valued natural, historic and cultural resources. Such a network can provide continuous protected areas along streams and rivers create habitat and travel corridors for wildlife, connect existing forest areas to create forest interior habitat, and provide areas for public access and recreation.
- Prepare comprehensive watershed management plans for all watersheds, to guide efforts to protect, restore and improve the County's water resources. Complete and update all watershed management plans on a regular cycle.
- Encourage active participation of individuals and local community and environmental organizations in restoration activities.
- Strengthen the storm water management requirements for redevelopment, in coordination with State requirements.
- Ensure that the retrofit program adequately addresses storm water management needs in older communities.
- Ensure adequate and sustained funding for the storm water management program.
- Use low impact development practices, including bioretention facilities, when designing new storm water management and retrofitting storm water management for County facilities.

- Strengthen buffer requirements to enhance protection of stream and wetland resources.

The General Plan encourages cluster zoning which has resulted in new residential developments that are more compatible with the rural landscape in the less developed parts of the County than the conventional three-acre lot zoning. The clusters of one-acre lots near large preserved parcels generally require less road surface, disturb less of the site's sensitive environmental areas, and provide a more varied and attractive setting than conventional large-lot subdivision.

Zoning Ordinance

A zoning ordinance is an important tool that regulates how land should be developed. A Zoning Ordinance includes: 1) use of land and structures and the height and bulk of structures; 2) density of population and intensity of land and structural use; and 3) provision for yards and setbacks. Development is regulated by dividing the community into zones or districts and setting specific development parameters for each of these districts.

The County's Zoning Ordinance was adopted in August 2006. The Comprehensive Zoning Plan was adopted in 2004. The Plan is administered by the Planning and Zoning Department. The Zoning Plan works in conjunction with other laws that concern development in the County such as the Subdivision and Land Development Regulations, Adequate Public Facilities Ordinance, and Forest Conservation Ordinance. Three zones in particular help maintain the County's environmental integrity:

- The R-ED District is established to accommodate residential development at a density of two dwelling units per net acre in areas with a high proportion of sensitive environmental and/or historic resources. Protection of environmental and historic resources is to be achieved by minimizing the amount of site disturbance and directing development to the most appropriate areas of a site, away from sensitive resources. To accomplish this, the regulations allow site planning flexibility and require that development proposals be evaluated in terms of their effectiveness in minimizing alteration of existing topography, vegetation and the landscape setting for historic structures.

- The Resource Conservation (R-C) District is established to preserve natural features and the rural landscape, while allowing low density, clustered residential development. Residential development is to be permitted only when it is located and designed to minimize its impact on agricultural land, farming operations, and sensitive environmental features; to create attractive rural developments; and to respect existing features of the rural landscape.

- The Rural Residential (R-R) District is established to allow low density residential development within a rural environment. The Rural Residential District is intended for an area of the County which is already largely committed to low density residential subdivisions. Cluster development is permitted in order to protect environmental and landscape resources and to preserve agricultural land.

Subdivision Regulations

The County's Subdivision and Land Development Regulations were revised in October 2009. Subtitles 11 and 12 comprise the Adequate Public Facilities Ordinance and Forest Conservation, respectively.

Section 16.115 contains information on Floodplain Preservation. Most land within the 100-year floodplain is considered a protection area (i.e., a stream valley or valuable ecological area or scenic resource). In subdivisions and site development plans containing a 100-year floodplain, the floodplain land is protected by: deeding the floodplain land to the County; or by granting a floodplain easement to the County. In terms of prohibitions on the use of floodplain land, building materials and other debris cannot be stored or discarded in floodplain; and no clearing, excavating, filling, altering drainage, or impervious paving, can occur on land located in a floodplain unless required or authorized by the County.

Building Codes

Building codes set construction standards for the minimum acceptable level of safety for buildings in a community. Building codes are also important in mitigating the impact of non-flood hazards on new buildings. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. These standards should typically include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above or otherwise protected from flooding.

County Code Title 3 – Building Code

The International Building Code (IBC) is the County's building code. The IBC regulates construction materials and methods for all structures (except for one- and two-family dwellings). The one- and two-family dwellings are regulated by the International Residential Code (IRC). The IBC and IRC establish criteria that resist damage to natural hazards including wind speed (for hurricane, tornados, thunderstorms, winter storms) seismic activity, snow load, and flooding. The Code prohibits building in any 100-year floodplain or stream or drainage course and also prohibits development in areas that are subject to flooding, erosion, unstabilized slope or fill within danger of a high-hazard dam. The Code has wind loading requirements for new structures and tie-down requirements for mobile homes.

However, these codes are not retroactive codes, and do not include older buildings. Only pre-existing structures are subject to the codes that exist at the time of construction and when there are major additions to structures, they need to be brought up to the new code's standards. Older buildings are more vulnerable to damage from natural hazards unless they are brought up to the current code's standards.

Building Code Effectiveness Grading Schedule

The Building Code Effectiveness Grading Schedule (BCEGS) is a program that measures local building code natural hazard protection standards and code administration. The Building Code Effectiveness Grading Schedule is used by the insurance industry to determine how well new construction is protected from wind, earthquake and other non-flood hazards. The BCEGS program assigns each community a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10.

BCEGS ratings are conducted once every five years. The last BCEGS score rating for Howard County was completed in 2005. The County received a very high rating overall, the highest rating received for any Maryland county. Howard County received a score of 3 for single and two-family residential structures and 3 for industrial and commercial structures.

Floodplain Development Regulations

Floodplain development regulations protect building and infrastructure from damage and prevent development in areas that will increase the flood risk to surrounding buildings or cause other problems.

Chapter 6 of the Design Manual, Floodplain Management, is administered by the Department of Public Works, Bureau of Environmental Services. The following are the highlights from the Manual:

- The County requires a two foot freeboard requirement;
- New development or substantial improvements to structures in the floodplain are prohibited;
- Fill and building foundations are required to be designed to protect them from scour and erosion; and
- New structures in the floodplain are required to submit first floor elevations.

The Howard County Code does not permit the construction of new residential, industrial, institutional or commercial buildings within the 100-year floodplain. If the 100-year ultimate floodplain is increased, then appropriate flowage easements are required to be granted by all affected property owners and the design approved by the Department of Public Works, the Department of Planning & Zoning/Development Engineering Division; or where necessary, by the Maryland Department of the Environment, Water Management Administration.

Existing buildings within the 100- year floodplain are regarded as non-conforming uses. If the floodplain cannot be altered, flood proofing of such buildings may be encouraged, where feasible. The County's ultimate policy regarding buildings where flood proofing is not feasible is to seek their removal from the 100-year floodplain.

On all subdivision plats and site plans, the 100- year floodplain is required to be shown for all drainage areas of 30 acres or larger or those having a 10-year runoff in excess of 100 cfs.

County Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS)

The official flood map for the County is the FIRM. Howard County's Flood Insurance Study was completed in 1986. Preliminary digital Flood Insurance Rate Maps (DFIRMs) were released for Howard County in 2009 and are currently in review by the County. They will be made available by FEMA for public review and comment in early 2011. The DFIRMS include cross sections (with elevations) and the 100-year flood. The studies included 139 detailed HEC-RAS studies and 52 approximate studies.

Continued Compliance with NFIP

Participation in the NFIP is based on a voluntary agreement between a community and FEMA. Compliance with the NFIP, however, extends beyond mere participation in the program. The three basic components of the NFIP include 1) floodplain identification and mapping risk; 2) responsible floodplain management; and 3) flood insurance. Table 6.1 identifies the NFIP requirements and documents how the County addresses these requirements. The table is

based on a list of questions that were originally developed by the Delaware Emergency Management Agency and tailored to Maryland communities.

Table 3.1 National Flood Insurance Program Compliance

Requirement	Yes/No	County Action
1. Floodplain Identification and Mapping		
a. Does the County maintain a copy effective FIRM (flood insurance rate map) maps and FIS (flood insurance study) that is accessible to the public?	Yes	FIRM and FIS are available in the Storm Water Management Department.
b. Has the County adopted the most current DFIRM or FIRM and FIS?		Current FIRM is from 1986. DFIRMs have recently been released and are under review.
c. Does the County support request for map updates?	Yes	LOMA can be done without County input. LOMR are reviewed and signed by the County. The County is currently working with FEMA and MDE for a MapMod update of the entire FIRM (DFIRMs)
d. Does the County share with FEMA any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	Yes	If during the subdivision review process a new development determines a reduction in the flood plain delineation of the FIRM floodplain, then a LOMR submission to FEMA is required of the developer. Not all previous County prepared studies were submitted to FEMA, but again, the entire FIRM is being updated and the County is cooperating and supplying whatever data is requested.
e. Does the County provide assistance with local floodplain determinations?	Yes	The Department of Public Works assists residents in interpreting the FIRM and County flood studies to determine the property's flood plain status. The County also provides advice regarding elevation certificates and LOMA applications.
f. Does the County maintain a record of approved Letters of Map Change?	Yes	Copies of the LOMC are maintained by the county.
2. Floodplain Management		
a. Has the municipality adopted a compliant floodplain management ordinance that at a minimum regulates the following:		
(1)Does the County issue permits for all proposed development in the SFHA?	Yes	All proposed development requires plans to go through the County's subdivision approval processor to acquire a building permit for new structures. However, County Code prohibits any new structures in the 100 year flood plain.
(2)Does the County obtain, review and utilize any Base Flood Elevation and floodway data, and require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	Yes	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.

Requirement	Yes/No	County Action
(3)Does the County identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation, including anchoring, using flood resistant materials, designing or locating utilities and service facilities to prevent water damage?	Yes	All new structures must be at least two feet above the 100 year BFE.
(4) Does the County document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	No	No new structures are allowed in the flood plain
b. If a compliant floodplain ordinance was adopted, does the County enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	Yes	Restrictions on flood plain use are enforced through the subdivision and building permit process
3. Flood Insurance		
a. Does the County educate community members about the availability and value of flood insurance?	Yes	The County sends an annual letter to residents in the floodplain providing information about the floodplain dangers and the need for insurance. The County however does not give specific information nor recommends insurance providers.
b. Does the County inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	Yes	Significant FIRM changes have been rare. We had a series of sub-100 acre drainage areas removed from the FIRM in 1998 in response to requests from homeowners that were being told to get flood insurance when the County subdivision plans showed them out of the floodplain. (LOMR had not been done for those subdivisions) The owners who had contacted the County were informed of the LOMR. Currently, we have begun planning for notifying affected property owners of changes from the new DFIRM, the new DFIRM may not be issued until 2011.
c. Does the County provide general assistance to community members relating to insurance issues?	Yes	As above, we assist residents in interpreting the FIRM and County flood studies to determine the resident's property's flood plain status. We provide advice regarding elevation certificates and LOMA applications. We don't give assistance regarding specific insurance issues such as where to get it, cost, coverage, etc.
d. When was the latest community assistance visit conducted? Were there any comments from MDE/FEMA during that visit?	Yes	Last CAV was on November 9, 2005. Howard County was found to meet the requirements for continued participation in the NFIP. MDE requested a letter describing "the requirement for a developer to submit for County review a Letter of Map revision for any reduction in the FEMA mapped floodplain."

Maryland Department of the Environment (MDE) cooperates with FEMA to provide assistance to communities participating in the NFIP. Through MDE's Community Assistance Program, periodic Community Assistance Visits (CAV) are conducted to review community performance.

A Maryland State Model Floodplain Management Ordinance that contains recommendations for improved management of floodplains has been adopted by communities participating in the NFIP, including those in Howard County. The International Building Code includes flood provisions that, in part, satisfy the minimum requirements of the National Flood Insurance Program. A comparison of the IBC's provisions and the County's Floodplain Ordinance could identify inconsistencies between them and ensure they are not in conflict with each other.

Maryland State Model Floodplain Ordinance

Some highlights from the Model Floodplain Ordinance are included below:

- All new and substantially improved structures are required to be built one foot above the base flood elevation.
- Ordinances do not allow buildings or fill in the floodway. Any development that impedes floodwaters or causes an increase in water surface elevations during the 100-year flood is not allowed.
- Existing buildings can only be replaced or substantially improved so long as they do not increase in footprint and any minor additions are required to be elevated.

The Community Rating System

The goal of the Community Rating System (CRS) program is to provide incentives for communities to go beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding. The incentives are in the form of premium discounts. The CRS is administered by FEMA's National Flood Insurance Program (NFIP). Under the CRS, flood insurance premiums for properties in participating communities are reduced to reflect the flood protection activities that are being implemented. A community receives a CRS classification based upon the credit points it receives for its activities. It can take on a wide range of activities that reduce flood losses. These activities include but are not limited to: better mapping, regulations, public information, flood damage reduction and/or flood warning and preparedness programs.

