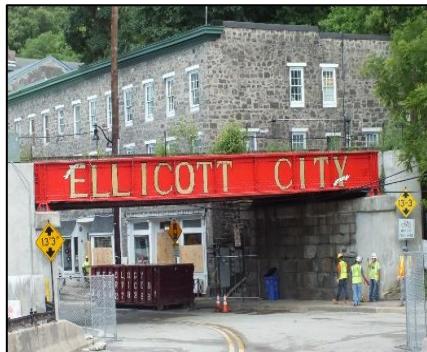

2024-2029 Howard County Natural Hazard Mitigation Plan Update



Acknowledgements

This Hazard Mitigation Plan was prepared under the guidance of the Howard County Office of Emergency Management, and the Joint Steering Committee. The Howard County Office of Emergency Management would like to thank the following departments and organizations for their assistance with the development of this Plan as well as their dedication and continued commitment to making Howard County a more resilient County:

- Baltimore County Office of Emergency Management
- Columbia Association
- Constellation Home (formerly Baltimore Gas and Electric)
- Howard County Administration
- Howard County Community Organizations Active in Disaster
- Howard County Department of Community Resources and Services
- Howard County Economic Development Authority
- Howard County Department of Fire and Rescue Services
- Howard County Department of Inspections, Licenses, and Permits
- Howard County Department of Planning and Zoning
- Howard County Department of Public Works
- Howard County Department of Recreation and Parks
- Howard County Health Department
- Howard County Department of Technology and Communication Services
- Howard County Office of Community Sustainability
- Howard County Office of Human Rights and Equity
- Howard County Office of Law
- Howard County Office of Transportation
- Howard County Police Department
- Howard County Public School System
- Howard EcoWorks
- University of Maryland Center for Health and Homeland Security

Acronyms

Acronym	Definition
AAR	After Action Report
ACS	American Community Survey
APL	Applied Physics Laboratory
ASL	American Sign Language
BCA	Benefit Cost Analysis
BES	Howard County Department of Public Works Bureau of Environmental Services
BFE	Base Flood Elevation
BGE	Baltimore Gas and Electric/Constellation Home
BMP	Best Management Practices
BOE	Board of Education
BRIC	Building Resilient Infrastructure and Communities
BWI	Baltimore Washington International Thurgood Marshall Airport
CAG	Community Advisory Group
CAV	Community Assistance Visit
CFR	Code of Federal Regulations
CDBG	Community Development Block Grant
CIP	Capital Improvement Plan
CRS	Community Rating System
CSA	Combined Statistical Area
DFIRM	Digital Flood Insurance Rate Map
DFRS	Howard County Department of Fire and Rescue Services
DILP	Howard County Department of Inspections, Licensing, and Permits
DMA2K	Disaster Mitigation Act of 2000
DNR	Department of Natural Resources
DPW	Howard County Department of Public Works
DPZ	Howard County Department of Planning and Zoning

Acronym	Definition
DRP	Howard County Department of Recreation and Parks
EDA	Economic Development Authority
EF-Scale	Enhanced Fujita Scale
EOC	Emergency Operations Center
EMPG	Emergency Management Performance Grant
EPA	Environmental Protection Agency
F-Scale	Fujita Scale
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FMP	Flood Mitigation Plan
GBS	General Building Stock
GIS	Geographic Information System
H&H	Hydrology & Hydraulic
HCC	Howard County Community College
HCGH	Howard County General Hospital
HCPD	Howard County Police Department
HCPSS	Howard County Public School System
HHPD	High Hazard Potential Dams
HIRA	Hazard Identification and Risk Assessment
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	Department of Housing and Urban Development
IA	Individual Assistance
ICS	Incident Command System
IP	Improvement Plan
ISDN	Integrated Services Digital Network
JSC	Joint Steering Committee
LOMA	Letter of Map Amendment

Acronym	Definition
LOMR	Letter of Map Revision
MARC	Maryland Area Regional Commuter
MDE	Maryland Department of the Environment
MDEM	Maryland Department of Emergency Management
MDP	Maryland Department of Planning
MGS	Maryland Geological Survey
MSA	Metropolitan Statistical Area
MSD	Maryland School for the Deaf
MTA	Maryland Transit Administration
MUIH	Maryland University of Integrative Health
NCDC	National Climate Data Center
NCR	National Capital Region
NEC	National Electrical Code
NFIP	National Flood Insurance Program
NHMP	Natural Hazard Mitigation Plan
NOAA	National Oceanic Atmospheric Administration
NIMS	National Incident Management System
NWS	National Weather Service
OEM	Howard County Office of Emergency Management
PA	Public Assistance
PDM	Pre-Disaster Mitigation Grant
PDSI	Palmer Drought Severity Index
PGA	Peak Ground Acceleration
PHEP	Public Health Emergency Preparedness
PIO	Howard County Office of Public Information
PSAP	Public Safety Answering Point
RL	Repetitive Loss
RLP	Rural Legacy Program
RTA	Regional Transportation Agency
SHA	State Highway Administration
SHEDLUS	Spatial Hazard Events and Losses Database

Acronym	Definition
SHSP	State Homeland Security Grant Program
SRL	Severe Repetitive Loss
SWMD	Howard County Department of Public Works – Stormwater Management Division
UASI	Urban Area Security Initiative
UMD	University of Maryland
USFS	United State Forest Service
USGS	United States Geological Survey
VPC	Vision Planning and Consulting, LLC
WATS	Wide Area Telephone Service
WUI	Wildland-Urban Interface
ZIP	Zone Improvement Plan

DRAFT

Table of Contents

TABLE OF CONTENTS.....	6
TABLE OF FIGURES	7
CHAPTER 1: INTRODUCTION	9
BACKGROUND	9
PURPOSE	10
SCOPE.....	10
AUTHORITY	10
ORGANIZATION.....	11
CHAPTER 2: COMMUNITY PROFILE.....	12
HOWARD COUNTY IN CONTEXT	12
HISTORY OF HOWARD COUNTY	27
LAND USE	28
GROWTH AND DEVELOPMENT	29
CHAPTER 3: PLANNING PROCESS.....	38
WHAT IS HAZARD MITIGATION PLANNING?	38
HAZARD MITIGATION PLAN UPDATE PROCESS	38
CHAPTER 4: HAZARD IDENTIFICATION, PROFILING, AND RISK ASSESSMENT	43
HAZARD IDENTIFICATION	43
OVERVIEW OF HOWARD COUNTY'S NATURAL HAZARDS HISTORY	49
RISK ANALYSIS AND ASSESSMENT	54
EMERGING HAZARD TRENDS	169
CHAPTER 5: CAPABILITY ASSESSMENT.....	171
INTRODUCTION	171
PLAN INTEGRATION	171
PLANS IN DEVELOPMENT	192
HOWARD COUNTY GOVERNMENT ORGANIZATION	193
COMMUNITY CAPABILITY ASSESSMENT.....	197
CHAPTER 6: MITIGATION STRATEGY.....	212
MITIGATION GOALS AND OBJECTIVES	212
IDENTIFICATION OF MITIGATION ACTIONS	215
PRIORITIZATION	218
IMPLEMENTATION PLAN	219
FUNDING SOURCES.....	228
CONTINUED COMPLIANCE WITH THE NATIONAL FLOOD INSURANCE PROGRAM (NFIP)	230
CHAPTER 7: PLAN MONITORING AND MAINTENANCE.....	233
UPDATE PROCESS SUMMARY.....	233
DISTRIBUTION.....	233
MONITORING, EVALUATION, AND PROGRESS REPORTS	233
CIRCUMSTANCES TO INITIATE NHMP REVIEW AND UPDATES	235
BENEFIT COST ANALYSIS	235
CONTINUED PUBLIC INVOLVEMENT	235
PLAN ADOPTION	236
HAZARD MITIGATION PLANS SAMPLE ANNUAL REPORT FORM	237
APPENDIX A: MEETINGS.....	239
APPENDIX B: SURVEY RESULTS.....	252
COMMUNITY HAZARD SURVEY	252

SHORT FORM SURVEYS.....	263
APPENDIX C: FLOOD MITIGATION ACTIONS.....	267
APPENDIX D: PRESS RELEASES, NOTICES, AND PUBLIC PARTICIPATION.....	274
APPENDIX E: JOINT STEERING COMMITTEE DETAILED LIST & INVITATION	298
APPENDIX F: LOCAL MITIGATION PLAN REVIEW TOOL.....	303
PLAN REVIEW CHECKLIST	305
PLAN ASSESSMENT	312
APPENDIX G: HAZARD DEFINITIONS	314

Table of Figures

Figure 1: Central Maryland Population.....	12
Figure 2: Population Ranking of Maryland Counties and Baltimore City	13
Figure 3: Howard County Watersheds.....	14
Figure 4: Job Ranking of Maryland Counties and Baltimore City.....	15
Figure 5: Central Maryland Job Totals	15
Figure 6: Jobs in Howard County by Job Type	16
Figure 7: Major Employers in Howard County.....	17
Figure 8: Howard County Population by Race and Hispanic Origin	18
Figure 9: Howard County Population by Select Minority Race	18
Figure 10: Language Spoken at Home & English Proficiency in Howard County.....	19
Figure 11: Age of Howard County Residents	20
Figure 12: Howard County Household Income	21
Figure 13: Disability Status of the Civilian Noninstitutionalized Population in Howard County	22
Figure 14: Households by Type in Howard County.....	22
Figure 15: Commuting to Work in Howard County	23
Figure 16: Vehicles Available at Occupied Housing Units.....	24
FIGURE 17: FEMA COMMUNITY RESILIENCE INDEX IN HOWARD COUNTY	25
Figure 18: Washington-Baltimore-Northern Virginia Combined Statistical Area	26
Figure 19: Howard County Population Centers	27
Figure 20: Howard County Land Use	30
Figure 21: Population Density.....	31
Figure 22: Population Density in 2030	31
Figure 23:Population Density in 2035	32
Figure 24: Howard County Residential Permits 2017 – 2021	33
Figure 25: Designated Place Types by 2030.....	34
Figure 26: Hazard Mitigation Planning Process	39
Figure 27: Risk Formula.....	44
Figure 28: Most-Likely Scenario Risk Scores from 2023 HIRA	48

Figure 29: CRCI Indicators & Heat Severity	61
Figure 30: Heat Severity and Structural Assets.....	62
Figure 31: Population Densities of Residents 65 Years and Older	63
Figure 32: Residents 45 to 64 Years Old	64
Figure 33: Community Resilience Index, Major Roadways, & Transmission Lines	76
Figure 34: Howard County Major Watersheds	83
Figure 35: Howard County Flood Zones.....	84
Figure 36: Howard County 100 Year Floodplain Special Flood Hazard Area	87
Figure 37: Howard County Critical Facilities	88
Figure 38: Howard County EEAI By Census Track	91
Figure 39: Comparison of Distribution of Buildings in Flood Hazard Areas & EEAI Scores.....	91
Figure 40: Digital Flood Insurance Rate Map as of August 26, 2022	93
Figure 41: United States Wind Zones Map	100
Figure 42: United States Wind Zones Zoomed-in Image of Maryland.....	100
Figure 43: Mobile Home Parks in Howard County.....	104
Figure 44: Tree Canopies, Vegetation, Structures, Roads, Water, and Pavement Map	105
Figure 45: Tornado Tracks for Howard County and Surrounding Area, 1950-2022	107
Figure 46: Drought Intensity 2000-Present (2023)	115
Figure 47: Community Resilience Index & Drought Intensity 2000- 2023.....	117
Figure 48: Historical Drought in Maryland, 2000-2022	120
Figure 49: Flooding in the Valley Mede Subdivision	124
Figure 50: Tropical Storm Lee: Flooding Along Main Street Ellicott City	124
Figure 51: Tropical Storm Lee: Flooding at a Municipal Parking Lot in Historic Ellicott City	125
Figure 52: Historical Hurricanes & CCRI	127
Figure 53: Structural Assets & CCRI	128
Figure 54: Electrical Infrastructure	129
Figure 55: Howard County: Storm Tracks, 1950-2021	132
Figure 56: Howard County Fire Stations	140
Figure 57: United States Earthquake Hazard Map.....	148
Figure 58: Howard County Earthquake Hazard	148
Figure 59: Nursing Homes & Percentage with a Disability	151
Figure 60: Approximate Epicenter of Maryland Earthquakes since 1758	153
Figure 61: Howard County Electrical Infrastructure	159
Figure 62: Zoonotic Disease Spread.....	163
Figure 63: Sample Slide from OEM Presentation at JSC Meeting 1	240
Figure 64: Sample Slide from OEM Presentation at JSC Meeting 2	246
Figure 65: Sample Slide from OEM Presentation at JSC Meeting 3	249
Figure 66: Howard County OEM Nextdoor Account Post	252
Figure 67: Howard County OEM Nextdoor Account Post (Email Confirmation)	253
Figure 68: Email to COAD to take Community Hazard Survey.....	254
Figure 69: Email to LEPC to take Community Hazard Survey	255

Chapter 1: Introduction

This Chapter provides a general introduction to the 2024-2029 Howard County Natural Hazard Mitigation Plan (NHMP) update and includes the following sections:

- Background
- Purpose
- Scope
- Authority
- Organization

Background

The Disaster Mitigation Act of 2000 established a requirement that jurisdictions must develop and implement NHMPs to remain eligible for various pre-and post-disaster Federal Emergency Management Agency (FEMA) grant programs.