There are ten CRS classes. A community that does not apply for the CRS or that does not obtain the minimum number of credit points is a class 10 community. For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount (a Class 10 is not participating in the CRS and receives no discount). The CRS classes for local communities are based on 18 activities that are credit worthy; they are organized under four categories: public information, mapping and regulations, flood damage reduction, and flood preparedness.

As of May 1, 2008, there were 1,049 communities in the United States in the CRS (class 9 and below). Of these, six are Maryland communities:

- Caroline County (class 9)
- Harford County (class 7)
- Howard County (class 8)
- City of North Beach (class 8)
- Town of Ocean City (class 7)
- Prince George's County (class 5)

The CRS program not only encourages starting new programs but also emphasizes the fact that the programs should be ongoing in order to receive credit year after year. Therefore the County is required to recertify to FEMA on an annual basis that it is continuing to implement its CRS selected activities. If the County fails to maintain the same level of involvement in flood protection each year, it could result in a loss of CRS credit points, thereby leading to an increase of flood insurance rates to residents.

Storm Water Management

Storm water management regulations address the runoff of storm water from new developments onto other properties and into floodplains. Development outside a floodplain can contribute significantly to flooding problems; when land is developed, the natural ground cover is replaced and runoff is increased. Thus, in order to prevent storm water from flooding roads and buildings, storm sewers and ditches are constructed to transport the water effectively.

Storm water management regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. The goal is to ensure minimal increase in the rate of storm water discharge after development, in comparison to the site's conditions prior to development.

A retention basin or retention pond is a type of constructed wetland that is used to contain storm water or rain run-off. It provides an area to hold water from a small surrounding drainage area that would otherwise flow into other areas. The water remains in the local area that it was deposited. A detention basin holds water for a limited period of time from a larger basin area to prevent flooding and releases all the water contained in a short period of time.

Chapter 5 Design Manual, Storm Water Management

Chapter 5 of the Design Manual includes criteria and standards for the design of safe, efficient and coordinated storm drainage systems. These standards are compatible with those of the Howard Soil Conservation District, and the Maryland Department of the Environment, the Maryland State Highway Administration, and other governmental agencies.

The Design Manual applies to all storm drainage, floodplains, and storm water management systems and requires new projects to be designed according to the manual in cases where a new project abuts or is affected by an existing project. Design criteria and operation and maintenance requirements for the following storm water management are included in the Design Manual: retention ponds – wet basins; detention ponds - dry basins; extended detention ponds; underground facilities (private); storm water retrofits; rain gardens; dry wells; and bioretention facilities.

A Storm Water Management Plan that is approved by the Department of Public Works or the Department of Planning and Zoning/Development Engineering Division for appropriate storm water management measures that control or manage runoff is required for all residential, commercial, industrial or institutional uses that cause disturbance of over 5,000 square feet of land area. The following activities are exempt from the provisions and requirements of providing storm water management if the work will not cause an adverse impact of the receiving wetland, watercourse or water body:

- Additions or modifications to existing single-family residential structures that do not disturb over 5,000 square feet of land area. Disturbance is defined as any area in which the natural, or existing, vegetative cover has been removed or altered and, therefore, is susceptible to erosion.
- Developments that do not disturb over 5,000 square feet of land area.

The Storm Water Management Act of 2007 and following changes in the Howard County Design Manual require removal or treatment of 50% of the impervious surface in redevelopment projects. All redevelopment projects, previously defined as any construction, alteration or improvement, exceeding 5,000 square feet as a stand-alone impact, on previously developed (impervious) areas, shall reduce the existing site imperviousness by at least 50 percent. Where site conditions prevent the reduction of impervious area, storm water management practices are implemented to provide qualitative control for at least 20 percent of the site's impervious area. When a combination of impervious area reduction and storm water management practice implementation is used, the combined reduction shall equal or exceed 20 percent of the site's original impervious area.

All redevelopment projects exceeding 5,000 square feet as a stand-alone impact, on previously developed (impervious) areas, are required to reduce the existing site imperviousness by at least 20 percent. Where site conditions prevent the reduction of impervious area, storm water management practices are required to be implemented to provide qualitative control for at least 20 percent of the site's impervious area. When a combination of impervious area reduction and storm water management practice implementation is used, the combined reduction should equal or exceed 20 percent of the site's original impervious area.

The following non-structural storm water management practices can be used 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.

The County encourages the use of non-structural storm water management practice to minimize the reliance on structural BMP's.

Culvert, arch and bridge design criteria are included in the County's Design Manual. Bridges in the 100- year floodplain are required to pass the 100- year design storm. The 100-year storm must have more than a 1-foot increase in backwater above the existing 100-year water surface elevation. A freeboard of 1 foot between the 100-year water surface elevation and the highest point of the arch or the lowest chord of the bridge is required for the 100-year design storm. Culverts and arches on public roads that are located in the 100- year floodplain are required to pass the 100- year storm. The roads and/or driveways cannot be flooded on the above storm frequency. The water surface elevation is required to be a minimum of one foot below the outside edge of the pavement.

For bridge structures, the minimum freeboard between the underside of the superstructure and the design storms water surface elevation is required to be at least one foot. For perennial streams, the culvert is required to be at least one foot lower than the final stream invert.

Storm water management facilities cannot be located in wetlands or 100-year floodplains. Exceptions are for quantity management behind road crossings, wetland ponding systems in degraded wetlands and retention facilities.

Open Space Preservation

While open space is an amenity and serves the community in many ways including parks, greenways, recreational opportunities, and golf courses, it also serves a beneficial function: it reduces the vulnerability to flooding when the floodplain is preserved as open space. By preserving floodplains, wetlands, and natural water storage areas, the existing storm water storage capacities of an area are maintained. Open space can exist in the form of reserve open lands, purchased, or dedicated by developers in the form of easements.

Columbia Watershed Management Plan
The Columbia Watershed Management Plan was developed by the Columbia Association with the objective of protecting and restoring the waters of Columbia. The Plan identifies solutions for restoring the watershed infrastructure, performing intensive investigations to find pollution sources and designing restoration projects to reduce them. The Plan also emphasizes educating and involving residents and property owners in watershed stewardship.

Land Preservation, Recreation and Parks Plan – 2006
The County's Land Preservation, Parks and Recreation Plan identifies recreational and open space needs in the County and discusses natural resource areas including wetlands. One of the major goals of the plan is to guide the development of recreation and parks services and direct the County's efforts to conserve and protect its natural environment and farmland. The Plan includes the following goals for natural resource conservation that have a direct bearing on flooding:

- Ensure the environmental integrity of rivers, streams, and wetlands;
- Safeguard the environmental integrity of the Patuxent reservoirs;
- Restore and protect stream valley environments; and
- Improve storm water management at park sites with alternative control measures such as bioretention, water gardens, pervious parking surfaces, etc.

Capital Improvements Program

The County Council has an operating and a capital budget which it adopts annually, by department. Capital expenditures are prioritized on an annual basis. The approved operating budget for 2011 allocates 11.7 percent of its budget for public facilities and 13.6 percent for public safety. The 2011 Capital Budget allocates approximately $521,000 for bridge improvements; $3,920,000 for storm drainage projects, and $8,315,000 for road construction projects. Flood mitigation projects in some or all of these categories are identified later in this Plan.

County's Staffing and Training Capabilities

In terms of staffing for flood related projects,

- The County houses an official floodplain administrator/CRS coordinator in the Department of Public Works, Bureau of Environmental Services;

- The Land Development Division and the development Engineering Division in the department of Planning and Zoning comprise a number of planners and engineers who conduct plan reviews. Long Range and comprehensive plans are developed in the Comprehensive and Community Planning Division of the Department of Planning and Zoning;
- Zoning and review of building permits are conducted in the Division of Zoning Administration and Public Service (Department of Planning and Zoning); and
- GIS services are performed in the Department of Technology and Communication Services.

Table 3.2 identifies the various types of training received by county personnel.

Table 3.2 Training Received by Howard County staff

Training	Staff Position
GIS	Yes
Floodplain Management/NFIP Regulations	Yes
Community Rating System	Yes
Building Inspection	Yes
Building Code Administration	Yes
Building Retrofits	Yes

Howard County Government Structure

This section identifies the functions the various levels and departments of government are responsible for and summarizes the roles of department in Howard County that implement hazard mitigation-related activities directly or indirectly.

Howard County Council

The Howard County Council serves as the legislative branch of the local government and is responsible for approving laws in Howard County including authorizing the annual budget, approval of tax rates, and approval of all major applicable plans. The Council has five elected members that represent five different districts within the County.

The Department of County Administration

This department provides technical and administrative assistance as required as well as facilitates interdepartmental cooperation to ensure the efficient operation of the County government. Other responsibilities include the administration of human resources and labor relations, legislative coordination, and development of standard operational policies and procedures. The Office of Budget is housed within this department, which is responsible for the preparation of the annual budget.

The Department of Fire and Rescue

The Department of Fire and Rescue comprises volunteer and full time staff that serve at 11 different fire stations across the County. Each station has at least one fire engine and a variety of other rescue equipment. This Department also houses the Office of Emergency Management.

The Office of Emergency Management

The Office of Emergency Management (OEM) facilitates multi-agency planning that enhances the domestic preparedness for all hazards and to protect the health, safety, and welfare of all persons in Howard County. Operational roles include implementation of the Emergency Operations Plan during a state of emergency. This emergency response is often initiated at the Emergency Operations Center. The primary hazard mitigation related functions of OEM are to:

- Plan and lead Howard County's coordinated emergency response to all hazards;
- Coordinate and periodically update the Emergency Operations Plan and the Natural Hazards Mitigation Plan;
- Manage and coordinate county-wide response to, and recovery from, disasters and threats resulting from natural and human causes;
- Operate, maintain, and enhance the County's Emergency Operations Center (EOC);
- Coordinate the County's disaster response/recovery needs with regional, state, and federal government agencies;
- Serve as a coordination point for federal disaster relief programs and a receiving point for homeland security initiatives and funding;
- Facilitate county-wide compliance with federal requirements for implementation of the National Incident Management System and the National Response Plan;
- Engage citizens in preparedness and response efforts via the Community Emergency Response Network (CERN); and
- Plan, conduct, and evaluate exercises that test and improve disaster preparedness on a county-wide basis.

The Department of Housing and Community Development

This Department provides affordable housing opportunities for low and moderate income residents in the County. It administers Federal, State, and locally funded programs to obtain loans and grants for low income housing, rental assistance, and community facilities.

The Department of Inspections, Licenses and Permits

The Department of Inspections, Licenses and Permits ensures buildings are built in a safe and functional manner. Construction standards set by the County Council are administered through this department in the form of construction codes.

The Department of Planning and Zoning

This Department is tasked with developing innovative, functional plans and implementing strategies that effectively address growth and redevelopment. The Department of Planning and Zoning's mission is to enhance the quality of life, prosperity, and stewardship of natural and cultural resources within the County. Divisions within this Department include: Transportation; Community Planning; Historic Preservation; Environment; Agriculture; Development; Forms, Fees & Applications; Zoning and Subdivision Regulations; and Publications and Reports.

Department of Public Works

The Public Works Department is responsible is for improving and managing facilities and infrastructure within the County. This includes design, construction, operation and maintenance of facilities in accordance with Local, State, and Federal regulations. This department comprises five bureaus: administration, engineering, environmental services, facilities, highways, and utilities.

The Storm Water Management Division is housed within the Bureau of Environmental Services is responsible for inspecting storm water management facilities and restoration projects. It aids residents in interpreting flood insurance maps and floodplain studies. The Bureau of Engineering comprises Construction and Inspection; Survey; Transportation and Special Projects; and Utility Design Divisions.

CHAPTER 4: PROPERTY PROTECTION

Introduction

Property protection measures involve those techniques used to modify existing buildings that are subject to flood damage. Most of these measures are implemented by or cost-shared with property owners and are thus relatively inexpensive to the community compared with other (structural) flood protection measures. Most protection measures do not affect the appearance or use of a building. Examples of property protection measures include: relocation, acquisition, building elevation, flood-proofing, sewer backup protection, flood insurance, and mandates. These measures are elaborated below.