Hazard mitigation is defined by FEMA as “any sustainable action that reduces or eliminates long-term risk to people and property from future disasters.”¹ The hazard mitigation planning process involves the formulation of actions to reduce injuries, deaths, property damage, economic losses, and degradation of natural resources caused by natural and human-caused disasters. Mitigation is one of five mission areas in emergency management. FEMA’s definitions of these areas are listed below:

- Prevention – Prevent, avoid, or stop an imminent, threatened, or actual act of terrorism.
- Protection – Protect our citizens, residents, visitors, and assets against the greatest threats and hazards in a manner that allows our interests, aspirations, and way of life to thrive.
- Mitigation – Reduce the loss of life and property by lessening the impact of future disasters.
- Response – Respond quickly to save lives, protect property and the environment, and meet basic human needs in the aftermath of a catastrophic incident.
- Recovery – Recover through a focus on the timely restoration, strengthening and revitalization of infrastructure, housing, and a sustainable economy, as well as the health, social, cultural, historic, and environmental fabric of communities affected by a catastrophic incident.²

While this Plan focuses on only the mitigation of natural hazards, the County has also developed and updated two other Annexes as part of the 2024-2029 update: Annex A: Human-Caused Hazards Mitigation Plan and Annex B: Cultural and Historical Hazard Mitigation Plan. The first Annex addresses human-caused hazards and the second addresses hazards that threaten cultural and historical elements

¹ Hazard Mitigation Assistance Grants, FEMA, <https://www.fema.gov/grants/mitigation> (last visited Feb. 10, 2023).

² Mission Areas and Core Capabilities, FEMA, <https://www.fema.gov/emergency-managers/national-preparedness/mission-core-capabilities> (last visited Feb. 10, 2023).

in the County. All County Hazard Mitigation Plans have been developed using an all-hazards approach, utilize a comprehensive and protective planning process, and establish more efficient mobilization of resources to ensure effective mitigation measures to protect life, property, and the environment in Howard County.

Purpose

This Plan seeks to reduce the County's human, social, environmental, and economic losses from future disasters. The NHMP was developed in accordance with FEMA's hazard mitigation requirements found in 44 C.F.R. § 201.6, Local Mitigation Plans. An essential aspect of comprehensive disaster mitigation planning is developing a thorough understanding of potential hazards, vulnerabilities, and risks. As stated in the regulation, the purpose of the hazard vulnerability analysis is to:

- Identify the natural hazards that impact the County;
- Identify actions and activities to reduce any losses from those hazards; and
- Establish a coordinated process to implement the plan, taking advantage of a wide range of resources.³

This Plan works in tandem with, and includes sections from, the County's 2023 Hazard Identification and Risk Assessment (HIRA), which was completed independent of this effort and is updated regularly.

Scope

In July 2022, the Howard County Office of Emergency Management (OEM) began the process of updating this Plan for the next five-year cycle (2024-2029). This Plan will receive annual updates to the mitigation action items and relevant statistics, and it will cover Howard County and its communities. This update will include changes to the County's Hazard Identification and Risk Assessment (HIRA) and updates to the mitigation actions reviewed each year by the Joint Steering Committee (JSC).

This update continues the planning cycle with previous iterations of the Plan. The Plan's goals and objectives will be revisited to ensure their continued relevance and efficacy. Mitigation actions from the previous Plan are evaluated to determine which have been completed, which are pending, and which, if any, were deferred or cancelled, and new actions will be developed with the input and collaboration from the JSC, and prioritization and implementation plan developed for all ongoing and new actions.

Authority

Federal:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, Pub. L. 100-707, as amended. The Act is codified at 42 U.S.C. 5121, *et. seq.*

³ 44 C.F.R. § 201.1(b).

- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206.
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended.

State of Maryland:

- State of Maryland Hazard Mitigation Plan, 2021.

Howard County Code of Ordinances:

- Title 3, Subtitle 1 – Building Code.
- Title 16, Subtitle 1 – Subdivision and Land Development Regulations.
- Title 16, Subtitle 7 – Floodplain.
- Title 18, Subtitle 9 – Stormwater Management.

FEMA Guidance Documents:

- FEMA. Local Mitigation Planning Policy Guide. April 2022.
- FEMA. Local Mitigation Planning Handbook. March 2013.
- FEMA. Local Mitigation Plan Review Guide. October 2011.

Organization

This Plan comprises seven chapters:

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Hazard Identification, Profiling, and Risk Assessment
- Chapter 5: Capability Assessment
- Chapter 6: Mitigation Strategy
- Chapter 7: Plan Monitoring and Maintenance

Chapter 2: Community Profile

This Chapter presents a brief overview of Howard County, mirroring the “Introduction” section of the County’s Comprehensive Emergency Response and Recovery Plan (CERRP). Factors relevant to the causes and effects of hazard risks in the County, including its geographic layout, climate, demographic makeup, and employment and industry profile, are described in this Chapter.

Howard County in Context

Located in central Maryland between Baltimore and Washington (18 miles from Baltimore City and 27 miles from Washington D.C.), Howard County is the smallest of Maryland’s 23 counties at about 254 square miles. Only Baltimore City, the 24th jurisdiction in Maryland, is smaller at 92 square miles. In terms of total population, however, Howard County ranks 6th in the State with an estimated population of 335,000 in 2021. The five other jurisdictions with greater populations are also all located in central Maryland adjacent to Howard County. Including Carroll and Frederick Counties (ranked 7th and 9th in the State, respectively), a total of just over 4.8 million residents live in central Maryland, 78% of the State’s total 6.2 million residents. Howard County’s 335,000 residents make up 5.4% of the State total.

FIGURE 1: CENTRAL MARYLAND POPULATION

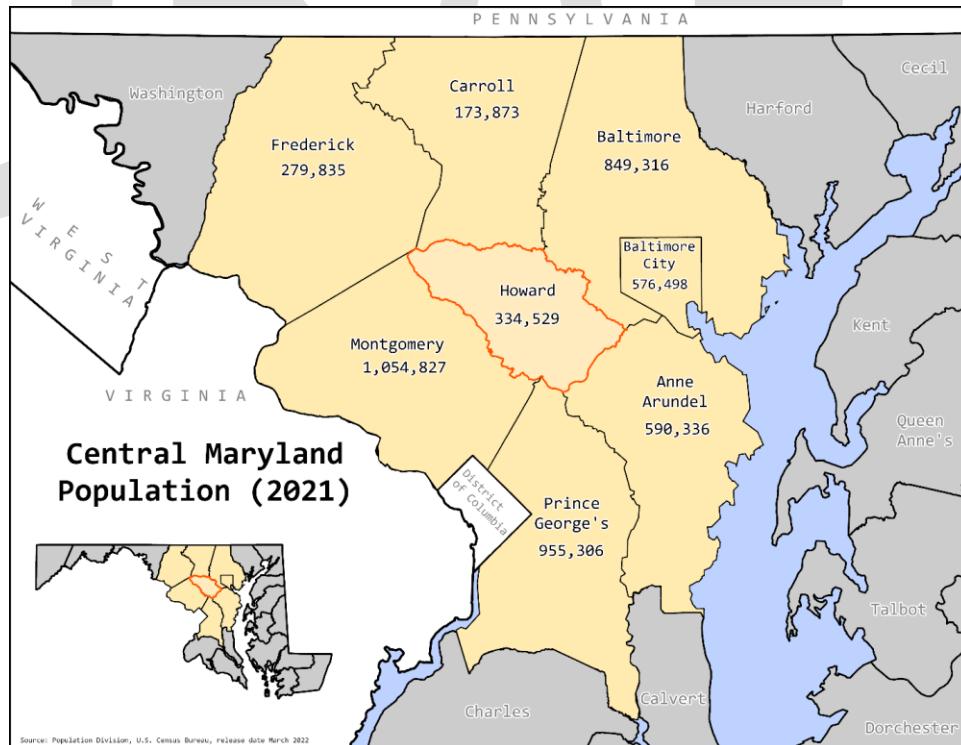


FIGURE 2: POPULATION RANKING OF MARYLAND COUNTIES AND BALTIMORE CITY

Population Ranking of Maryland Counties and Baltimore City - July 1, 2021

1	Montgomery County	1,054,827	13	Wicomico County	103,980
2	Prince George's County	955,306	14	Cecil County	103,905
3	Baltimore County	849,316	15	Calvert County	93,928
4	Anne Arundel County	590,336	16	Allegany County	67,729
5	Baltimore City	576,498	17	Worcester County	53,132
6	Howard County	334,529	18	Queen Anne's County	50,798
7	Frederick County	279,835	19	Talbot County	37,626
8	Harford County	262,977	20	Caroline County	33,386
9	Carroll County	173,873	21	Dorchester County	32,489
10	Charles County	168,698	22	Garrett County	28,702
11	Washington County	154,937	23	Somerset County	24,584
12	St. Mary's County	114,468	24	Kent County	19,270
Maryland Total					6,165,129

Source: Population Division, U.S. Census Bureau, release date March 2022

Physical Geography and Climate

Howard County is in the Piedmont Plateau region of Maryland, with rolling hills making up most of the landscape. It is bounded on the north and northeast by the Patapsco River, on the southwest by the Patuxent River, and on the southeast by the Deep Run River and the Chessie Seaboard Express (CSX) railroad line. Both the Patapsco and Patuxent run largely through publicly accessible parkland along the County borders. The Patuxent border includes the Triadelphia and Rocky Gorge reservoirs, which provide drinking water for residents in Montgomery and Prince George's Counties as well as a small portion of southern Howard County. Howard County is the only "Maryland-locked" county in the state—that is, the only county not bordering the Chesapeake Bay, the Atlantic Ocean, another state, the Potomac River, or Washington D.C.

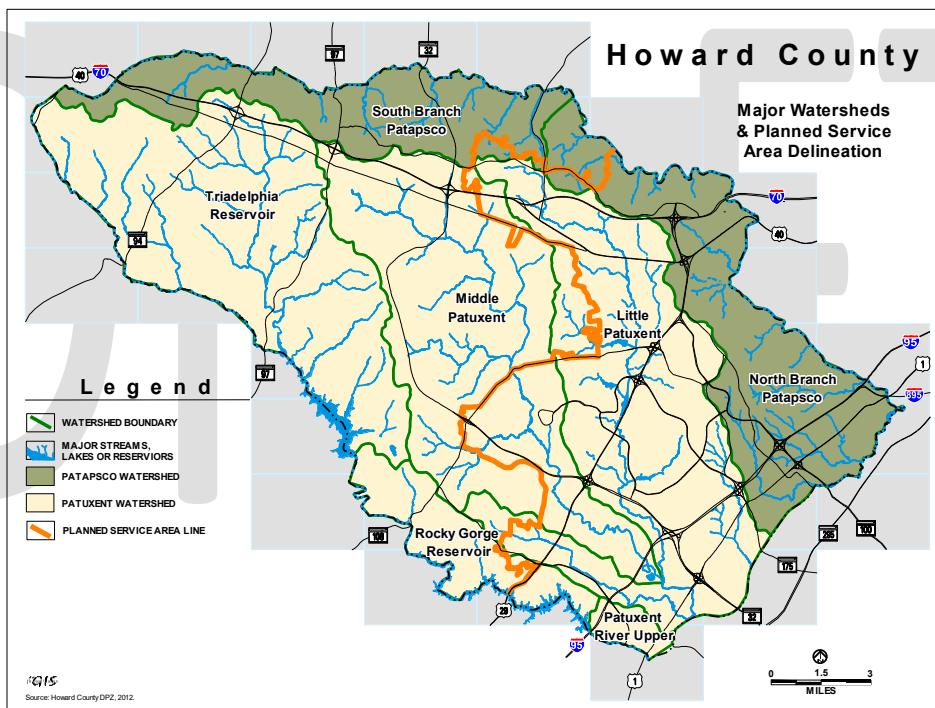
The two major watersheds in Howard County are the Patapsco and the Patuxent. Most wastewater is treated by the Little Patuxent Water Reclamation Plant owned and operated by Howard County. Waste from the Patapsco area is treated by the Patapsco treatment plant located in Baltimore City. There are close to 1,000 miles of rivers and streams in Howard County and several moderately sized artificial lakes, including Centennial Lake just north of MD108 and east of US29 and lake Kittamaqundi in Downtown Columbia. These lakes are part of Howard County's stormwater management system.

The western portion of Howard County largely consists of farmland and forest, much of which has been permanently preserved through County and State agricultural and environmental preservation programs, and large lot residential development on well and septic systems. This area, known as the Rural West, is approximately 60% of the total County land area and is delineated by the Planned Service Area line. The roughly 40% of county land east of this line is served by the public water and sewer system owned and operated by Howard County. The eastern portion of the County includes higher

density suburban development with a population density about 8 times that of the west—3.9 persons per acre compared to 0.5 persons per acre.

Howard County lies in the humid subtropical climate zone. Utilizing data from September 1900 to August 2022, the 12-month average temperature for Howard County is 53.3°F, which is a 3.2°F increase from September 1900. The average annual rainfall has increased by 5.5 inches from September 1900 to August 2022 and is approximately 43.2 inches annually. The County's average yearly snowfall is about 24 inches. The National Climatic Data Center (NCDC) Storm Events Database⁴ provides data on the impacts to the County that were associated with wind, hail, and tornadic activity hazards. Based on the collected data, the County has been impacted by over 500 events since 1950.

FIGURE 3: HOWARD COUNTY WATERSHEDS



Jobs and Economy

Howard County has a significant job base, ranking 6th highest in the State with 178,000 jobs located in the County, most all of which are in the east. This represents about 6.9% of the total 2.6 million jobs Statewide. The eight jurisdictions in central Maryland have 2.1 million of the 2.6 million total, representing about four out of every five jobs in the State.

⁴ *Storm Events Database*, NAT'L CTRS. FOR ENVTL. INFO., <https://www.ncdc.noaa.gov/stormevents/> (last visited Feb. 16, 2023).

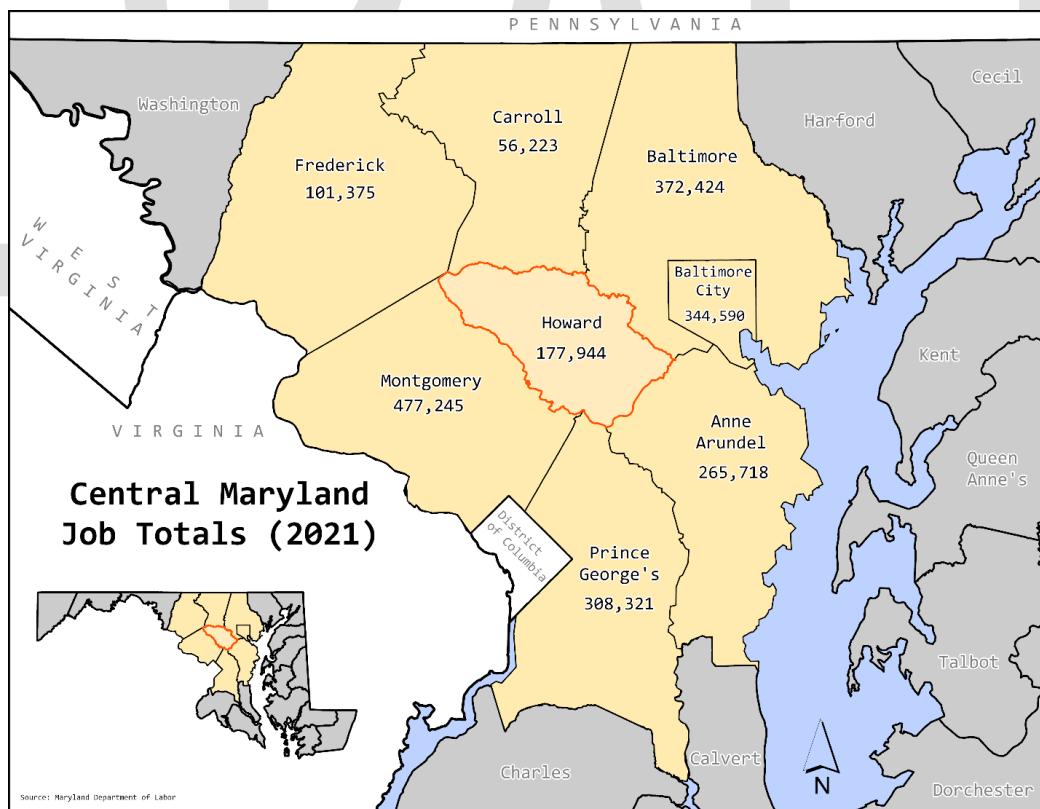
FIGURE 4: JOB RANKING OF MARYLAND COUNTIES AND BALTIMORE CITY

Job Ranking of Maryland Counties (and Baltimore City) -- 4th quarter 2021

1 Montgomery	477,245	13 Charles	40,355
2 Baltimore County	372,424	14 Cecil	33,470
3 Baltimore City	344,590	15 Allegany	27,047
4 Prince George's	308,321	16 Queen Anne's	23,083
5 Anne Arundel	265,718	17 Worcester	22,344
6 Howard	177,944	18 Calvert	21,459
7 Frederick	101,375	19 Talbot	16,874
8 Harford	94,336	20 Garrett	11,835
9 Washington	63,065	21 Dorchester	12,231
10 Carroll	56,223	22 Caroline	9,889
11 St. Mary's	46,441	23 Kent	7,555
12 Wicomico	45,619	24 Somerset	6,501
Total			2,585,944

Source: Maryland Department of Labor, Licensing and Regulation

FIGURE 5: CENTRAL MARYLAND JOB TOTALS



Service-providing employment makes up about 79% of the 178,000 jobs in Howard County, while about 11% are goods-producing jobs and the remaining 9% are government jobs. Professional and business services account for more than 33% of all jobs located in Howard County, followed by trade,

transportation, and utility jobs (19%), and then education and health services (11%). An estimated 5% of all jobs are for manufacturing and 6% for construction. The table below summarizes all jobs by job type in Howard County. Note that these jobs reported by the Maryland Department of Labor Licensing and Regulation do not include proprietors who are not on an employer payroll. According to the latest available 2020 U.S. Bureau of Economic Analysis (BEA) data, there were an additional 50,073 proprietor jobs in Howard County.

FIGURE 6: JOBS IN HOWARD COUNTY BY JOB TYPE

Jobs in Howard County by Job Type - 4th Quarter, 2021

Job Type	Jobs	Percent
Government Sector		
Federal Government	721	0.4%
State Government	1,754	1.0%
Local Government	14,332	8.1%
Subtotal/Average	16,807	9.4%
Goods Producing		
Natural Resources and Mining	298	0.2%
Construction	10,722	6.0%
Manufacturing	8,818	5.0%
Subtotal/Average	19,838	11.1%
Service Providing		
Trade, Transportation, and Utilities	32,853	18.5%
Information	3,163	1.8%
Financial Activities	8,911	5.0%
Professional and Business Services	59,665	33.5%
Education and Health Services	19,365	10.9%
Leisure and Hospitality	13,142	7.4%
Other Services	4,188	2.4%
Subtotal/Average	141,287	79.4%
TOTAL	177,944	100.0%

Source: Maryland Dept. of Labor, Licensing, and Regulation

The latest labor force statistics from the Maryland Department of Labor (August 2022) indicate that of the 192,866 Howard County residents in the labor force, 186,157 are employed, resulting in 3.5% unemployment, the lowest unemployment rate in Maryland. The Statewide average is 4.4%.

According to the latest American Community Survey (ACS), conducted in 2021 by the U.S. Census Bureau, 98,980 Howard County residents work in Howard County and 72,574 residents commute to work outside the County. The 2021 ACS also estimates that 74,590 out-of-county residents commute into Howard County to work. Subtracting the 72,574 Howard County residents who leave the County each day for work from the 334,529 estimated 2021 resident population and then adding back in the 74,590 out-of-county in-commuters results in a “daytime population” estimate of 336,545. Given in-commuters exceed out-commuters by a modest 2,016 workers, the daytime population is only slightly higher than the resident population total. Thus, Howard County does not “empty out” during the

workday, nor does the population swell by a very large amount either—the County's population remains relatively consistent over the course of the day amid a significant regional commuting pattern.

The table below summarizes the major public and private sector employers in Howard County. The largest employer in the county is the Howard County Public School System (HCPSS), followed by the Johns Hopkins Applied Physics Lab (APL) and then the Howard County Government. These three employers combined employ close to 19,000 people and account for about 11% of all jobs in the County.

FIGURE 7: MAJOR EMPLOYERS IN HOWARD COUNTY

Major Employers in Howard County - 2021

1 Howard County Public School System	8,561	11 Freshly	820
2 Johns Hopkins Applied Physics Lab	7,200	12 Wells Fargo	810
3 Howard County Government	3,200	13 Maxim Healthcare Services	675
4 Howard County General Hospital	1,800	14 Oracle	650
5 Verizon	1,700	15 W.R. Grace	600
6 Howard Community College	1,400	16 Sysco Food Services	515
7 The Columbia Association	1,200	17 Enterprise Community Partners	505
8 Lorien Health Systems	1,190	18 Humanim	475
9 Coastal Sunbelt Produce	1,050	19 Leidos	450
10 Nestle Dreyer's Ice Cream	835	20 Tenable Network Security	415

Sources: Howard County Economic Development Authority, Howard County Public School System

Race and Languages

Howard County has a racially diverse population. According to the latest American Community Survey (2021), about 48% of Howard County residents are White, 20% African American, 20% Asian, and 8% Hispanic. The minority populations in Howard County have steadily increased over time and the County became a “majority-minority” County for the first time with the release of the 2019 ACS survey data, when the white population was less than 50% of the total. The adjacent counties of Montgomery, Prince George’s, and Baltimore City have been “majority-minority” for many years. Of all races, Howard County’s Asian population has increased the most significantly since 2010, growing by 63% over the last 11 years. During this same period the white population in Howard County has decreased by 4%. Asian Indians make up the greatest number of Asians in Howard County, followed by Korean, other Asians, Chinese, and then Vietnamese, Filipino, and Japanese.