Building Relocation

Relocation involves moving a building to another location on higher ground. While this is often the best way to protect it from flooding, it can prove expensive for heavier (exterior brick and stone wall structures) and for large and irregularly shaped buildings. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where a new flood-free lot (or portion of their existing lot) available. The Department of Public Works Bureau of Environmental Services would administer building relocations.

Acquisition

Acquisition is similar to relocation, where buildings in the flood-prone area are removed to avoid future damage to them. However, in this case, the buildings are acquired by the local or state government and the land is converted to public use such as a park. Acquiring buildings and removing them from the floodplain is not only the most effective flood protection measure available, it is also a method to convert a problem area into a community asset and obtain environmental benefits. However, a “checkerboard” pattern in which nonadjacent properties are acquired could occur when some owners are reluctant to leave. Typically, no cost is borne by the homeowner in an acquisition project.

Acquisitions can be funded by the Federal Emergency Management Agency (FEMA) using post-disaster mitigation funds that are administered through MEMA. The buyout would involve eligible willing sellers only and be funded with 75 percent federal dollars and a 25 percent local match.

The Department of Public Works, Storm Water Management Group administers building demolitions and acquisitions. Federal dollars for building acquisition are provided by FEMA and administered by MEMA. In the past 13 years or so, the following buildings have been acquired and demolished: three houses on Main Street in Ellicott City, one commercial building in Sykesville, and two houses in the Harwood Park area in Elkridge. The acquisitions were done through grants from FEMA. The houses in Harwood Park on Glenmore Avenue and Hawthorn Avenue were purchased in 2004 through the County’s Floodplain Acquisition Program and partially funded through a grant from the State. These homes were purchased by the County and demolished and the property was handed over to the County’s Department of Recreation

and Parks to be maintained as open space in perpetuity. The County has considered applying for grants to acquire other homes, but these properties have not had a suitable benefit/cost ratio.

Currently, the County does not maintain a database of acquired properties since there have been only a couple in the past several years.

Building Elevation

This technique involves raising a building above the flood level so that water can flow under the building, causing little or no damage to the structure or its contents. Elevating a building will change its appearance. If only a small elevation is required, such as a couple feet, the front door would be three steps higher than before. If the building is raised 8 or more feet, the lower area can be wet flood-proofed and used for parking and for storage of items that will not be damaged by flood waters.

Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with NFIP regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

Elevation of properties is typically done on their own by individual homeowners. The County maintains a record of elevation certificates for some properties within the flood plain.

Barriers

A barrier can be built of dirt or soil (“berm”) or concrete or steel (“floodwall”) and are used to prevent floodwaters from reaching a building. The standard design for earthen berms is three horizontal feet for each vertical foot (3:1 slope) requiring a minimum area six feet wide for each foot in height. Floodwalls need less room, but are more expensive. Barriers must be placed so as not to create flooding or drainage problems on neighboring properties, nor can they be constructed in the floodway. Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, a barrier needs to handle leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier. There is no evidence of any barrier walls in the County that protect against surface flooding.

Dry and Wet Flood-proofing

The dry flood-proofing technique involves using measures to seal up a building so floodwaters are prevented from entering it. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting and openings such as doors, windows, and vents are closed, either permanently, with removable shields, or with sandbags. Examples of dry flood-proofing modifications include the following:

- installing watertight shields over doors and windows;
- reinforcing walls to withstand floodwater pressures and impact forces generated by floating debris;

- using membranes and other sealants to reduce seepage of floodwater through walls and wall penetrations;
- installing drainage collection systems and sump pumps to control interior water levels, collect seepage, and reduce hydrostatic water pressures on the floor slab and walls;
- installing backflow valves to prevent the entrance of floodwater or sewage flows through utilities; and
- anchoring the building to resist flotation, collapse, and lateral movement.

Dry flood-proofing of a building has the following advantages and disadvantages:
Advantages

- The appearance of the building is not altered.
- It is appropriate for buildings on concrete slab floors (without basements) and for those without no cracks.
- It is recommended where floodwaters are less than three feet and slow moving or for buildings that are too expensive to elevate (e.g., a slab building).

Disadvantages

- The waterproofing compounds can deteriorate over a period of time.
- It is dependent on human action for the installation of closures on windows and doorways.
- It cannot be used if the structure has a basement.

Wet flood-proofing, unlike dry flood-proofing, allows floodwaters to enter a structure. Wet flood-proofing is appropriate for structures with uninhabited areas below the flood elevation, such as unfinished basements, garages, and crawlspaces. Because wet flood-proofing allows floodwaters to enter a structure, modifications must be made to minimize damage to the portion of the structure below the flood elevation and its contents. Typically, the structure is designed so that walls and floors below the flood elevation are resistant to damage from floodwaters, and utilities and other valuable equipment are located above the flood elevation.

Wet flood-proofing is not feasible for one-story houses because the flooded areas are the living areas. However, basements, crawlspaces, garages, and accessory buildings can be wet proofed simply by relocating furnaces, heavy furniture and electrical outlets. Fuse and electric breaker boxes should be located high and near a door in order to safely turn the power off to the circuits serving flood prone areas.

No matter how little it is done, flood damage is reduced by wet proofing. For example, thousands of dollars in damage can be prevented by simply moving furniture and electrical appliances out of a basement. The County does not maintain any documentation of properties that have been flood-proofed. While there are not technical experts to advise residents on how to flood-proof their properties, the Department of Public Works send out flood-related publications annually to advise residents on these matters.

While the County's Department of Public Works-Bureau of Environmental Services Division has administered a Floodplain Management Program since 2000 and required flood elevation certificates since then, the County has not maintained any records of properties that have been flood-proofed as this is typically done by the individual property owners who bear the time and cost of flood-proofing their properties. These properties would be on record if a building permit was required.

Sewer Backup Protection

In areas where sanitary and storm sewers are combined, basement flooding can be caused by storm-water overloading the system and backing up into the basement through the sanitary sewer line. In areas where sanitary flows and storm-water are carried in separate pipes, the same problem can be caused by cross connections between the sanitary and storm sewers or by infiltration or inflow into the lines.

Buildings that have downspouts, footing drain tile, and/or a sump pump connected to the sanitary sewer service may be flooded inside when heavy rains overload the system. If local code does not require these systems to be directly connected to the sewer system, they should be disconnected. Rain water and surface water should be directed out onto the ground where it will flow away from the building.

Other approaches may be used to protect a structure against sewer backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from flowing out of the lowest opening in the building, the floor drain. They cost less than $25 a piece. However, if water is deep enough in the sewer system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain. The following two measures are more secure, but more expensive ($3,000-$4,000): a) an overhead sewer, which keeps water in the sewer line during a backup, and b) a backflow protection valve that prevents backups from flowing into the building.

The Little Patuxent Reclamation Plant is located in Savage and currently has a capacity of 25 million gallons per day. It is a biological nutrient removal (BNR) process facility that removes nitrogen and phosphorus.

The Bureau of Utilities has a Capacity management operations (CMOM) program for pretreatment that prohibits the discharge of solid waste into the sewer. The Howard County Code Section 18.122a – Regulation of sewer discharges into collection system, discharges obstructive waste. Industries are required to put in pre-treatment devices (grease interceptors, screens) to catch waste. The Bureau conducts inspections on a regular basis and requires industries to send reports. Restaurants are provided wastewater discharge permit for the removal of food from wastewater before discharge from sewer main. Industries are required to put in pre-treatment devices to remove obstructive waste so that it will be removed from wastewater before it is discharged into the county sewer line.

The Bureau has monitoring stations that determine if pipelines have the capacity to be able to accommodate discharge from a certain community. Sewage Backups are handled by the Bureau of Utilities. For sewage blockage issues, the County can dispatch a sewer truck to send a high-pressure water hose down through the cleanout, near the property line, and out to the sewer main. This typically resolves the problem if the blockage is on the County's side and will ensure that the County's portion of your sewer service is open and not causing the problem.

Flood Insurance

With the purchase of flood insurance, as long as the policy is in force, the property is protected. Although most homeowner’s insurance policies do not cover a property for flood damage, an

owner can insure a building for damage by surface flooding through the National Flood Insurance Program.

Flood insurance coverage is provided for insurable buildings and their contents damaged by a "general condition of surface flooding" in the area. Building coverage is for the structure. This includes all things that typically stay with the building when it changes ownership, including: utility equipment (furnace or water heater); wall-to-wall carpeting; built-in appliances; and wallpaper and paneling.

Ten percent of a residence's building coverage may apply to a detached garage or carport. Other appurtenant structures are required to be insured under a separate policy.
Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage. Items not insurable include:

- items outside a building, such as fences, car ports, landscaping and driveways;
- jewelry, artwork, furs and similar items valued at more than $250;
- finished structural parts of a basement, such as paneling and wall to wall carpeting;
- animals and livestock;
- licensed vehicles;
- money or valuable papers; and
- contents in a basement.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times and not wait for the river 'to rise' before they buy their coverage.

Through the Basement Backup Insurance, the National Flood Insurance Program covers seepage and sewer backup for an additional deductible provided there is a general condition of flooding in the area which was the proximate cause of the basement becoming wet. Several insurance companies offer coverage for damage incurred should a sump pump fail or a sewer line back-up. Most exclude damage from surface flooding that would be covered by the NFIP. Each company has different amounts of coverage, exclusions, deductibles, and arrangements.

National Flood Insurance Program

FEMA produces loss and claim statistics for all NFIP communities throughout the Country. Tables 4.1 and 4.2 provide data on the loss and policy statistics respectively, for Howard County as of March 2010. Howard County incurred 0.8 percent of the total losses for the State of Maryland and 0.9 percent of the total policies.[3]

Table 4.1 Howard County insured loss statistics

Area	Losses	Total Payments
Maryland	14,425	$237,869,311.15
Howard County	113	$557,442.89

Source: bsa.nfipstat.com as of 3/31/2010

[3] FEMA's Policy and Claim Statistics for Flood Insurance http://www.fema.gov/business/nfip/statistics/pcstat.shtm

Table 4.2 Howard County NFIP policy statistics

Area	Policies in Force	Insurance in Force	Whole Written Premiums in Force
Maryland	68,697	$14,170,390,900	$35,407,802
Howard County	609	$166,779,200	$349,168

Mandates

Mandates are compulsions that are used when incentives are inadequate to convince a property owner to take protective actions. An example of a mandate: If the project is worth more than 50 percent of the value of the original building it is considered a “substantial improvement”. The building must then be elevated or otherwise brought up to current flood protection codes.

Currently, there is a two-foot freeboard mandate for structures in the 100-year floodplain. Also, the County requires an elevation certificate for all residential and nonresidential structures built in special flood hazard areas at or above the base flood elevation. The certificate is required to indicate that the lowest floor of the structure has been built at or above the base flood elevation. The elevation certificate is required to be completed before the structure is used or a certificate of occupancy is issued.

CHAPTER 5: EMERGENCY SERVICES

Introduction

Emergency services involve measures to protect people during and after a disaster. In this Chapter, the following five types of emergency services measures are discussed: 1) Threat recognition; 2) Warning; 3) Response; 4) Critical facilities protection; and 5) Post-disaster recovery and mitigation.

Threat Recognition

A flood threat recognition system provides early warning to emergency managers. The National Oceanic and Atmospheric Administration (NOAA) Weather Radio is considered the official source for weather information.

There are two levels of notification in flood warning programs: 1) a flood watch - where conditions are right for flooding; and 2) a flood warning - when a flood has started or is expected to occur. Under certain conditions, the National Weather Service may issue a “flash flood watch.” This means the amount of rain expected may cause rapid increases in local stream flows and/or localized ponding.

In Maryland, the County Emergency Management Agencies (EMAs) are alerted by the Maryland Emergency Management Agency. Warnings from the National Weather Service are relayed to municipalities by county EMAs that monitor weather radio and broadcast networks. Howard County's weather is forecasted by the National Weather Service located in Sterling, Virginia. This location provides daily updates on weather advisories, watches, and warnings. In the event of severe weather, up-to-date information is broadcast on local television channels and the following radio channels: WBAL-AM 1090, WMAL-AM 630, WTOP-FM 107.7, WIYY-FM 97.9 and updated on the County’s Emergency Management website http://www.co.ho.md.us/News

The County‘s flood warning system comprises two sets of gauges: one that monitors the Patapsco River Basin and the other that monitors the Little Patuxent River Basin. When there is a flood threat, the flood warning alarms only go to a pager and cell phone kept by the flood warning on-call staff.

Warning

Once a flood threat is recognized, the first priority is to alert others through the flood warning system. The second priority is to respond with actions that can prevent or reduce damage and injuries. Alert and warning systems in the county comprise of the following:

- Emergency Management Network (EMnet) that is administered statewide by MEMA and provides a means for the County to deliver emergency public information and advisories directly to the news media via a satellite dish located at the EOC;
- Emergency Alert System (EAS) which is a network of public broadcast stations and interconnecting facilities to operate in a controlled manner during a national emergency and for warnings that need immediate action such as tornadoes and flashfloods;

- National Warning System (NAWAS) is used for warning of national emergencies. This is a civil defense system sued to disseminate warnings from the National Warning Center to each state by landline;
- Howard County Notification System (HCNS) which serves as the community's calling system used to deliver emergency and routine messages;
- AM Radio Travelers Information System (TIS) doubles as part of the county's alert and warning system to disseminate emergency information to residents and visitors; and
- Radio Amateur Civil Emergency Service (RACES) which provides communications of local government under the direction of the OEM.

The County maintains a local flood warning system comprising several rain and stream level gauges located throughout the County. These gauges are monitored during storms to determine when significant flooding can be expected. If necessary, County residents who live in low lying flood prone areas will be alerted to possible flooding hazards. More information on Howard County river gauges is available at http://www.afws.net/data/md/Howard.HTM

Response

An Emergency Operations Plan (EOP) is a document that identifies emergency planning, organization, and response policies and procedures including details to address the integration and coordination with other governmental levels, when required. The EOP identifies how the jurisdictions will respond to extraordinary events or disasters from preparation through recovery. Typically, emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available. They should also be reviewed and revised after a disaster and incorporate the changing conditions. A well-written Emergency Operations Plan will contain information to enable emergency management staff to identify the number of properties flooded or that would be flooded, roads that would be under water, and critical facilities that would be affected during a flood event. This information will enable staff to determine the resources that will be needed to respond to the predicted flood event.

Howard County's Emergency Operations Plan is administered by the County's Fire and Rescue staff. The Howard County Emergency Operations Plan identifies actions to be taken by the county government as well as cooperating private organizations. This helps to reduce the County's vulnerability to any disasters that may strike, to establish capabilities for protecting citizens from the effects of disasters, and to provide recovery in the aftermath of any emergency involving extensive damage or debilitating influence on the normal pattern of life within the community. The Basic Emergency Operations Plan and all 20 annexes are working documents and are reviewed and revised on an ongoing basis. The annexes are based on the Emergency Support Functions (ESFs). The Basic Plan is coordinated using the Incident Command System (ICS) and the National Incident Management System (NIMS). The Basic Plan also identifies the organizations and assigned responsibilities of key personnel including the EOC Director as well as various personnel that would be involved for respective Operation Levels (Table 5.1).

The Basic Plan sets out general operational procedures for responding to a variety of hazards that could occur in the County as identified by the County's Natural Hazard Mitigation Plan and other assessments.

The Howard County OEM ensures that the Federal, State and County activities are implemented with respect to emergency management procedures. Coordination is obtained at the regional level, state level, and with private entities. The County has entered into compacts with seven Baltimore urban area jurisdictions through the Baltimore Regional Emergency Management Compact (BREAC). BREAC provides for mutual cooperation in emergency exercises, testing or training activities using equipment or personnel that simulates performance of aid sharing by signatory jurisdictions. In terms of state coordination, in accordance with the Maryland Public Safety Code Title 14 Subtitle 7, county agencies may have mutual aid agreements that authorize Howard County government to ask other governments for assistance in the event of a disaster.

Table 5.1 Agency responsibilities for flood emergency responses

Action	Responsible Agency
Ordering an evacuation	County Executive (Title 6 of the County Code)
Conducting an evacuation	Office of Emergency Management with advise from the Department of Public Works, Bureau of Environmental Services, Storm Water Management Division
Operating and maintaining the flood warning system	Department of Public Works, Bureau of Environmental Services, Storm Water Management Division
Activating the emergency operations center	Fire and Rescue, OEM (Title 17 of the County Code)
Opening and operating evacuation shelters	Citizen Services
Sandbagging certain areas	Department of Public Works
Closing streets or bridges	Department of Public Works, Bureau of Highways
Guarding sandbag walls and other protection measures	Department of Public Works, Bureau of Highways
Shutting off power to threatened areas	Responsibility of the property owners or DFRS (Title 17 of the County Code.) Power company would be responsible for the actual shut-offs
Identifying landfill and debris staging and storage areas for use during emergencies	Department of Public Works, Bureau of Environmental Services, Solid Waste Operations Division
Releasing children from school	Board of Education

Emergency management services at the State level are coordinated by the Maryland Emergency Management Agency. At the county level, the Howard County Department of Fire and Rescue, Office of Emergency Management is the entity responsible for planning and coordinating plans, procedures, and resources in preparation for natural as well as human-caused disasters. The County EMA is located at 6751 Columbia Gateway Drive. The Primary Emergency Operations Center will be located at the Ligon Building in Ellicott City and is expected to be completed in October 2010.

The 2009 Emergency Operations Plan identifies the EOC as the location for centralized policy direction and control of emergencies and a location for coordination of the County's emergency response and recovery, including interagency and intergovernmental response activities, information collection and analysis, communication, and resource allocation and tracking. An Alternate EOC (AEOC) is the designated operating facility used in the event that the EOC is inoperable. It provides the same functions as the EOC. The back-up center is located at the Public Safety Training Center. This Center is currently being utilized as the EOC while construction of the primary EOC is in progress.

The 911 Communications Center serves as the County's Public Safety Answering Point (PSAP) and provides communications support to the field with all available communication media. It is staffed 24 hours a day, seven days a week.

The Technology and Communications Annex (ESF 2) provides information and guidance on the available and potentially available emergency communications systems for Howard County in responding to and recovering from emergencies.

The County's hazard response for EOC activation and evacuations can be found under the Title 6 County Code. The purpose of an evacuation plan is to provide an orderly and coordinated evacuation in the event of small scale localized evacuations such as a riverine flood, hazardous materials incident, fixed nuclear facility incident, major fire or transportation accident, or a large scale evacuation (enemy attack or a hurricane).The County does not have a separate evacuation plan. However, the police department does have a "thru-vacuation plan" and other traffic plans for moving people through and around the County. There is a need to develop a specific evacuation plan for vulnerable areas. The County's Department of Fire and Rescue website also provides a link to emergency management information. (http://www.co.ho.md.us/FAR/FAR_HomePage.htm) and links to the Office of Emergency Management, hazards, educational programs, and frequently asked questions. However, a link to brochures and other information to assist families in developing a disaster preparedness plan to be better equipped to handle a disaster is not available on the website.

Critical Facilities Protection

Critical facilities include emergency operations centers, police and fire stations, hospitals, and roads and bridge and those facilities, that, if flooded, would create secondary disasters such as hazardous materials facilities, water and wastewater treatment plants and pump stations, schools, and nursing homes.

Critical facilities are vital to the functioning of a community and to the flood response effort. If a critical facility is flooded, workers and resources may be unnecessarily drawn away from protecting the rest of the community. If such a facility is adequately prepared, it will be better able to support the community's flood response efforts.

The Little Patuxent Water Reclamation Plant located at 8900 Greenwood Place, the North Laurel SPS building at 10150 Washington Boulevard, the Pumping Station on Brockbridge Road, and the Fire Department in Lisbon are within the floodplain.

Post-Disaster Recovery and Mitigation

Post disaster recovery refers to steps taken by a community to prepare people and property after a disaster and for the next disaster. These activities are implemented during recovery to keep people from immediately going "back to normal" (i.e., the way they were before the disaster). While recovery operations follow a disaster, mitigation actions are undertaken when communities are in 'quiet' mode, prior to a disaster or several months after a disaster occurs in order to reduce the impact of a future disaster.

Some examples of recovery actions include the following:

- Clearing streets;
- Cleaning up debris and garbage;
- Patrolling evacuated areas to prevent looting;
- Providing safe drinking water;
- Monitoring for diseases and vaccinating residents for diseases such as tetanus; and
- Regulating reconstruction to ensure that it meets all code requirements.

After a disaster, various types of assistance may be available to the County by local, state and federal governments. In the event of a Presidential disaster declaration, the County becomes eligible for Individual Assistance (IA) and Public Assistance (PA). Individual Assistance are typically funded by the US Small Business Administration and other federal, state, and local agencies that support the program and are designed to provide help to individuals and businesses, homeowners and renters, as they recover from disasters.

The Public Assistance program is largely funded by FEMA with local and state matches. The PA program provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain non-profit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver governmental-like services.

Post-disaster damage assessment efforts within the County are carried out by the Department of Inspections, Licenses, and Permits (DILP). ESF 19, Damage Assessment, is responsible for conducting preliminary damage assessment. DILP is entrusted with ensuring that significant personnel are trained to conduct rapid damage assessment immediately following the emergency. PDW staff will be responsible for coordinating activities with the Flood Mitigation Steering Committee after a flood event, to ensure that the applicable mitigation actions are brought to the County Commission for potential implementation. This coordination should be reflected in the update of the County's Emergency Operations Plan.

ESF 18 in the EOP addresses Long-Term Community and Economic Recovery and Mitigation

Examples of mitigation actions include the following:

- Conducting a public information campaign to advise residents about various mitigation alternatives that could be considered;
- Assessing damage to public facilities and developing measures to mitigate hazards in the future;
- Acquiring substantially or repeatedly damaged properties from willing sellers; and
- Applying for post-disaster mitigation funds.

The 2004 Howard County All-Hazard Mitigation Plan was funded by FEMA and the Maryland Emergency Management Agency. The Plan provides recommendations for the mitigation of a number of different hazards (including floods) that pose a risk to the County's structures and residents. The Mitigation Plan is due for an update in 2010. This Flood Mitigation Plan will serve as an annex to the mitigation plan update. FEMA's Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) are two common funding sources that assist with flood-related mitigation activities.

CHAPTER 6: STRUCTURAL PROJECTS

Introduction

Structural projects are designed to control floodwaters and include: reservoirs, levees and floodwalls, channel improvements, crossings and roadways, drainage and storm sewer improvements, and drainage system maintenance. Based on their sheer magnitude, structural flood control is generally the most expensive type of mitigation measure in terms of installation costs, maintenance requirements and environmental impacts. Therefore, considerable and thorough analysis is required before a structural project is selected. Since these projects often have regional or watershed-wide implications, they are typically planned, funded and implemented by regional agencies such as watershed authorities.

Flood control projects have the following advantages and disadvantages:

Advantages

- These projects can provide the greatest amount of protection for the land area used;
- Due to land limitations, may be the only practical solution in some circumstances;
- They can be beneficial to the community for water supply and recreational uses; and
- Regional detention may be more cost-efficient and effective than requiring numerous small detention basins.

Disadvantages

- They disturb the land and disrupt natural water flows, often destroying wildlife habitat;
- They require regular maintenance in order to function properly;
- They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage;
- They can create a false sense of security as people protected by a project often believe that no flood can ever reach them; and
- They end up promoting more intensive land use and development in the floodplain.

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Reservoirs and Dams

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought). Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have be built close to or disrupt the area to be protected.

Reservoirs are very efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased. In urban areas, some reservoirs are simply manmade holes with the capacity to store floodwaters. While reservoirs and detention basins are an effective means to control flooding by storing water, they have the following disadvantages:

- Threat of flooding to the protected area if the reservoir's dam fails;

- Facility maintenance expenses;
- Failure to prevent floods if their design capacity is exceeded;
- Sediment deposition may occur and reduce the storage capacity over time;
- Their impact on water quality as they are known to affect temperature, dissolved Oxygen, Nitrogen, and nutrients; and
- If not designed correctly, they may cause backwater flooding problems upstream.

The Maryland Department of the Environment lists a total of 12 dams in its dam inventory for Howard County. Overall, the County ranks as medium-low risk for dam failure. The 2009 County Emergency Operations Plan identifies two high hazard dams - the Centennial Park Dam and the Columbia Gateway dam. Other dams that are of significant hazard are those at Lake Elkhorn, North Laurel Pond, Wilde Lake, and Wyndemere Pond. The Brighton Dam and Rocky Gorge Dam are potential threats to businesses in Laurel.

DPW operates and maintains two high hazard dams and two significant hazard dams. The County also contains or borders on additional dams that are not owned by the County, which could impact residents. These include Wilde Lake, Lake Elkhorn, T. Howard Duckett Dam, Brighton Dam, and Liberty Reservoir.