FIGURE 8: HOWARD COUNTY POPULATION BY RACE AND HISPANIC ORIGIN
Howard County Population by Race and Hispanic Origin - 2021

Race	Estimate	Margin of Error	%	% Margin of Error
White alone	159,429	+/-1,360	47.7%	+/-0.4
African American	67,713	+/-1,479	20.2%	+/-0.4
Asian	66,297	+/-1,771	19.8%	+/-0.5
Hispanic or Latino	25,589	****	7.6%	****
Two or More Races	13,082	+/-2,483	3.9%	+/-0.7
Some Other Race	1,752	+/-1,065	0.5%	+/-0.3
American Indian & Alaskan Native	429	+/-331	0.1%	+/-0.1
Native Hawaiian & Pacific Islander	238	+/-395	0.1%	+/-0.1
TOTAL	334,529	****	100.0%	****

Source: 2021 American Community Survey, US Census Bureau

Note that, other than the Hispanic or Latino category, all are non-Hispanic only

**** No sample observation, controlled to annual Population Division estimate

FIGURE 9: HOWARD COUNTY POPULATION BY SELECT MINORITY RACE
Howard County Population by Select Minority Race Detailed Breakdown - 2021

Race	Estimate	Margin of Error	%	% Margin of Error
Asian	66,297	+/-1,771	19.8%	+/-0.5
Asian Indian	23,313	+/-3,521	7.0%	+/-1.1
Korean	15,183	+/-2,937	4.5%	+/-0.9
Other Asian	11,388	+/-3,018	3.4%	+/-0.9
Chinese	9,435	+/-2,193	2.8%	+/-0.7
Vietnamese	3,031	+/-1,489	0.9%	+/-0.4
Filipino	2,957	+/-1,221	0.9%	+/-0.4
Japanese	990	+/-718	0.3%	+/-0.2
Hispanic or Latino	25,589	****	7.6%	****
Other Hispanic or Latino	16,241	+/-2,337	4.9%	+/-0.1
Mexican	5,955	+/-2,227	1.8%	+/-0.7
Puerto Rican	2,729	+/-1,337	0.8%	+/-0.4
Cuban	664	+/-413	0.2%	+/-0.1

Source: 2021 American Community Survey, US Census Bureau

Note that percents are percent of total Howard County population

**** No sample observation, controlled to annual Population Division estimate

As expected in a place with a significant minority population, over a quarter of Howard County residents five years and older speak a language other than English. However, most are also proficient in English—only 8.2% of the population five years and older speak English less than “very well” according to the latest American Community Survey. The largest portion of these less than very well English speakers are Asians. Despite these relatively low percentages, the County should nonetheless be prepared to communicate to all its residents, as the less than “very well” English speakers in the County number

more than 26,000 residents. Including this group's young children under five not accounted for in this statistic, the number would be even greater.

FIGURE 10: LANGUAGE SPOKEN AT HOME & ENGLISH PROFICIENCY IN HOWARD COUNTY

**Language Spoken at Home & English Proficiency in Howard County - 2021
(Population 5 years and over)**

Language & English Proficiency	Estimate	Margin of Error	% Margin of Error
English Only	225,962	+/-5,453	71.4% +/-1.7
Language other than English	90,333	+/-5,453	28.6% +/-1.7
Speak English less than "very well"	26,020	+/-3,227	8.2% +/-1
Spanish	18,698	+/-2,298	5.9% +/-0.7
Speak English less than "very well"	7,365	+/-1,765	2.3% +/-0.6
Other Indo-European languages	24,461	+/-4,432	7.7% +/-1.4
Speak English less than "very well"	5,159	+/-1,394	1.6% +/-0.4
Asian and Pacific Islander languages	33,733	+/-3,571	10.7% +/-1.1
Speak English less than "very well"	11,576	+/-2,116	3.7% +/-0.7
Other languages	13,441	+/-3,187	4.2% +/-1
Speak English less than "very well"	1,920	+/-987	0.6% +/-0.3
TOTAL	316,295	+/-4	100%

Source: 2021 American Community Survey, US Census Bureau

Note that percents are percent of total Howard County population 5 years and over

Children and the Elderly

According to the latest American Community Survey conducted in 2021, the median age in Howard County is 39.9 years old. About 6% of the population is under five years old (18,234 residents) and 1.3% is 85 and over (4,419 residents). About 24% of the population is under 18 and 14% is 65 and over. School-aged residents in Howard County—those five to 17 years old—amount to about 19% of the population, close to 1 out of every 5 residents.

The baby boomers—those born between 1946 and 1964—are currently aged 58 to 76 years old. The leading edge of this large demographic group began turning 65 in 2011. As this group continues to age, the 65 and older population is expected to increase by close to 50% between 2020 and 2030 when the youngest boomers turn 66. At that time, about one out of every five Howard County residents will be 65 and older (21% of the population). Also, by 2030, more than 9,700 residents in Howard County are expected to be 85 and older, more than double the number in that age group today. It is important to anticipate and plan for this rapid growth of the older and more vulnerable population in Howard County.

FIGURE 11: AGE OF HOWARD COUNTY RESIDENTS

Age	Estimate	Margin of Error	%	% Margin of Error
Under 5 years	18,234	+/-4	5.5%	+/-0.1
5 to 9 years	22,271	+/-2,037	6.7%	+/-0.6
10 to 14 years	24,944	+/-2,040	7.5%	+/-0.6
15 to 19 years	22,528	+/-954	6.7%	+/-0.3
20 to 24 years	18,868	+/-907	5.6%	+/-0.3
25 to 29 years	18,974	+/-488	5.7%	+/-0.1
30 to 34 years	20,732	+/-119	6.2%	+/-0.1
35 to 39 years	21,275	+/-2,076	6.4%	+/-0.6
40 to 44 years	27,476	+/-2,079	8.2%	+/-0.6
45 to 49 years	23,404	+/-417	7.0%	+/-0.1
50 to 54 years	22,700	+/-427	6.8%	+/-0.1
55 to 59 years	22,779	+/-2,087	6.8%	+/-0.6
60 to 64 years	21,145	+/-2,099	6.3%	+/-0.6
65 to 69 years	16,531	+/-1,263	4.9%	+/-0.4
70 to 74 years	13,462	+/-1,308	4.0%	+/-0.4
75 to 79 years	8,672	+/-1,101	2.6%	+/-0.3
80 to 84 years	6,115	+/-1,032	1.8%	+/-0.3
85 years and over	4,419	+/-1,008	1.3%	+/-0.3
TOTAL	334,529	****	100.0%	
18 years and over	254,023	+/-129	75.9%	+/-0.1
21 years and over	243,310	+/-1,225	72.7%	+/-0.4
62 years and over	61,383	+/-1,870	18.3%	+/-0.6
65 years and over	49,199	+/-400	14.7%	+/-0.1
75 years and over	19,206	+/-347	5.7%	+/-0.1

Source: 2021 American Community Survey, US Census Bureau

**** No sample observation, controlled to annual Population Division est.

Income and Poverty

Howard County is the wealthiest jurisdiction in Maryland and one of the wealthiest in the United States. In 2021, the median household income in Howard County was \$133,267. The mean was \$165,657. By comparison, the Statewide median household income in 2021 was \$90,203 and the mean was \$119,958. For the U.S., the median and mean household incomes were an even lower \$69,717 and \$97,962, respectively.

The poverty rate in Howard County was estimated to be 6.4% in 2021. For residents under 18, the poverty rate was 8.1%. Given the small sample size, there are large margins of error associated with this data and the actual numbers or residents are not reported. A separate dataset from Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program reports that the overall poverty rate in Howard County was 5.5% (+/-1.1%) in 2020 (latest available). Overall, poverty in Howard County is relatively low compared to Maryland as a whole, which had a reported SAIPE poverty rate of 9.0% (+/-0.3%) in 2020.

FIGURE 12: HOWARD COUNTY HOUSEHOLD INCOME

**Howard County Household Income - 2021
(Occupied Housing Units)**

Household Income	Estimate	Margin of Error	%	% Margin of Error
Less than \$10,000	3,496	+/-1,095	2.9%	+/-0.9
\$10,000 to \$14,999	1,929	+/-935	1.6%	+/-0.8
\$15,000 to \$24,999	3,496	+/-1,236	2.9%	+/-1
\$25,000 to \$34,999	2,893	+/-1,011	2.4%	+/-0.8
\$35,000 to \$49,999	6,871	+/-1,396	5.7%	+/-1.2
\$50,000 to \$74,999	11,693	+/-1,659	9.7%	+/-1.4
\$75,000 to \$99,999	11,331	+/-1,694	9.4%	+/-1.4
\$100,000 to \$149,999	25,917	+/-2,365	21.5%	+/-1.9
\$150,000 to \$199,999	20,734	+/-2,093	17.2%	+/-1.7
\$200,000 or more	32,186	+/-2,175	26.7%	+/-1.8
TOTAL	120,546	+/-1,453	100%	
Median household income	\$133,267	+/-7,347		
Mean household income	\$165,657	+/-10,819		

Source: 2021 American Community Survey, US Census Bureau

Individuals with Disabilities

An estimated 7.6% of all noninstitutionalized residents in Howard County have disabilities, and 22.9% of all noninstitutionalized residents 65 years have disabilities. For Maryland, these rates are higher—11.3% of all residents and 28.6% of residents 65 years and older, and for the U.S., the rates are even higher—13.0% of all residents and 32.6% of residents 65 years and older.

Given the County's rapidly aging population, these disability rates are expected to increase in the future. It is important that the County plan for a corresponding increase in the number of residents who may require enhanced assistance during an emergency in the years ahead.

FIGURE 13: DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION IN HOWARD COUNTY

Disability Status	Estimate	Margin of Error	%	% Margin of Error
Total Population	330,151	+/-1,935		
With a disability	25,030	+/-3,280	7.6%	+/-1
Under 18 years	80,500	+/-129		
With a disability	2,626	+/-915	3.3%	+/-1.1
18 to 64 years	201,326	+/-1,496		
With a disability	11,341	+/-2,378	5.6%	+/-1.2
65 years and over	48,325	+/-817		
With a disability	11,063	+/-1,454	22.9%	+/-2.9

Source: 2021 American Community Survey, US Census Bureau

Household Composition

Of the more than 120,000 households in Howard County, about 60% are married-couple households. Just over 4% are cohabitating couple households, 13% are male households with no spouse or partner present, and 23% are female households with no spouse or partner present.

FIGURE 14: HOUSEHOLDS BY TYPE IN HOWARD COUNTY

Household Type	Estimate	Margin of Error +/-	%	% Margin of Error
Married-couple family	72,667	+/-2,810	60.3%	+/-2.2
With children of the householder under 18 years	35,105	+/-2,198	29.1%	+/-1.8
Cohabiting couple household	4,974	+/-1,025	4.1%	+/-0.8
With children of the householder under 18 years	1,373	+/-607	1.1%	+/-0.5
Male householder, no spouse/partner present	15,612	+/-1,880	13.0%	+/-1.5
With children of the householder under 18 years	1,513	+/-835	1.3%	+/-0.7
Householder living alone	9,096	+/-1,587	7.5%	+/-1.3
65 years and over	1,956	+/-589	1.6%	+/-0.5
Female householder, no spouse/partner present	27,293	+/-2,232	22.6%	+/-1.9
With children of the householder under 18 years	7,099	+/-1,468	5.9%	+/-1.2
Householder living alone	12,797	+/-1,579	10.6%	+/-1.3
65 years and over	7,022	+/-991	5.8%	+/-0.8
TOTAL HOUSEHOLDS	120,546	+/-1,453	100.0%	

Source: 2021 American Community Survey, US Census Bureau

About 37% of Howard County households include children under 18 years old. For Maryland and the U.S., only 27% and 26% of households, respectively, include children under 18. Compared to other counties, Howard County has a relatively high percentage of households with children. About 18%, almost one out of every five households in the County, are single occupancy households where the residents live alone. This compares to 28% both Statewide and nationally. Close to 7.5% of households

in Howard County include residents 65 years and older living alone. This compares to a higher 11% Statewide and nationally.