Several dams in the County were originally built for power generation and recreation but are not being maintained and therefore are not performing the functions for which they were intended. The following is the status of these dams:

- Simpkins Dam – Ilchester – permit issued; contract will be awarded and construction started Fall 2010 for removal
- Daniels Dam – being structurally evaluated for consideration of whether to retain, repair, or remove the dam
- Bloede Dam – being structurally evaluated for consideration of whether to retain, repair, or remove the dam Union Dam – removed in March of 2010

All dams in State of Maryland are subject to inspections by the State of Maryland's Dam Safety Division and the Corps of Engineers. A potential failure at any of the dams in the County would be called into the Emergency Management Department and relayed to citizens via local radio outlets.

Dam break emergency action plans (EAPs) exist for the following six dams[4]:

- Centennial Park Dam (high hazard)
- Columbia Gateway Dam on Samuel Morse Drive (high hazard)
- Lake Elkhorn Dam (significant hazard)
- Wilde Lake Dam (significant hazard)
- North Laurel Dam on Sewall Avenue (significant hazard)
- Wyndermere Dam on Old Scaggsville Road (significant hazard)

Local Emergency Action Plans exist for Centennial Lake, Columbia Gateway Dam (Samuel Morse Drive), North Laurel Dam (Sewall Avenue), Wyndemere Dam (Old Scaggsville Road) and were last revised in October 2009.

[4] Source: 2009 Howard County Emergency Operations Plan

Levees/Floodwalls

Barriers that are constructed out of earth are termed as levees and those that are constructed of concrete or steel between the watercourse and the property to be protected are called floodwalls. Levees occupy more space than floodwalls; therefore, when adequate space for a levee is not available, floodwalls are used, even though they are usually more expensive. Levees and floodwalls are usually not constructed in the floodway. Designs for both levees and floodwalls are required to provide for access through (e.g., watertight closures) or over (e.g., ramps or stairs) the barrier. In addition, the designs for both levee and floodwall projects are required to compensate for any loss of flood storage that will result from construction. There are no levees or floodwalls within the County.

Bridge Modifications

Modifications to bridges involve the replacement, enlargement, or removal of existing bridge decks at roadway and railway crossings. Oftentimes, bridges are not large enough to pass flood flows, causing floodwater to back up upstream of the structure.

In Howard County, the Bureau of Highways, which is a part of the County's Public Works Department, is entrusted with the maintenance and improvement of roadways and bridges. DPW operates 970 miles of local roads and 147 bridges. Capital projects are managed by the Transportation and Special Projects Division in the Bureau of Engineering.

The largest bridges in the County are located where I-70 crosses the Patapsco River and in the eastern part of the County where I-95 spans the Patuxent River and U.S. 29 crosses Rocky Gorge Reservoir.

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The State Highway Administration completed a preliminary hydrologic analysis for MD 295 from MD 100 to I-195. The full project includes the stretch on MD 100 to I-195 and Hanover Road from High Tech Drive in Howard County to MD 170 (Aviation Blvd) in Anne Arundel County. The purpose of the study was to investigate the hydraulic need for a new structure over Deep Run and the required elevation for that structure so that the road meets the flooding requirements for an arterial roadway. The findings of this report will serve as the foundation to analyze floodplain changes. SHA determined that a permit would not likely be issued to the project if floodplain elevations are modified by more than 0.5' or 1', unless additional mitigation measures are taken. In the design phase, coordination with FEMA will be required to ultimately determine impacts to regulated floodplains, as well as identify appropriate mitigation measures.

Channel Improvements

Channels can be improved by making them wider, deeper, or straighter. Improving channel conveyance causes more water to flow through it at a faster rate. However, channelized streams could create or worsen flooding problems downstream as larger volumes of water are transported at a faster rate. While channel improvements are one-time projects, they have to be maintained regularly to clean out blockages caused by overgrowth or debris. Some communities pass ordinances prohibiting dumping and making riverfront owners responsible for maintaining these areas. A proper maintenance program includes picking up debris as well as riparian restoration, i.e., removing non-native growth. By planting native grasses and plants, there are

fewer sources of logs and woody debris, soils are better stabilized, bank erosion is reduced and habitat is improved.

Channel Improvements - The Department of Public Works (Bureau of Highways) maintains roadside drainage ditches on an as-needed basis and maintains rip-rap right at their storm drain outfalls and road culverts. The Bureau of Utilities may place rip-rap over a water or sewer line to protect the pipes, as needed, where they cross under a stream. In terms of stream channelization, some streams are piped as part of a storm drainage improvement project or more often a new development. Beyond that, there are no other notable channelization projects.

Dredging

Dredging is a form of conveyance improvement. However, it is often cost prohibitive because the need to dispose of the dredged material. Dredging may not be effective in most cases given the large volume of water that comes downstream during a flood, and so removing a foot or two from the bottom of the channel will have little effect on the height of the flood. Dredging is not a permanent improvement. Unless in-stream and/or tributary erosion are corrected upstream, the dredged areas usually fill back in within a few years, and the process and expense have to be repeated. In order to protect the natural values of the stream, Federal law requires an Army Corps of Engineers permit before dredging can proceed. This can be a lengthy process that requires much advance planning and many safeguards to protect habitat.

Occasionally, some storm water management ponds in the County are dredged. The County has a dredging project for Centennial Lake. Currently, the Columbia Association is dredging from all three of their lakes.

Diversion

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. During normal flows, the water stays in the old channel. During flood flows, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river. Unless the receiving water body is relatively close to the flood prone stream and the land in between is low and vacant, the cost of creating a diversion can be prohibitive. Where topography and land use are not favorable, a more expensive tunnel is needed. Sometimes diversions could cause new flood problems when diversion channels may be blocked by residents who do not understand, or disagree with, their purpose.

Occasionally the County's Bureau of Environmental Services relocates a short stretch of stream channel, by a few feet in an effort to fix and relocate an eroding stream bank away from a structure (house, shed, fence, etc). There are no other diversions in Howard County on record.

CHAPTER 7: NATURAL RESOURCE PROTECTION

Introduction

Natural resource protection activities focus on preserving floodplains and watersheds, thereby improving their naturally beneficial functions. These functions include: storage of floodwaters, absorption of flood energy, groundwater recharge, removal/filtering of excess nutrients, pollutants, and sediments from floodwaters, habitat for flora and fauna, and recreational and aesthetic opportunities, among others. These measures are implemented by a variety of public and private entities ranging from local park districts and regulatory agencies to land developers and farmers. The following five natural resource protection activities are discussed below in light of reducing the County's susceptibility to flood damage and also in improving the quality of life in the community: 1) Chesapeake Bay Critical Area Program; 2) wetland protection and forest conservation; 3) erosion and sedimentation control; 4) best management practices; and 5) dumping regulations.

Wetland Protection and Forest Conservation

Wetlands are often found in floodplains and depression areas of a watershed and also serve as a natural filter to help improve water quality and provide healthy habitat for fish, plants, and wildlife. They receive and store floodwaters, thus slowing and reducing downstream flows and protect shorelines from erosion. Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Both these agencies are required to sign off on individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits. The purpose of the permit is to protect wetlands by preventing development that would adversely affect them, and in this case, wetlands are required to be mitigated. Wetland mitigation can include creation, restoration, enhancement or preservation of wetlands. The appropriate type of mitigation is addressed in each permit. Development regulations and educating property owners and local officials on the benefits are some ways to protect wetlands.

As reported in the 1999 Comprehensive Recreation, Parks and Open Space Plan, the County has approximately 3,000 acres of nontidal wetlands, most of which are located in stream valleys associated with the 100-year floodplain. Section 16 of the County Code addresses wetlands and specifies the following:

- Grading, removal of vegetative cover and trees, paving, and new structures are not permitted within 25 feet of a wetland in any zoning district.
- Grading, removal of vegetative cover and trees, paving, and new structures are not permitted within 50 feet of an intermittent stream bank; 75 feet of a perennial stream bank for Use I streams as classified by the Maryland Department of the Environment in residential zoning districts; 100 feet of a perennial stream bank for Use III and IV streams; and 50 feet of a perennial stream bank in nonresidential zoning districts.

Section 16.116 of the Subdivision and Land Development Ordinance discusses the protection of wetlands and streams. Grading, removal of vegetative cover and trees, paving, and new structures is not permitted within 25 feet of a wetland in any zoning district. Grading, removal of vegetative cover and trees, paving and new structures is not permitted within:

(i) 50 feet of an intermittent stream bank;
(ii) 75 feet of a perennial stream bank for use I streams as classified by the Maryland Department of the Environment in residential zoning districts and residential and open space land uses;
(iii) 100 feet of a perennial stream bank for use III and IV streams; and
(iv) 50 feet of a perennial stream bank in nonresidential zoning districts.

In residential subdivisions, wetlands, streams, and their buffers are required to be located in required open space or a non-buildable preservation parcel rather than on residential lots.

The Howard County Forest Conservation Manual is the technical manual used to establish standards of performance required in preparing forest stand delineations and forest conservation plans. The Forest Conservation Manual is prepared by the Department of Planning and Zoning. The Manual includes standards and guidelines for forest conservation plans, forest stand delineations, reforestation and afforestation, forest mitigation banking, and other forestry related activities.

The Maryland Forest Service defines a buffer of at least 50 feet to be forested on each side of a stream with an increase of 4 feet for every 1 percent increase in slope. Section 12 of the County Code discusses Forest Conservation requirements. A Forest Conservation Plan is required for a subdivision plan, site. Unless exempted, any person or unit of local government developing land 40,000 square feet or greater in an area is required to file a forest conservation plan with the Department of Planning and Zoning.

Erosion and Sedimentation Control

Erosion occurs along stream banks and shorelines when the volume and velocity of flow or wave action destabilize and wash away the soil. Surface water runoff can erode soil from construction sites, sending sediment into downstream waterways. This sediment tends to settle down when the water flow slows down and can clog storm sewers, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands. When channels are constricted and flooding cannot deposit sediment in the bottomlands, and results in clogged streams or increased dredging costs. These issues are addressed through sedimentation and erosion measures which include: phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices. Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project.

Erosion and Sediment Control regulations are contained in Chapter 7 of the County's Design Manual. The Department of Public Works coordinates with the Howard Soil Conservation District in administering soil erosion and sediment control regulations in the county. The Howard Soil Conservation District is the ultimate review and approval authority. Field inspection for erosion and sediment control facilities and practices are conducted by the Department of Inspections, Licenses, and Permits. The Maryland Department of the Environment's (MDE) publication, Maryland Standards and Specifications for Soil Erosion and Sediment Control serve as the basis for soil erosion and sediment control in Howard County.

Section 16.123 of the Land Development and Subdivision Ordinance addresses Sediment Control issues:

- The developer is required to plan for practical and effective sediment control on the site to prevent off-site damages due to erosion and sedimentation processes which are accelerated by changing vegetation and grades.
- Plans for erosion and sediment control measures are required to be prepared in accordance with the requirements of the Howard Soil Conservation District and be approved by the Department of Planning and Zoning in consultation with the Soil Conservation District, the Department of Inspections, Licenses and Permits and the Department of Public Works.

The County is also responsible for the coordination of the erosion and sediment control with other components of the storm drainage system, the provision of standard details, application of erosion control to storm drains and supplemental requirements related to both health and safety.

The erosion and sediment control plans are required to indicate how sediment will be prevented from entering the filtration area. Filtration BMP's such as bioretention, surface sand filters, underground sand filters, perimeter sand filters, organic filters and pocket sand filters and non-structural BMP's such as dry wells, dry swales, wet swales, etc. cannot serve as a sediment control device during construction.

Based on erosion and sediment control regulations from the Maryland Department of the Environment, an approved plan is required for any earth disturbance of 5,000 square feet or more and 100 cubic yards or more; plan approval exemptions for agricultural uses; plan review and approval by the Howard Soil Conservation District; and project inspection by the County's Department of Licensing and Permitting. Clearing or grading activities that disturb less than 5,000 square feet of land area and less than 100 cubic yards of earth are not required to submit a plan.

The County's Department of Public Works-Bureau of Highways coordinates various water quality programs and designs storm drains and storm water ponds for established parts of the County. The County follows a State mandated maintenance program and County staff is required to check and clean storm water ponds and dredge them periodically.

Best Management Practices

The term Best Management Practices refers to design, construction and maintenance practices and criteria that minimize the impact of storm water runoff rates and volumes, prevent erosion, protect natural resources and capture nonpoint source pollutants (including sediment). In addition to preventing increases in downstream flooding and minimizing water quality degradation, BMPs preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple uses of drainage and storage facilities.