Commuting to Work & Access to Transportation

Close to 64%, or two out of every three workers in Howard County, drive alone to work. About 4% carpool to work and only about 1% use public transportation. The remaining 1% walk, 2% commute by other means, and a significant 29% work from home. Statewide, 62% of workers drive alone, 7% carpool, 3% use public transportation, and as of 2021, 24% work from home. The percentage of Howard County residents working from home increased dramatically with the COVID-19 Pandemic. Prior to the pandemic, only about 8% of Howard County residents worked from home in 2019. Looking at these numbers for the U.S., 68% drive alone, 8% carpool, 3% use public transportation, and 18% work from home.

FIGURE 15: COMMUTING TO WORK IN HOWARD COUNTY

Commuting to Work in Howard County (civilian employed population 16 years and over) - 2021

Commuting to Work	Estimate	Margin of Error +/-	%	% Margin of Error
Car, truck, or van—drove alone	108,892	+/-4,397	63.5%	+/-2.1
Car, truck, or van—carpoled	7,542	+/-1,708	4.4%	+/-1.0
Public transportation (excluding taxi)	1,455	+/-742	0.8%	+/-0.4
Walked	1,173	+/-703	0.7%	+/-0.4
Other means	2,693	+/-1,157	1.6%	+/-0.7
Worked at home	49,799	+/-3,586	29.0%	+/-1.9
TOTAL COMMUTERS	171,554	+/-4,042	100.0%	

Source: 2021 American Community Survey, US Census Bureau

The Maryland Transit Administration (MTA) provides limited commuter bus service from within Howard County to Baltimore City and Washington D.C. Buses stop at park and ride lots, village centers, and in Downtown Columbia. MTA also operates the Maryland Area Rail Commuter (MARC) trains along Route 1 that provide rail access to Baltimore and Washington D.C. The Regional Transportation Agency (RTA) also provides more localized bus service in Howard County, Anne Arundel County, the City of Laurel, and Northern Prince George's County. Like most suburbs, however, transit ridership in Howard County is limited.

Howard County Office of Transportation's rider surveys have concluded that the local bus system in Howard County mostly attracts riders who are transit dependent—that is, they do not have access to vehicles. The system does not attract riders who choose to take transit as an alternate means, but primarily only riders who have no other means of transportation. Surveys also determined that two-thirds of riders live within 3 blocks of a bus stop, as transit dependent riders typically choose to live near bus stops. The table below summarizes the availability of vehicles to Howard County workers. A relatively small number of Howard County households do not have access to a vehicle.

FIGURE 16: VEHICLES AVAILABLE AT OCCUPIED HOUSING UNITS

Vehicles Available	Estimate	Margin of Error	%	% Margin of Error
No vehicles available	4,143	+/-1,347	3.4%	+/-1.1
1 vehicle available	33,119	+/-2,705	27.5%	+/-1.2
2 vehicles available	55,169	+/-2,870	45.8%	+/-2.3
3 or more vehicles available	28,115	+/-2,224	23.3%	+/-1.8
OCCUPIED HOUSING UNITS	120,546	+/-1,453	100.0%	

Source: 2021 American Community Survey, US Census Bureau

FEMA Community Resilience Index

The FEMA Community Resilience Index (CRI) is a composite index of 22 indicators commonly used across 14 peer-reviewed community resilience methodologies. The index provides a relative composite value by county and by census tract, measured as an average of counts of standard deviations from the national mean for each indicator.

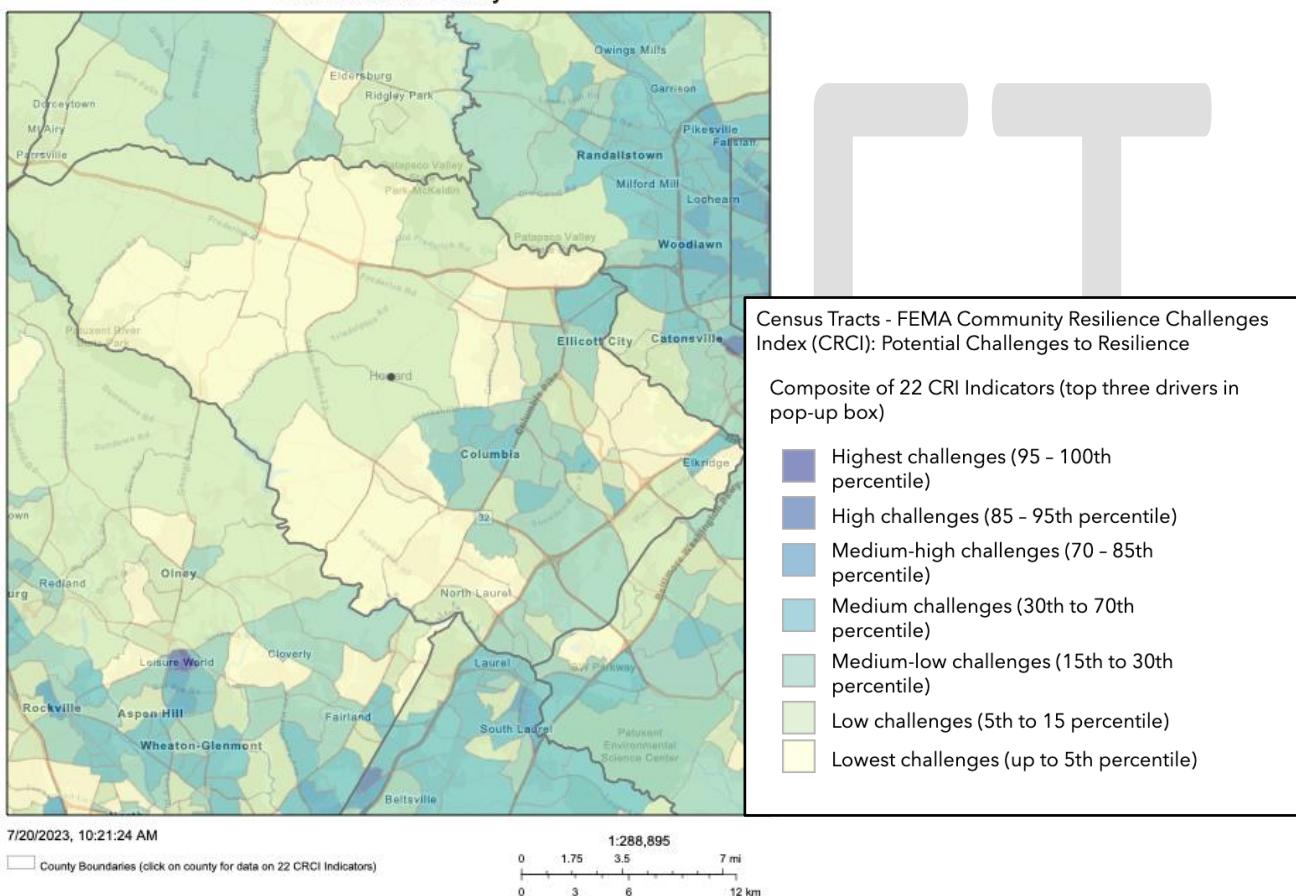
The goal of using this index is to get a relative assessment of a community's potential resilience and gives insights into population and community characteristics from which to build emergency operations plans and targeted outreach strategies. The indicators for the index are below with the first three representing the top drivers for the index. The percentages are representative for **Howard County as a whole**.

- Percent without Highschool Diploma: 4.63%
- Percent Age 65 and Older: 13.93%
- Percent with a Disability: 8.25%
- Percent Households (HH) without a Vehicle: 3.85%
- Percent HH with Limited English: 3.11%
- Percent Single-Parent HH: 18.40%
- Percent HH without a Smartphone: 7.07%
- Percent Mobile Homes: 0.78%
- Percent Owner-Occupied Housing: 70.44%
- Number of Hospitals per 10,000 People: 0
- Number of Medical Practitioners per 1,000 People: 34.07
- Percent without Health Insurance: 3.88%
- Percent Below Poverty Level: 5.50%
- Median HH Income: \$129,549
- Percent Unemployed Labor Force: 3.81%
- Percent Unemployed Women in Labor Force: 3.52%
- Percent Workforce Employed in Predominant Sector: 25.56%
- Income Inequality: 0.41 (Gini Index)
- Social/Civic Organizations per 1,000 People: 0.33

- Percent Without Religious Affiliation: 56.90%
- Percent Inactive Voters: 2.62%
- Population Change: 0.42

Please see the legend and map below for Howard County's Community Resilience Index *by Census Tract*. You can see that in Howard County, there are no "Highest Challenges" census tracts. Most "Medium Challenges" to "Medium-High Challenges" cluster around population centers, such as Columbia, Elkridge, Ellicott City, and North Laurel. This tells us that more resources and outreach need to be targeted to these underserved populations to improve Howard County's overall resilience.

**FIGURE 17: FEMA COMMUNITY RESILIENCE INDEX IN HOWARD COUNTY
CRI Howard County**



Planning Zones and Communities

Howard County is part of the Baltimore-Columbia-Towson Metropolitan Statistical Area (MSA), which includes the City of Baltimore, Columbia, Towson, and six other counties in addition to Howard County. Howard County is also part of the Baltimore-Washington-Northern Virginia Combined Statistical Area (CSA), one of the largest populous metropolitan areas in the United States. The figure below shows the boundaries of the Baltimore-Columbia-Towson MSA, and its location within the Baltimore-Washington-Northern Virginia CSA.

FIGURE 18: WASHINGTON-BALTIMORE-NORTHERN VIRGINIA COMBINED STATISTICAL AREA



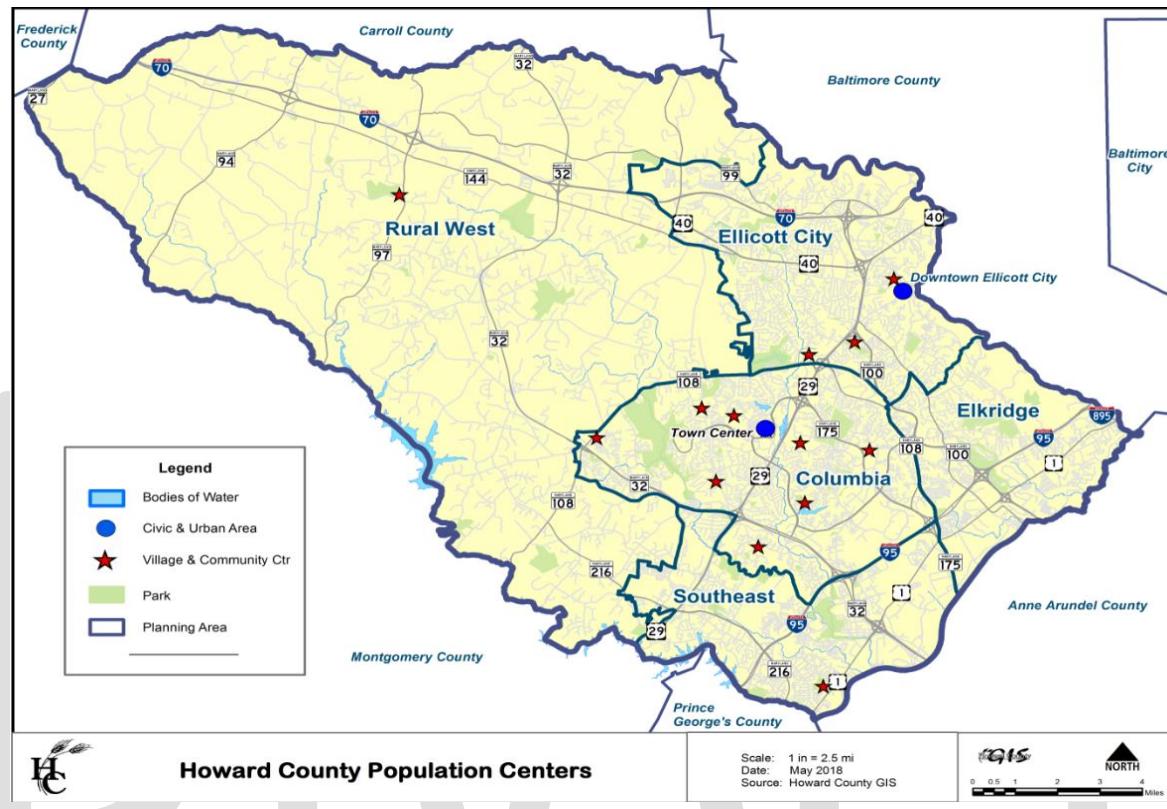
There are no incorporated municipalities in the County. The major population centers include:

- Columbia;
- Ellicott City;
- Elkridge;
- Savage;
- North Laurel; and,
- West Friendship.

Columbia, developed by James Rouse in 1965, is considered a popular example of the New Town Movement in the United States. Columbia was designed to be a self-sustaining community and a model for future urban development. Rouse's plan introduced the village and neighborhood concept, plans for business and industry, recreation and open space, and the Town Center. According to the United States Census Bureau, Columbia's population is estimated at 104,681 (as of 2020) and would be Maryland's second largest city if incorporated.

Ellicott City, located in the northeastern part of the County, serves as the County Seat. Founded in 1772, Ellicott City is prone to flooding from the Patapsco River and surrounding tributaries, which have had a major impact on the history of the town.

FIGURE 19: HOWARD COUNTY POPULATION CENTERS



*Source: Howard County Department of Technology and Communication Services, GIS Division

History of Howard County

Howard County played an important role not only in the development and progress of the State of Maryland, but also in the development of the nation. Howard County's most prominent resident, Charles Carroll of Carrollton, was the only Roman Catholic signer of the Declaration of Independence. Howard County is named after John Eager Howard, a Revolutionary War hero and three-term governor of Maryland. The B&O Rail Terminal in Ellicott City was the first station along the Baltimore and Ohio Railroad.

Elkridge

Howard County's central location between Baltimore and Washington D.C., and its abundant natural resources, were both instrumental to the development of the County. Prior to the 1700's, settlement in the area was slow until tobacco became a valuable export. The area now known as Elkridge was initially developed by farmers selling their tobacco to English merchants. As the Industrial Revolution progressed, iron became a major export through the port. Simultaneously, the population was increasing along the Patapsco and Patuxent Rivers.

Ellicott City

In 1772, three brothers from Pennsylvania, known as the Ellicott Brothers, purchased land on the Patapsco River. The Patapsco River's strong currents provided ideal conditions for milling. The three brothers constructed a mill and settled the area then known as Ellicott's Mills, now known as Ellicott City. The Ellicott Brothers further expanded their holdings and acquired several flour and iron mills. Although the opportunities for workers encouraged settlers to migrate towards the Patapsco River region, these settlements remained sparse. By 1851, the area was officially recognized as separate from Anne Arundel County.

The railroad system changed Ellicott Mills from a small industrial town into a robust commercial hub. The first section of the Baltimore and Ohio Railroad was constructed in Ellicott Mills in the early 1900s. As the first station along the railroad, it revitalized the economy in the Patapsco valley. However, by the 1950s, the town began to decline as the push to migrate to the suburbs gained popularity.

Columbia

In the early 1960s, land developer James Rouse purchased over 1,000 acres of land in Howard County. This area became the community of Columbia. The community was intended to eliminate racial, religious, and income segregation. Columbia was to be self-sustaining with resources such as jobs, schools, commercial districts, and health and medical facilities. The "New Town District," designed by Rouse, gave developers more flexibility on where they could develop throughout the community.

Land Use

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

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

There are 16 different types of generalized land use in Howard County, including six residential, two commercial, two industrial, one mixed-use and two government and institutional land uses. In addition,

there is a Transportation, Communications, and Utilities land use, as well as a use for parks, open space, and recreation. The Planned Service Area contains all six residential land uses, with the higher density residential land uses, including single family attached, rental apartments, and condo apartments typically located in Columbia, Elkridge, Ellicott City, Savage, and North Laurel. The residential land uses in the Rural West are mainly characterized by low-density residential uses, including single family detached and undeveloped residential. The combination of the preservation easements, park and open space, and low density single-family residential land uses make up a significant portion of the rural West. In the Planned Service Area, the park and open space land use is frequently located around residential development, acting as a buffer between the floodplain and residential properties. Higher density forms of residential development, such as townhouses and apartments, are almost exclusively found within the Public Service Area and single family detached residential has a lower average parcel acreage than within the Rural West.

Approximately 39% of land in Howard County, approximately 64,000 acres, is preserved through some type of land conservation measure. "Howard County preserves land by a wide variety of means including public parkland, Columbia Association [] and other homeowners' association open space, agricultural preservation, environmental and forest conservation easements, and regulations on floodplain, riparian buffer, and steep slopes in private development."⁵

Howard County's two commercial land uses are commercial and undeveloped commercial. The commercial land use is primarily located in the Planned Service Area, with several small defined locations along Ten Oaks Road, Route 27, Route 32, Route 94, Route 97, Route 144, Interstate 70, and other small defined locations in the Rural West. The majority of the commercial land use is found near major population centers, such as Clarksville, Columbia, Jessup, Elkridge, Ellicott City, Fulton, Savage, and North Laurel. Columbia Town Center, including The Mall in Columbia, which serves as a major retail center. Another retail cluster can be found on the Interstate 95 corridor, particularly between Route 32 and Route 175, as well as off Snowden River Parkway.

The Route 1 corridor is the principal location of the County's industrial land use. The majority of the industrial land is located east of Route 1 and makes up a significant portion of the land between Route 1 and Howard County's border with Anne Arundel County. Clusters of industrial uses are also located off Snowden River Parkway. There are numerous Government and Institutional land uses scattered throughout the County. The most prominent institutional land use is the University of Maryland's Central Maryland Research & Education Center - Clarksville facility, a dairy research center. Other Government and Institutional land uses include schools, hospitals, and County government buildings.

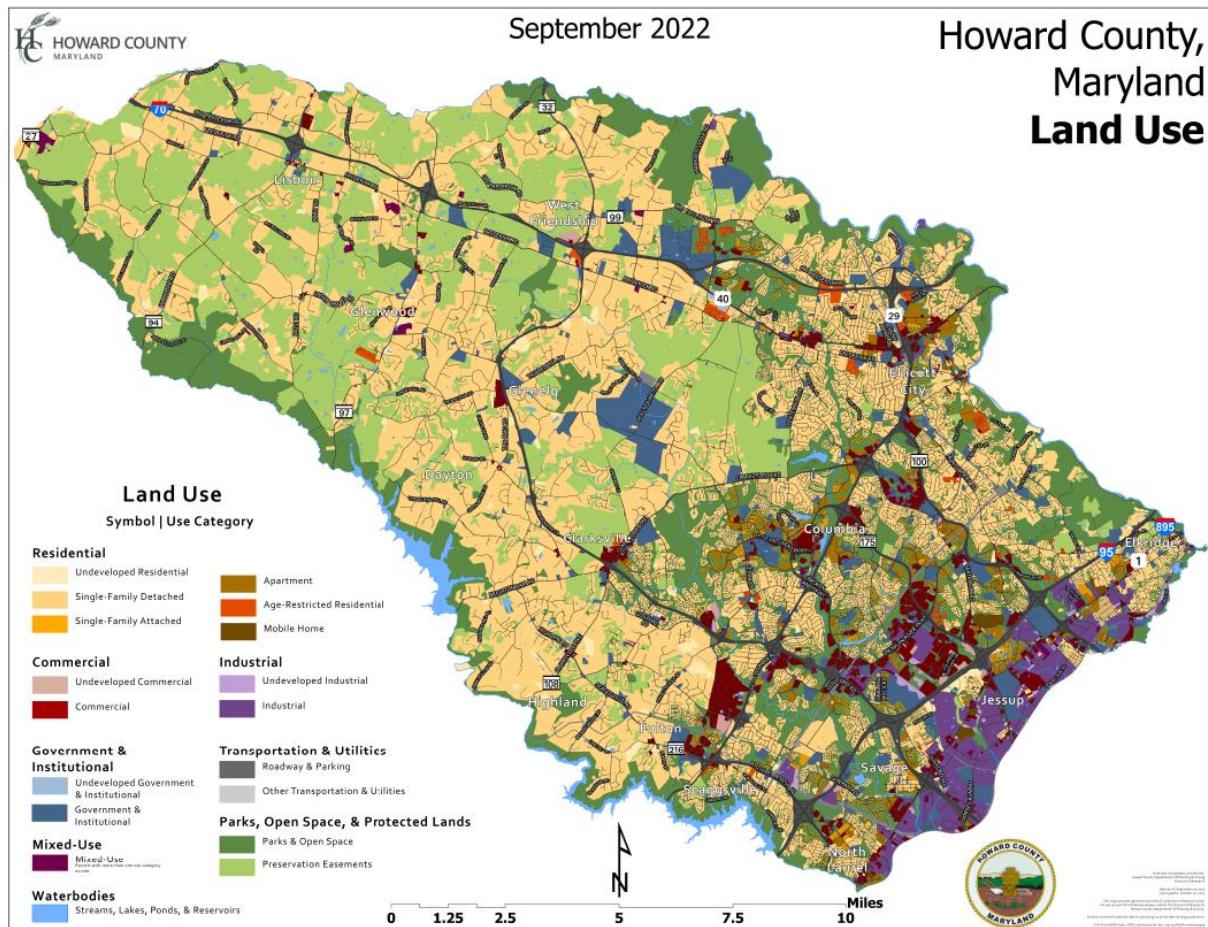
Growth and Development

The Countywide population density average as of 2021 was roughly 1,320 persons per square mile. The eastern portion of the County, inside the Planned Service Area, has a much greater population density

⁵ HOWARD CTY., MD., *PlanHoward 2030* 27 (2018) <https://www.hocobydesign.com/5676/widgets/17345/documents/10762>.

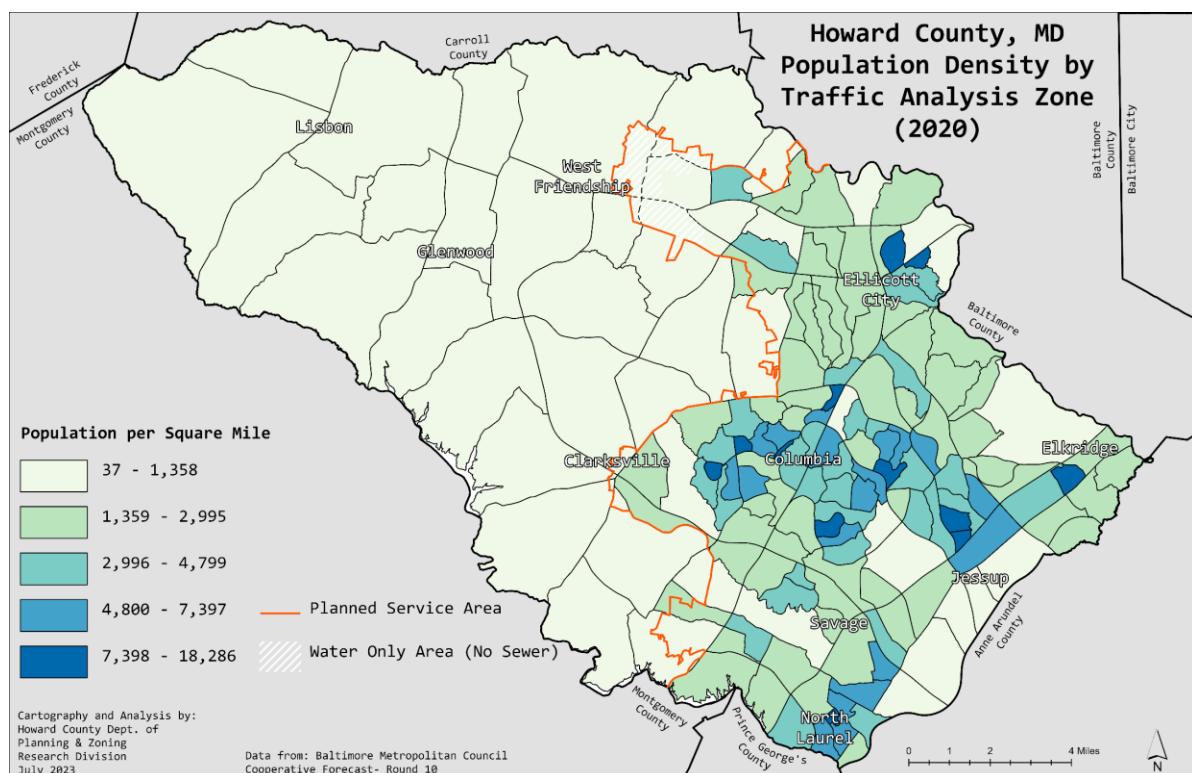
per square mile than compared to the rural western portions, where population density decreases rapidly once outside the Planned Service Area. As shown on the next page in Figure 20, population density reflects the residential land uses and the Planned Service Area, with the eastern part of the County being more densely populated than the Rural West.