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the Environmental Protection Agency and Maryland Department of the Environment. Nonpoint source pollutants come from non-specific locations and are harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm

chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry.

The General Plan 2000 encourages the development and implementation of watershed management plans as a comprehensive approach to protecting and restoring the County's water resources. The Plan promotes Best Management Practices to protect water quality and avoid erosion as part of agricultural activities and land development[5].

The Department of Public Works, Bureau of Environmental Services is entrusted with the responsibility of inspecting and requiring maintenance of the BMPs. These BMPs that the Bureau oversees are not agricultural in nature, but are storm water management BMPs built as part of approved development plans. Structural BMP facilities that are outlined in the Storm water Design Manual are required to be located on open space lots within the appropriate easements. BMP's on individual lots such as dry wells, rain gardens and overland flow used to obtain storm water management disconnection credits are not required to have easements.

Dumping Regulations

While BMPs address pollutants that are liquids or suspended in water that are washed into a lake or stream, dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Although these materials do not pollute the water, they can obstruct flows and reduce the channels' and wetlands' ability to convey or clean storm water. Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. People may not realize the consequences of their actions and for example, may fill in the ditch in their front yard without realizing that it is needed to drain street runoff. Therefore, a dumping enforcement program could prevent this and help in education people on the same.

Dumping and placing debris in channels are addressed in Section 18.500 of the Howard County Code. Residents are prohibited from discharging any pollutant or non-storm water discharge into a storm drainage facility or waterway which contaminates or alters the physical, chemical, or biological properties of any water conveyed to a storm drainage facility including, without limitation, a change in the temperature, taste, color, turbidity, or odor.

Exceptions to this rule include: waterline flushing or discharges from other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising groundwater, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, foundation or footing drains, air conditioning condensate, irrigation waters, springs, individual residential vehicle washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and fire fighting activities; and discharges permitted under a NPDES storm water discharge permit or a non-storm water discharge permitted under a NPDES discharge permit.

Dumping into streams and rivers is considered a violation of the Howard County Code. This includes grass clippings and branches that can accumulate and plug channels. Residents are also encouraged to check that local storm drains are clear of debris when a heavy rain or snow event is expected, to prevent water from backing up and flooding local areas.

[5] 2006 Land Preservation, Recreation, and Parks Plan

CHAPTER 8: PUBLIC INFORMATION

Introduction

The Public Information aspect of flood mitigation involves the dissemination of pertinent information to property owners, renters, businesses, and local officials about hazards such as flooding and ways to protect people and property from these hazards. These actions are intended to educate the community and encourage them to be better prepared to face a hazard. Public information can be disseminated in many ways. The following six methods are discussed in this chapter: 1) Map information; 2) Library and websites; 3) Outreach projects; 4) Technical assistance; 5) Real estate disclosure; and 6) Educational programs.

Map Information

Flood maps provide valuable information about past and potential flood hazards and can help residents and businesses, who are aware of the potential hazards, take steps to avoid problems and/or reduce their exposure to flooding. They are also useful to real estate agents and house hunters as they can determine if a property is flood prone and whether flood insurance may be required.

The Department of Planning and Zoning and the Department of inspection, Licenses and Permits (for building permits) enforce the floodplain management ordinances and coordinates the review of new development projects in the floodplain with developers and their consultants. In the past, the County has filed a Letter of Map Amendment (LOMA) for the owner and conducted the survey as well, but this has been discontinued due to the liability issue. Presently, the property owner hires a surveyor to file the LOMA with FEMA. All paperwork is sent by the property owner to, and administered by, FEMA. The County may get a phone call that the owner is interested in filing a LOMA, but don't typically receive anything from the owner or from FEMA once a LOMA has been issued.

Library and Web Sites

The community library and local web sites are common places for residents to seek information on hazards, hazard protection, and protecting natural resources. Interested property owners can read or check out handbooks or other publications that cover their situation. Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government. However, more recently, web sites have become popular as research tools as they provide quick access to a wealth of public and private sites and sources of information.

The main library is located on Little Patuxent Parkway and its five branches are located in East Columbia, Elkridge, Glenwood, Miller, and Savage. The libraries stock flood related books and publications. The libraries' website offers a search feature where flood related books, publications and FIRMS may be viewed by typing the keywords on their website http://polaris.hclibrary.org/polaris/search/searchresults.aspx?ctx=1.1033.0.0.6&type=Keyword&term=flood%20&by=KW&sort=RELEVANCE&limit=TOM=*&query=&page=0.

The County and local libraries provide residents with flood risk information FEMA FIRMs. These maps show the locations of properties relative to the floodplain. The County's website at http://gis.howardcountymd.gov/InteractiveMap/Myinteractive.aspx enables resident to access the County mapping Geographic Information Systems and map their location to determine if they are in a flood area.

The Howard County website houses a link to flood information at http://www.howardcountymd.gov/DOA/DOA_PIO_FloodInfo.htm. The link contains information on what county residents should do during heavy rains and how to prepare during a flood. The link also contains a list of frequently flooded roads within the County for residents to avoid during a flooding situation. The link also contains information on Emergency Preparedness information: How to prepare for emergencies before they happen, emergency preparedness kits, and links to the Maryland Emergency Management Agency.

The following is a list of FEMA information booklets, manuals, and brochures that are available for review at the County building. In addition to these, there are other manuals and guides available for County officials.

1. Guide to Flood Maps
2. Preparing for Disaster
3. Preparacion y seguridad en inundaciones (Spanish)
4. National Flood Insurance Program Top Ten Facts for Consumers
5. An Insurance Preparedness Guide for Natural Disasters
6. Hurricane Floods- Safety Tips for Coastal Inland Flooding
7. Flood Preparation and Safety
8. After a Flood- The First Steps
9. After the Storm – A Citizen's Guide to Understanding Storm Water
10. Repairing Your Flooded Home
11. Preparing Makes Sense-Get Ready Now, by Homeland Security
12. Flood Insurance Rate Maps

Outreach Projects

Outreach projects are the first step in providing property owners information on property protection and assisting them in the design and implementation of projects. They include distributing notices to flood prone property owners to introduce the idea of property protection and identifying sources of assistance or articles in the newspaper. Examples of other approaches to improve awareness include the following:

- displays in public buildings or shopping malls;
- articles and special sections in newspapers;
- radio and TV news releases and interview shows;
- flood protection videos for cable TV programs or to loan to organizations;
- presentations at meetings of neighborhood groups, realtors, bankers, or other special interest groups;
- open houses that discuss flood-proofing techniques;
- web site notices with hyperlinks to other sources of information; and
- school curricula on flood preparedness and flood safety.

The Department of Public Works, Bureau of Environmental Services sends out annual letters to property owners located in or near areas that are subject to flooding. The letter contains information on the location of flood maps, permits, clearing of storm drains, obtaining flood insurance and important websites.

Technical Assistance

Technical assistance is typically provided by experts such as the local building department staff who offer free advice in terms of various available options and guide residents. Some building department or public works staff visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an activity that is especially appreciated by owners who are unsure of the project or the contractor. This is very helpful to educate owners who do not feel ready to retrofit their buildings without appropriate guidance. Technical assistance can be provided in one-on-one sessions with property owners or can be provided through seminars or open houses on specific topics such as: retrofitting techniques, selecting qualified contractors, and carrying out preparedness activities.

Another effective technique is called a *flood audit*. This involves a flood expert to visit a flood prone site, locates past and potential (e.g., the 100-year) flood depths on the property, and discusses alternative protection measures with the owner. The owner is given a written report with recommendations and a photograph of the property showing flood depths.

When a development project is being proposed in the floodplain, the County staff currently does not provide technical assistance (for example, informing the owner and developer that construction of structures should be as far away from source of flooding as possible and if any filling would be required), or alternate mitigation solutions.

The County's Bureau of Environmental Services that coordinates and prepares various environmental studies also provides technical advisors for surface and ground-water quality projects, the reservoir protection program, and for watershed studies.

Real Estate Disclosure

In many instances, people feel, in hindsight, that they would have taken steps to protect themselves from a disaster, such as a flood, if they had known their property was in a flood-prone area.

Federal law: Federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured by an insurable building that the property is in a floodplain as shown on the Flood Insurance Rate Map. Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only 10 days before closing, often the applicant is already committed to purchasing the property when they first learns of the flood hazard.

Maryland Real Property Disclosure Act: *Effective October 1, 2005, a new Maryland law took effect that substantially affects residential real estate sales within the State. Under the new law, a seller of residential real property - unless otherwise exempt - would still be required to complete and deliver to the purchaser a disclosure or disclaimer statement. In addition to this, a seller - whether the seller elects to give disclosure or disclaimer - is required to disclose to the*

purchaser, any latent defects of which the seller has actual knowledge. Under the new law, a latent defect is defined as material defects in real property or an improvement to real property that a purchaser would not reasonably be expected to ascertain or observe by a careful visual inspection of the real property and which would pose a direct threat to the health or safety of the purchaser or an occupant of the real property, including a tenant or invitee of the purchaser.

Currently, there is no requirement by the Board of Realtors for real-estate agent disclosure if a property is located in the floodplain.

Environmental Educational Programs

Environmental education programs can teach children about natural hazards, their cause and effect, and ways to be better prepared to face hazards, which can, in turn, be imparted to their parents. Assignments on developing an emergency kit for specific hazards can get parents interested and become involved in the exercises. Educational programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps.

The Department of Recreation and Parks regularly offers classes in environmental education. Programs are tailored to the needs of adult or children's groups.

The County hosts an annual Sustainability Summit "Greener Choices, Greener World" in Howard Community College in April. At the GreenFest, citizens are provided with information to make their environments more ecologically sound. The event focuses on purchasing green products, ecological home cleaning and lawn care, alternative energy, water conservation and reuse, organic and local food, and tips for greening everyday activities.

On July 14, 2010 a Rain Garden Workshop was conducted by the Department of Public Works in Ellicott City. The workshop demonstrated ways to design, build and install rain gardens to help soak up rainwater from downspouts, driveways, and sidewalks while protecting local waterways. The County, in cooperation with the Howard County Master Gardeners and the University of Maryland, has created a rain garden demonstration at the Howard County landfill. Residents can view the garden as they drive in to drop off their waste materials. In addition, the County has a rain barrel program where they provide a free rain barrel to residents. Rain barrels help residents control the runoff leaving their property. Those residents whose properties abut a stream, can also obtain free trees from the County through the Stream ReLeaf Program run by the Department of Recreation and Parks.

Font Hill Wetland Park offers educational programs on wetlands and the critical role they play in the Chesapeake Bay Watershed. This program is administered by the County's Recreation and Parks Department.

CHAPTER 9: GOALS AND OBJECTIVES

Introduction

The Mitigation Strategy comprised of goals, objectives, and recommendations, serves as the long-term roadmap for reducing potential losses identified in the earlier sections of the report. This Chapter identifies goals and objectives to help the County to be better prepared to face flooding and specific actions that should be implemented to reduce the community's vulnerability to flooding.

Goals and Objectives

The goals and objectives form a basis upon which, specific mitigation actions will be developed. During the Hazard Mitigation Steering Committee meetings and Public Meetings held in July and August 2010, citizens and local government representatives discussed the findings of the vulnerability assessment, its implications for flooding, and actions that needed to be taken to mitigate the flood risk. Mitigation goals and objectives have been developed for the County and its population center on this premise. For the purpose of this report, goals and objectives have been defined as the following:

- *Goals are general guidelines that explain what is to be achieved. They are usually broad policy-type statements, long term and represent global visions.*
- *Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, they are more specific and measurable.*

The following goals and objectives developed in this Plan have been divided into same categories as chapters 3 through 8 in the report: prevention; property protection; structural projects; emergency services; natural resource protection; and public information.

Prevention

Goal 1: Language in existing plans and ordinances should address protecting properties within the County from flooding.

- Identify techniques to ensure that development or redevelopment in the County does not increase the vulnerability to flooding.
- Continue to ensure proper enforcement of standards and ordinances to make them more effective.

Property Protection

Goal 2: New construction and reconstruction should be resistant to flood damage.

- Encourage high-risk, pre-FIRM residential structures to use retrofitting techniques to avoid repeated flooding.

- Support projects and programs to retrofit, relocate/acquire structures that are susceptible to flooding.

Emergency Services

Goal 3: Critical facilities should be less vulnerable to flooding.

- Identify appropriate mitigation techniques for critical facilities in the floodplain.