FIGURE 20: HOWARD COUNTY LAND USE



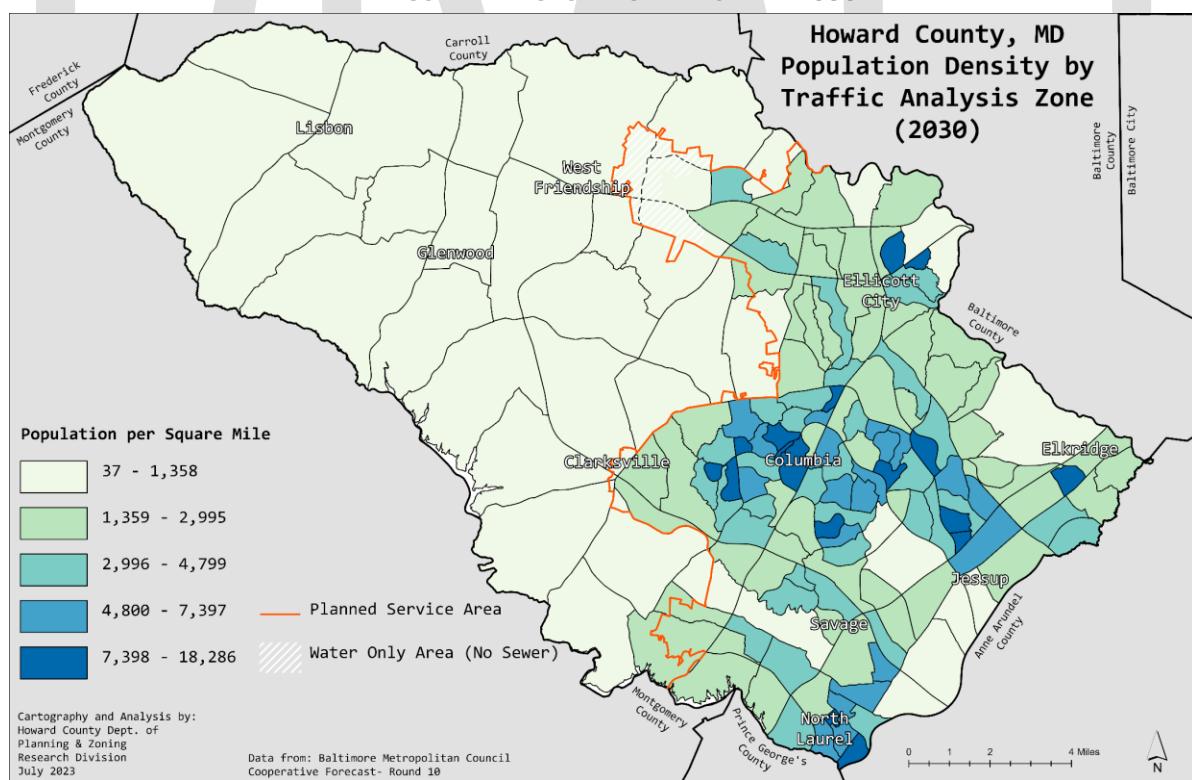
*Source: Howard County Department of Planning & Zoning, Research Division

FIGURE 21: POPULATION DENSITY



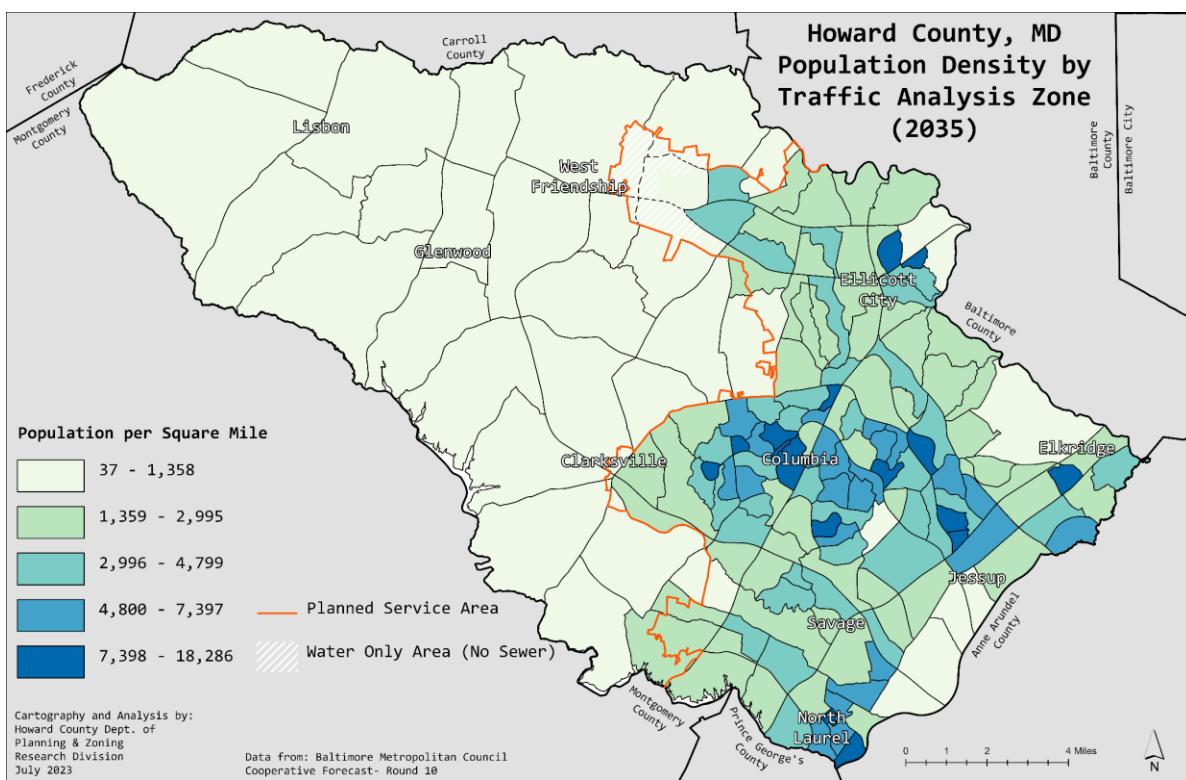
*Source: Howard County Department of Planning & Zoning, Research Division

FIGURE 22: POPULATION DENSITY IN 2030



*Source: Howard County Department of Planning & Zoning, Research Division

FIGURE 23: POPULATION DENSITY IN 2035



*Source: Howard County Department of Planning & Zoning, Research Division

If trends continue as the above maps predict, population density is not going to change significantly, and it will continue to stay around Columbia and Ellicott City with patches in Elkridge and North Laurel.

The U.S. Census Bureau estimates that the region's population growth has steadily increased over the last 10 years. The decennial census shows a 15.5% increase between 2000 and 2010, and a 15.8% increase between 2010 and 2020. Estimates project a 7.5% increase from 2020 to 2030. With the above traffic analysis zone population density maps and the U.S. Census Bureau statistics, the region is expected to continue to grow, but at a slower rate in the coming years, primarily due to limited land for new development. The table below provides the total number of residential building units with issued permits in the County from 2012 to 2021.

FIGURE 24: RESIDENTIAL BUILDING UNIT PERMITS ISSUED

UNITS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total = 12,611	945	1,311	959	1,153	1,077	1,185	2,114	895	1,173	1,799

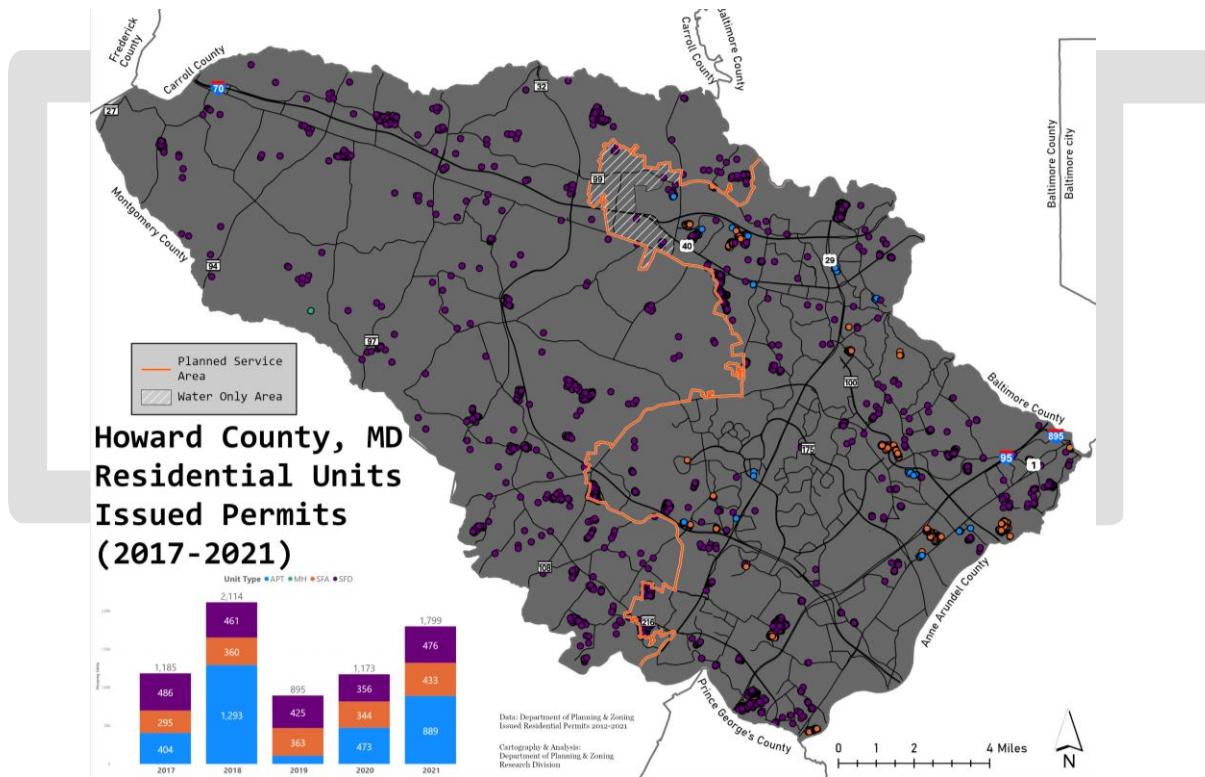
*Source: Howard County Department of Planning and Zoning, 2022 Development Monitoring System Report

According to DPZ's 2022 Development Monitoring System Report, between 2017 and 2021, a total of 7,166 residential units were permitted, coming out to an average of 1,433 new residential units per

year. Over that five-year period, 30% of the permitted units were for single family detached units, 25% were for single family attached units, and 44% were for apartment units (both rental and condo).⁶

Using issuance for residential building permits as a metric, this new development has mostly occurred within the Planned Service Area. Between 2012 and 2021, there were 12,611 residential building permits issued. “Greater percentages of apartment units are likely to persist given the zoning of the remaining underdeveloped land in the County as well as higher density redevelopment initiatives.”⁷ The County has anticipated this shift and has developed corridor plans for Route 1, Route 40, and Clarksville Pike (Route 108) and the Downtown Columbia Plan to reflect this transformation. *Figure 24* is a visual representation of Howard County’s Residential Permits 2017 to 2021.