Goal 4: Residents should be notified to evacuate early in the event of a flood.

- Improve public awareness and outreach during hazard events.

Goal 5: Better coordination and notification procedures during emergencies are needed.

- Continue to coordinate between departments within the County and population center that are responsible for implementing flood mitigation activities.

Structural Projects

Goal 6: It must be ensured that bridges, dams, and other structures maintain structural integrity.

- *Continue to ensure regular maintenance of flood structures in the county.*

Natural Resource Protection

Goal 7: Existing natural resources and open-space within the floodplain and watersheds should be protected.

- Continue to encourage Best Management Practices for storm water management and erosion and sediment control.

Public Information

Goal 8: Greater emphasis should be given to improving the flood-awareness among county residents.

- Involve community residents in the implementation of this Flood Mitigation Plan and in protecting their own health, safety and property.
- Educate citizens on the flood risk and practices to reduce the flooding potential in the county.
- Take advantage of mitigation funding opportunities

Mitigation Actions

This section includes specific mitigation projects that have been derived from the goals and objectives in Chapter 9 that should be implemented over a period of time. The mitigation actions developed have once again been classified in the same six categories as are the goals and objectives. For each action item, the relevant issue and the goal(s) the action supported by it, are identified. The agency or agencies responsible for implementation as well as applicable funding sources, an approximate cost, and general timeline for the implementation of each mitigation action are included. A detailed list of funding sources is provided at the end of this chapter. The abbreviations used below in the mitigation actions refer to the funding resources listed.

It is important to note that all of the responsible agencies listed below have ever-expanding responsibilities with limited staff resources. In order to accomplish many of these actions, strategies will have to be employed to either secure additional help or rearrange short-term priorities.

Prevention

The most recent Flood Insurance Study (and associated Flood Insurance Rate Maps) was completed for Howard County in 1986. DFIRMs will be made available for comment in early 2011.
Action 1a: Incorporate the results of any new flood studies into the new Digital Flood Insurance Rate Maps (DFIRMs).
Action 1b: Reconcile the new DFIRM data with the flood data in this Flood Mitigation Plan.
Action 1c: Prepare new hydrology and hydraulic studies for the Patuxent and Patapsco areas.
Goal: 1
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division
Possible Funding Sources: FEMA's Map Modernization Program
Approximate Cost: Staff time
Timeline: 1a and 1b: 1-2 years; 1c: 5-10 years

The Comprehensive Plan touches on the 100-year floodplain and other environmentally sensitive areas.
Action 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.
Goal: 1
Responsible Agencies: Planning and Zoning, Public Works-Bureau of Environmental Services: Storm Water Management Division
Funding Source: None required
Approximate Cost: Staff time
Timeline: 1-2 years

There is a need to preserve areas that are environmentally sensitive or hazardous for development such as: wetlands and floodplains. For example, cluster development allows for

areas of concentrated development where the remaining area could be left as undeveloped open space to preserve environmentally sensitive areas.
Action 3: Continue to encourage various land planning techniques (cluster development and transfer of development rights) to provide flexibility in design and conserve common open space.
Goal: 1
Responsible Agencies: Planning and Zoning
Funding Source: None required
Approximate Cost: Not applicable
Timeline: 1-2 years

There are areas within the County where large lots have been subdivided and trees have been cut down to accommodate for additional homes. Mature trees have been cut down and have not been replaced with new trees.
Action 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.
Goal: 1
Responsible Agencies: Planning and Zoning, Recreation and Parks
Funding Source: County funds
Approximate Cost: To be determined
Timeline: 1-2 years

The intensity of development in the County and the fact that it is landlocked makes it more prone to flashfloods since water does not have a place to flow to.
Action 5: Consider developing an Impervious Surface Ordinance for the County that encourages the reduction of newly installed impervious surfaces or offsets the impacts of these surfaces in the County.
Goal: 1
Responsible Agencies: Planning and Zoning
Funding Source: None required
Approximate Cost: Staff time
Timeline: 3-5 years

There is a need for improved coordination between various County departments and population centers within the county as well as at a regional level.
Action 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.
Action 6b: Encourage participation of representatives from the population centers at the quarterly meetings, particularly homeowners associations and Columbia Association so they deal with citizens' flood-related concerns and develop remedies and solutions.
Action 6c: Participate in regular regional meetings with Carroll and Baltimore Counties to address regional flood mitigation issues.
Goal: 5
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management, Carroll County Public Works, Baltimore County Public Works
Possible Funding Sources: None required

Approximate Cost: Staff time
Timeline: 1-2 years

Property Protection

A number of properties within the county flood during small-scale, high recurrence interval events. The location of other properties that incur repeated losses will provide a good indication of the areas and structures that will be threatened during a larger scale event.
Action 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.
Action 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.
Goal: 2
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division
Funding Source: FMA, PDM-C[6]
Approximate Cost: Staff time
Timeline: 7a: 3-5 years; 7b: 1-2 years

Emergency Services

The risk assessment identifies two critical facilities in Howard County that are at risk from flooding.
Action 8a: Develop appropriate mitigation solutions for High Road Academy School
Action 8b: Consider relocating the fire station in Woodbine to higher ground.
Goal: 3
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management
Possible Funding Sources: FMA, PDM
Approximate Cost: $150,000+
Timeline: 3-5 years

Senior centers in the county are used as emergency shelters.
Action 9: Consider structural hardening of the facilities - senior centers – Bain, Ellicott City, and Glenwood and the Department of Corrections Work Release Unit so they can serve as shelters during flood and wind events.
Goal: 3
Responsible Agencies: Office of Emergency Management
Possible Funding Sources: FMA, PDM
Approximate Cost: To be determined
Timeline: 5-10 years

[6] FMA – Flood Mitigation Assistance; PDM-C – Pre Disaster Mitigation - Competitive

Residents in the southeastern portion of the county in the Elkridge and Patapsco State Park areas are outside the reach of the county sirens. There is a need to improve the County's flood warning system.
Action 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.
Action 10b: Consider replacing the Dialogic System with a better emergency notification system.
Action 10c: Improve flood modeling system and capabilities to better predict crest height and timing.
Responsible Agencies: Office of Emergency Management, Department of Public Works – Bureau of Environmental Services: Storm Water Management Division
Possible Funding Sources: Emergency Management Planning Grant
Approximate Cost: <$100,000
Timeline: 10a and 10b: 1-2 years; 10c: 5-10 years

Flashfloods tend to occur when streams overflow. Treat streams as flash flood prone areas.
Action 11a: Create a rating system for areas that flood quickly, to rate the degree of flashflood threat and enhance the current warning system based on the flashflood threat.
Action 11b: Develop signage on roads that frequently flood to warn residents and commuters of the potential flood hazard.
Goal: 5
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management
Possible Funding Sources: None required
Approximate Cost: Staff time
Timeline: 1-2 years

Structural Projects

The wastewater treatment plant in Savage lies within the 100-year floodplain.
Action 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.
Goal: 6
Responsible Agencies: Public Works- Bureau of Environmental Services: Utility Design Division
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: 1-2 years

The County has a good dam inspection program.
Action 13a: Continue to implement the dam inspection program for the regular maintenance of all dams in the county.
Action 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.
Goal: 6
Responsible Agencies: Public Works-Bureau of Engineering
Possible Funding Sources: None required
Approximate Cost: Staff time

Timeline: Continuous

The dams in the County were originally built for power generation and recreation but some are not being maintained and therefore are not performing the functions for which they were intended.
Action 14: Continue to support the study of non-functioning dams on Patapsco River and remove those that are non-functioning and restore the environment.
Goal: 6
Responsible Agencies: Public Works-Bureau of Engineering
Possible Funding Sources: None required
Approximate Cost: Staff time
Timeline: Continuous

There are approximately 41 roads in the county that are frequently flooded, as identified by the Department of Highways.
Action 15: Continue to identify those roads that frequently flood and prioritize them to apply for federal funding to elevate these roads.
Goal: 6
Responsible Agencies: Public Works-Bureau of Engineering, State Highway Administration
Possible Funding Sources: Staff time
Approximate Cost: Staff time
Timeline: 1-2 years

The area on Route 1 at the junction between Howard and Prince George's County on the Middle Patuxent River floods periodically.
Action 16: Coordinate with the Public Works Department in Prince George's County to develop a mitigation solution.
Goal: 6
Responsible Agencies: Public Works-Bureau of Engineering, State Highway Administration
Possible Funding Sources: Staff time
Approximate Cost: Staff time
Timeline: 1-2 years

Natural Resource Protection

Undeveloped land comprises over 20 percent of the total land area and is mostly concentrated in the western part of the County. There is a need to protect natural resources and open-space, including parks and wetlands, within the floodplain and watersheds and consider raising the level of importance of preserving environmentally sensitive areas through the use of improved land use and storm water management principles.
Action 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.
Action 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.
Goal: 7

Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Recreation and Parks, Planning and Zoning
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: 17a: Continuous; 17b: 1-2 years

There are areas within the County that experience storm water runoff issues. For example, Old Columbia Road – Route 29 between Shaker Drive and Gorman Road experiences issues with storm water and the stream tributary of the Middle Patuxent, and Glen Court in Jessup that is built on a swamp.
Action 18: Develop incentives to resolve storm water run-off issues in problem areas throughout the County and work with individual property owners to develop mitigation solutions.
Goal: 7
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Ponds Division
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: 1-2 years

Clearing of trees for development has caused an increase of impervious surfaces and subsequent increase in run-off.
Action 19a: Continue to implement the County tree planting program and examine the stream network to identify areas for more opportunities to plant trees and explore the tree canopy goal.
Action 19b: Continue to enforce the Road Tree Law (to do no harm to existing trees on the boulevard).
Goal: 7
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Bureau of Highways, Tree Maintenance, Planning and Zoning, Recreation and Parks
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: Continuous

In the Deep Run Watershed in Old Ellicott City, there is an island upstream that blocks the flow of water.
Action 20a: Work with the Department of Natural Resources on watershed management issues and for periodic removal of debris from the stream at the Patapsco River and Historic Ellicott City.
Action 20b: Coordinate with DNR, MDE, and the Department of Planning, on stream bank maintenance, debris removal, and excess sedimentation so as not to exacerbate the flood issue in Historic Ellicott City and explore funding opportunities.
Goal: 7
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: 1-2 years

Public Information

There is a need to continue coordination between the county and residents in the floodplain and to make residents aware of flood issues and literature that is readily available.
Action 21a: Continue to ensure that the libraries in the County are stocked with flood protection publications.
Action 21b: Introduce natural hazards awareness programs in schools.
Action 21c: Coordinate with OEM; continue to make flood information available (annual informational mailings/pamphlets to residents in the floodplain) to the citizens via the Public Information Officer to be utilized during flood events.
Action 21d: Continue to distribute pamphlets in advance to inform citizens about how to prepare for potential flood events and for business owners regarding protecting inventory from flooding.
Goal: 8
Responsible Agency: Office of Public Information, Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management, Public Libraries
Possible Funding Sources: Local funds
Approximate Cost: <$50,000
Timeline: Continuous

The County's website could be further enhanced to contain more location-specific disaster-related information.
Action 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 on the County's website.
Action 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.
Action 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.
Goal: 8
Responsible Agency: Office of Public Information, Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management
Possible Funding Sources: None required
Approximate Cost: <$25,000
Timeline: 1-2 years

There is need for technical assistance to flood prone property owners.
Action 23a: Provide technical support to property owners: direct property owners to resources, property protection techniques, and funding sources.
Action 23b: Educate and make County staff available for on-site consultation as needed.
Goal: 8
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division
Possible Funding Sources: FMA, PDM-C, SRL
Approximate Cost: Staff time
Timeline: 1-2 years

Currently, Howard County is a Class 8 CRS community.
Action 24: Continue to implement mitigation actions from the Flood Mitigation Plan and strive to move up to a Class 7 community where residents can obtain a 15 percent reduction in flood insurance premiums.
Goal: 8
Responsible Agencies: Department of Public Works-Bureau of Environment Services: Storm Water Management Division
Funding Source: FMA
Approximate Cost: Staff time
Timeline: Continuous

The DFIRMs for Howard County are scheduled to be released after January 2011. Once adopted by the County Council, these digital maps will replace the paper FIRMs and become the official designation of flood zones in the county. Therefore it will be critically important for all stakeholders to understand how to use a DFIRM to make planning, building, and insurance decisions.
Action 25: When DFIRMs become available, provide training of the use of DFIRMs to stakeholder groups including planners, engineers, realtors, and community leaders.
Goal: 8
Responsible Agencies: Department of Public Works-Bureau of Environment Services: Storm Water Management Division
Funding Source: Local funds
Approximate Cost: <$25,000
Timeline: 1-2 years

Plan Implementation

It must be ensured that this Flood Mitigation Plan is properly implemented and updated.
Action 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.
Action 26b: Meet every six months to review projects that have been completed, altered, or are no longer applicable.
Action 26c: Update the Flood Mitigation Plan every five years and after a flood event.
Action 26d: Integrate this Plan into the All-Hazard Mitigation Plan as an annex.
Goal: All goals
Responsible Agencies: Public Works-Bureau of Environmental Services: Storm Water Management Division, Office of Emergency Management
Funding Source: No funding required
Approximate Cost: Staff time
Timeline: Continuous

Funding Sources

The following funding sources provide grants for flood mitigation planning and project related activities:

- Hazard Mitigation Grant Program (HMGP) – HMGP is administered by FEMA and provides grants to states, tribes and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation activities to be implemented as a community recovers from a disaster. Eligible projects include: elevating flood-prone homes or businesses; acquisition of flood-prone homes from willing owners and returning the property to open space; retrofitting buildings; and construction of floodwall systems to protect critical facilities.

- Pre-Disaster Mitigation (PDM) Program – The PDM program provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. The program provides technical and financial assistance to States and local governments to assist in the implementation of pre-disaster mitigation actions, which must be cost-effective and designed to reduce injuries, loss of life and damage and destruction of property.

- Flood Mitigation Assistance (FMA) Program – FMA provides funding to assist communities and states in implementing actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, or other National Flood Insurance Program (NFIP) insurable structures with a focus on repetitive loss properties. The NFIP enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Three types of FMA grants are available to States and communities: 1) planning grants to prepare Flood Mitigation Plans; 2) project grants to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures; and 3) technical assistance grants for the State to help administer the FMA program and activities.

- Severe Repetitive Loss (SRL) - A SRL property is defined as a residential property that is covered under a NFIP flood insurance policy and: 1) that 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 2) 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. Eligible flood mitigation project activities under the SRL program include: 1) acquisition and demolition or relocation of at risk structures and conversion of the property to open space; 2) elevation of existing structures to at least the base flood elevation; 3) minor physical localized flood reduction projects; and 4) dry flood-proofing for historic properties.

Most State and Federal grant programs require local communities to provide at least part of the necessary project funding in real dollars or through “in-kind” services. While the percentage of local contribution varies from program to program, Local communities need to assess their financial capability and resources to implement their hazard mitigation action plans.

CHAPTER 10 – PRIORITIZATION AND PLAN MAINTENENCE

Prioritization

Once the mitigation actions were finalized by the Steering Committee, mitigation actions were prioritized based on the following evaluation criteria The following questions were used by the Steering Committee to determine the level (high, medium, and low) for the social, administrative, and economic considerations for each action. These priorities were translated into points and facilitate the ranking and identification of high priority projects.

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 reducing flood risk?

Administrative Considerations – Administrative/Technical Assistance

- Is there sufficient staff currently 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?

These considerations were then grouped into low, medium, and high categories and assigned the following points: Timelines for these projects were also established: Short range projects – implemented within first 2 years; Medium range projects - 3 to 5 years; and Long range projects – over 5 years.

Table 10.1 Evaluation criteria for project prioritization

Criteria	Points	High	Points	Medium	Points	Low
Life/ Safety Impact	**10**	Significant impact on public safety for businesses, residents, properties	6	Direct impact on businesses, residents, properties	2	Minimal/negligible impact on businesses, residents, 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)

Table 10.2 Prioritization of mitigation actions

Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Timeline
1a/1b/1c	Incorporate the results of any new flood studies into the new Digital Flood Insurance Rate Maps (DFIRMs).	5.3	3.4	5	13.7	1-2 years
	Reconcile the new DFIRM data with the flood data in this Flood Mitigation Plan.	5.3	3.4	4.6	13.3	1-2 years
	Prepare new hydrology and hydraulic studies for the Patuxent and Patapsco areas.	5.3	3.4	4.6	13.3	5-10 years
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	1-2 years
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	1-2 years
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	1-2 years
5	Consider developing an Impervious Surface Ordinance for the County that encourages the reduction of newly installed impervious surfaces or offsets the impacts of these surfaces in the County.	4.3	3.4	5	12.7	3-5 years
6a/6b/6c	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	Continuous
	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	1-2 years
	Participate in regular regional meetings with Carroll and Baltimore Counties to address regional flood mitigation issues.	3.8	4.2	5	13	1-2 years
7a/7b	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	3-5 years
	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	1-2 years

Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Timeline
8a/8b	Develop appropriate mitigation solutions for High Road Academy School	8	3.4	5	16.4	3-5 years
	Consider relocating the fire station in Woodbine to higher ground.	8	3.4	1	12.4	3-5 years
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	5-10 years
10a/10b/ 10c	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	1-2 years
	Consider replacing the Dialogic System with a better emergency notification system.	7.2	3	3	13.2	1-2 years
	Improve flood modeling system and capabilities to better predict crest height and timing.	6.5	2.6	1	10.1	5-10 years
11a/11b	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	1-2 years
	Develop signage on roads that frequently flood to warn residents and commuters of the potential flood hazard.	6	5	3	14.0	1-2 years
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	1-2 years
13a/13b	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	Continuous
	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	Continuous
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	Continuous
15	Continue to identify those roads that frequently flood and prioritize them to apply for federal funding to elevate these roads.	7.8	3.2	4.6	15.6	Continuous
16	Coordinate with the Public Works Department in Prince George's County to develop a mitigation solution.	4.5	4.3	5	13.8	1-2 years
17a/17b	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	Continuous
	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	1-2 years
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	1-2 years

Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Timeline
19a/19b	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	Continuous
	Continue to enforce the Road Tree Law (to do no harm to existing trees on the boulevard).	4.4	5.8	5	15.2	Continuous
20a/20b	Work with the Department of Natural Resources on watershed management issues and for periodic removal of debris from the stream at the Patapsco River and Historic Ellicott City.	5.3	3.4	5	13.7	1-2 years
	Coordinate with DNR, MDE, and the Department of Planning, on stream bank maintenance, debris removal, and excess sedimentation so as not to exacerbate the flood issue in Historic Ellicott City and explore funding opportunities.	5.3	3.4	5	13.7	1-2 years
21a/21b/ 21c	Continue to ensure that the libraries in the County are stocked with flood protection publications.	2.3	3.8	3.3	9.4	Continuous
	Introduce natural hazards awareness programs in schools.	5	3.8	3.3	12.1	Continuous
	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	Continuous
22a/22b/ 22c	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	1-2 years
	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	1-2 years
	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	1-2 years
23a/23b	Provide technical support to property owners: direct property owners to resources, property protection techniques, and funding sources.	5	3.8	5	13.8	1-2 years
	Educate and make County staff available for on-site consultation as needed.	5	3.8	5	13.8	1-2 years
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	Continuous
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	1-2 years

Action No.	Project Description	Life/ Safety Impact	Admin/ Tech Support	Cost	Total Score	Timeline
26a/26b/ 26c/ 26d	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	Continuous
	Meet every six months to review projects that have been completed, altered, or are no longer applicable.	5.9	4.2	5	15.1	Continuous
	Update the Flood Mitigation Plan every five years and after a flood event.	5.9	4.2	5	15.1	Continuous
	Integrate this Plan into the All-Hazard Mitigation Plan as an annex.	6.2	4.2	5	15.4	Continuous

The actions listed have been prioritized into three categories: high, medium, and low priority, based on their total scores.

Table 10.3 Mitigation actions in priority order

Action No.	Project Description	Total Score
	HIGH PRIORITY	
13a	Continue to implement the dam inspection program for the regular maintenance of all dams in the county.	17.4
13b	Coordinate with the Bureau of Engineering, Licensing and Inspections to assist with inspections of bridges and dams to ensure integrity is maintained in the event of a flood.	17.4
11a	Create a rating system to rate the degree of flashflood threat and enhance the current warning system based on the flashflood threat.	16.9
8a	Develop appropriate mitigation solutions for High Road Academy School	16.4
15	Continue to identify those roads that frequently flood and prioritize them to apply for federal funding to elevate these roads.	15.6
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.	15.5
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.	15.4
26d	Integrate this Plan into the All-Hazard Mitigation Plan as an annex.	15.4
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.	15.2
19b	Continue to enforce the Road Tree Law (to do no harm to existing trees on the boulevard).	15.2
26b	Meet every six months to review projects that have been completed, altered, or are no longer applicable.	15.1
26c	Update the Flood Mitigation Plan every five years and after a flood event.	15.1

Action No.	Project Description	Total Score
	MEDIUM PRIORITY	
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.	14.8
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.	14.5
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.	14.5
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.	14.4
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.	14.2
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 15 percent reduction in flood insurance premiums.	14.1
11b	Develop signage on roads that frequently flood to warn residents and commuters of the potential flood hazard.	14
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.	13.8
16	Coordinate with the Public Works Department in Prince George’s County to develop a mitigation solution.	13.8
23a	Provide technical support to property owners: direct property owners to resources, property protection techniques, and funding sources.	13.8
23b	Educate and make County staff available for on-site consultation as needed.	13.8
1a	Incorporate the results of any new flood studies into the new Digital Flood Insurance Rate Maps (DFIRMs).	13.7
20a	Work with the Department of Natural Resources on watershed management issues and for periodic removal of debris from the stream at the Patapsco River and Historic Ellicott City.	13.7
20b	Coordinate with DNR, MDE, and the Department of Planning, on stream bank maintenance, debris removal, and excess sedimentation so as not to exacerbate the flood issue in Historic Ellicott City and explore funding opportunities.	13.7
14	Continue to support the study of non-functioning dams on Patapsco River and remove those that are non-functioning and restore the environment.	13.6
22a	Include the following information: flood and hazard data, safety precautions and emergency procedures, flood mitigation options, and sources of funding.	13.6
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.	13.6

Action No.	Project Description	Total Score
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.	13.6
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.	13.4
1b	Reconcile the new DFIRM data with the flood data in this Flood Mitigation Plan.	13.3
1c	Prepare new hydrology and hydraulic studies for the Patuxent and Patapsco areas.	13.3
10b	Consider replacing the Dialogic System with a better emergency notification system.	13.2
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.	13.1
LOW PRIORITY		
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.	13
6c	Participate in regular regional meetings with Carroll and Baltimore Counties to address regional flood mitigation issues.	13
5	Consider developing an Impervious Surface Ordinance for the County that encourages the reduction of newly installed impervious surfaces or offsets the impacts of these surfaces in the County.	12.7
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.	12.5
8b	Consider relocating the fire station in Woodbine to higher ground.	12.4
21b	Introduce natural hazards awareness programs in schools.	12.1
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.	12.1
25	When DFIRMs become available, provide training of the use of DFIRMs to stakeholder groups including planners, engineers, realtors, and community leaders.	11.3
9	Consider structural hardening of the facilities on higher ground so they can serve as shelters during flood and wind events.	10.8
10c	Improve flood modeling system and capabilities to better predict crest height and timing.	10.1
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.	10.1
21a	Continue to ensure that the libraries in the County are stocked with flood protection publications.	9.4

Plan Maintenance

Once this Plan has been reviewed by the Maryland Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA), the Plan will be adopted by the Howard County Council.

This Plan is envisioned to be a 'living document'; plan adoption is not considered the final step in the planning process but rather as a first step to implementation. The plan monitoring and maintenance schedule is a cycle of events that involves periodic review, adjustments, and improvement.

In order to ensure that the Plan continues to provide a framework for reducing the flood risk to the County, the Department of Public Works Bureau of Environmental Services: Storm Water Management Division will take responsibility to convene an annual meeting of the Hazard Mitigation Steering Committee. At this meeting, the Steering Committee will determine the status of each mitigation action. Each action proposed in the Mitigation Plan will be categorized as one of the following: completed, in progress, not started/delayed, modified, or cancelled. The Steering Committee will assist the Department of Public Works Bureau of Environmental Services: Storm Water Management Division in preparing a status report of the mitigation actions.

In addition to conducting an annual review of the Plan, the Steering Committee will review the Plan within 30 days after a flood event. Each goal and objective will be examined for its relevance and its validity to the changing situation in the County, and the mitigation actions will be reviewed to ensure that they address any recent issues that may have stemmed from the disaster.

APPENDIX

Meeting Materials