FIGURE 24: HOWARD COUNTY RESIDENTIAL PERMITS 2017 – 2021



*Source: Howard County Department of Planning & Zoning, Division of Research

The upcoming general plan, HoCo by Design further emphasizes this shift towards higher-density residential development and a focus on redevelopment and infill opportunities as available developable land reduces. There is also considerable respect paid towards the further protection and preservation of environmentally sensitive areas and agricultural lands. The County recognizes that climate change will impact hazards such as flooding, drought, and wildfires, and efforts to mitigate these risks will be largely driven by controlled and sustainable development and land use policies.

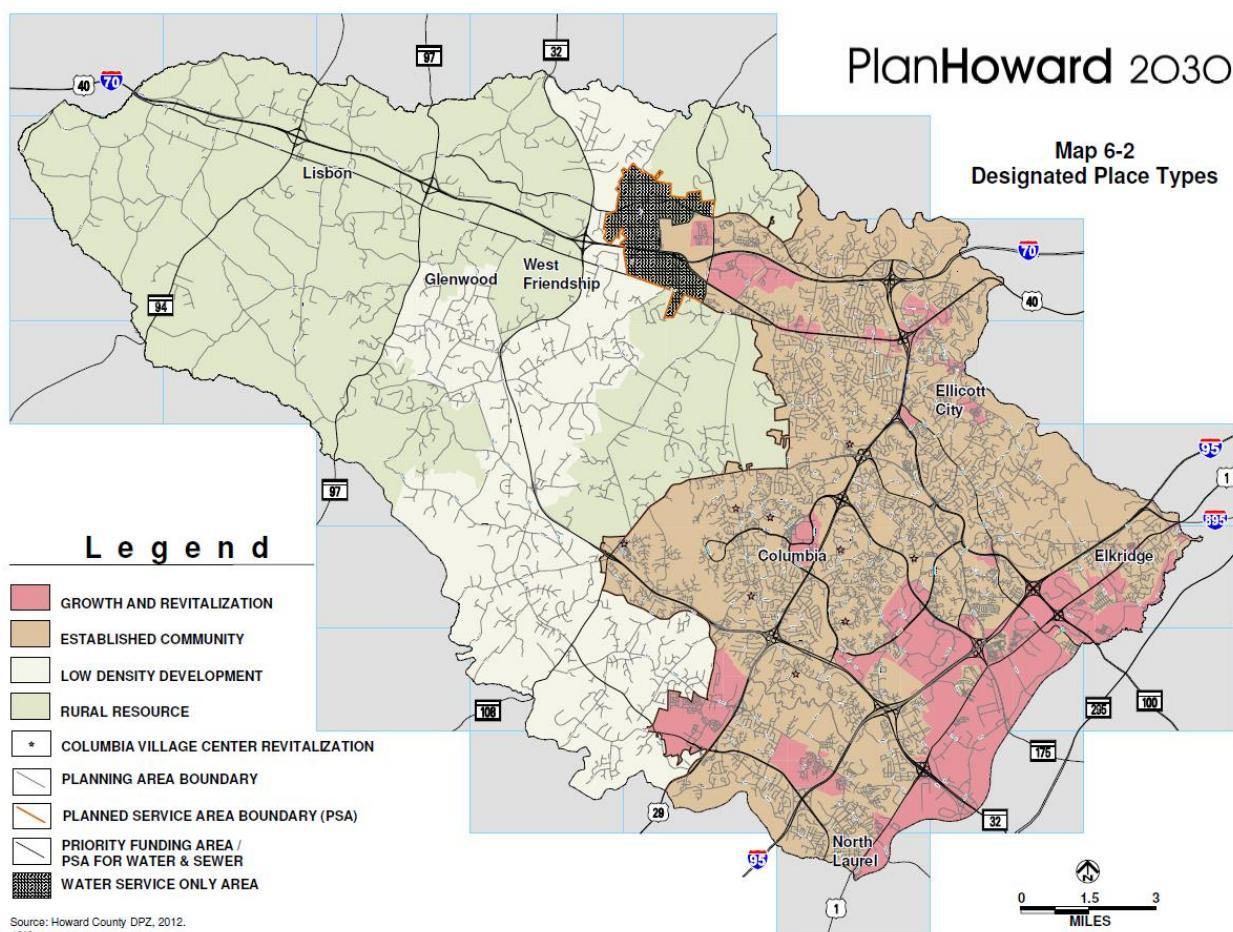
⁶ HOWARD CTY. DEPT. OF PLANNING AND ZONING, *Development Monitoring System Report: Howard County, Maryland* (April 2022), <https://www.howardcountymd.gov/sites/default/files/2022-04/2021%20DMS%20%281%29.PDF>.

⁷ *Id.* at 3.

Future Development

To further understand how development is occurring in the County, please refer below to the Designated Place Type map from PlanHoward 2030. This map shows the Growth and Revitalization area where future population and employment growth is expected to be concentrated over the next 20 years. Howard County's Zoning and Land Development regulations and other land use policies are designed to allow and direct future development and in-fill development in this Growth and Revitalization area. This area includes Downtown Columbia, the other nine Columbia village centers, areas along Route 1 and Route 40 Corridors, Maple Lawn and Turf Valley. There will be some in-fill development in the Established Community, Low Density, and Rural Resource areas, as shown on the map, but the most significant growth will occur in the Growth and Revitalization area.

FIGURE 25: DESIGNATED PLACE TYPES BY 2030



Development in Hazard-Prone Areas

Since the last NHMP that was approved in January of 2019, the County has proactively acquired multiple properties in hazard-prone areas (flood zones). This proactive approach decreases the community's vulnerability by removing occupied structures from flood-prone locations. In many instances, the County has razed these structures, and reforested the areas. In other instances, the structures remain, albeit uninhabited, while the County implements other flood mitigation strategies. Approximately 20

properties have been acquired in the Tiber-Hudson Watershed of the Patapsco River; three properties were acquired in the New Cut Watershed of the Patapsco River; and several other properties were acquired along the Autumn Hill Branch. According to County Code, no permits are issued for new structures within the 100-year flood plain.

Furthermore, the County continues to restrict development in known, mapped floodplain areas to protect vulnerable flood-prone communities. These restrictions include more rigorous stormwater management regulations in the Tiber Branch and Plumtree Watersheds by requiring stormwater quantity control for larger storm events than the State minimum requirements. Quality control requires stormwater facilities to have a post-development flow release rate equal to or less than the release rate of the property before development occurred. By definition, the pre-development release rate assumes the property is “woods in good condition” or that the property is in a natural state before development. This “natural state” means that the property can “capture and treat stormwater much better than typical residential land because the ground is able to store, soak in, filter, evaporate, and consume water”⁸.

Additionally, more rigorous stormwater quantity control is part of the development and implementation of the Ellicott City Safe and Sound Plan. More rigorous stormwater management regulations for all new development were implemented in 2020 to ensure much higher standards within the Tiber Branch, as well as the nearby Plumtree Watershed—the areas that were most impacted during the devastating storms of 2016 and 2018. These watersheds specifically include the following flood-prone Ellicott City communities: Valley Mede, Chatham, Dunloggin, Historic Ellicott City, and communities off Frederick Road and Old Columbia Pike.

As passed by Howard County Council, Council Resolution 123 (CR-123) requires management of short duration, high-intensity storms like those that occurred in 2016 and 2018, as well as the 10-year and 100-year storms for all future development within these watersheds. The goal of these 2020 stormwater regulations is to mitigate the increase of peak stormwater flow from new development to address the widest range of storm events that Ellicott City may experience. In addition, the County added the 10-year and 100-year management regulations to the Plumtree Watershed. As noted above, by releasing stormwater at a rate equal or less than what would have run off the site in a “woods in good condition” for storms up to and greater than a 100-year storm event, the County can mitigate/reduce the effects of greater flows coming from the developed or more impervious sites.

While there are other low-drainage areas in the County that are prone to “nuisance” flooding, largely a result of unanticipated conditions, such as clogged inlets or roadway culverts, the prior standard management requirements were not enough to protect Ellicott City and its surrounding communities against the type of storms experienced in 2016 and 2018. Past stormwater management requirements

⁸ MONTGOMERY CTY. DEPT. OF ENVIRONMENTAL PROTECTION, *WATER QUALITY CHARGE SINGLE FAMILY RESIDENTIAL CREDIT GUIDE*, (APRIL 2022), [HTTPS://WWW.MONTGOMERYCOUNTYMD.GOV/DEP/RESOURCES/FILES/DOWNLOADS/WATER/WQPC/HOW-IS-MY-WQPC-CREDIT-CALCULATED-GUIDE.PDF](https://www.montgomerycountymd.gov/dep/resources/files/downloads/water/wqpc/How-Is-My-WQPC-CREDIT-CALCULATED-GUIDE.PDF).

addressed modeled storm events where the rainfall intensity is distributed in a bell curve over a 24-hour period. This type of long duration storm event allows time for ponds to fill slowly and release the runoff at a controlled rate over an extended window before the peak of the storm is realized. The precipitation of the 2016 and 2018 storms was so intense, the ponds and storm drains were quickly overwhelmed. It was determined that, of the two storms, the 2016 storm caused the highest runoff in the shortest period, i.e., 6.6 inches of rainfall in 3.55 hours.

In addition to the more standard 24-hour bell curve distribution rain events, the County wanted future development in these two watersheds to also provide quantity control for a short duration, high-intensity rainfall event like that which was experienced in 2016 and 2018. For this reason, the County added 6.6 inches in 3.55 hours rain event to the 10-year and 100-year, 24-hour rainfall events as the requirement for any development in the Tiber Hudson and Plumtree Watersheds. With the addition of this short-duration, high-intensity storm management, the County's stormwater management practices for this watershed include both long-duration and short-duration events while maintaining requirements to also provide the state-mandated one-year, 24-hour event and water quality using small scale filtering devices known as Environmental Site Design (ESD).

Results of the new regulations will require large-scale stormwater practices, such as ponds and underground storage pipes to be installed in conjunction with the water quality ESD practices on all future development sites. These large facilities will reduce the stormwater impacts to both watersheds as well as adjacent and downstream property owners.

These new short-duration, high-intensity storm requirements became a complementary part of the County Executive's Ellicott City Safe and Sound Plan, which focused on comprehensive and holistic flood mitigation and recovery. The new regulations and the storage and conveyance projects (for example, drainage improvements to culverts and bridges to increase capacity) in the Safe and Sound Plan, will greatly reduce the depth of flooding and water velocity. All these efforts will help achieve the County's goals of mitigating flooding, preparing for a changing climate, ensuring public safety, protecting Ellicott City's historic charm while making it more resilient, and supporting property and business owners.

In summary, Howard County has proactively acquired many properties in hazard-prone areas and continues to restrict development in known, mapped floodplain areas. With new stormwater management regulations, County drainage projects, and the Ellicott City Safe and Sound Plan mitigation projects, Howard County is working to make these watersheds significantly less vulnerable to flooding hazards since the previous NHMP was approved.

Summary

Howard County has a diverse and growing population. It is a wealthy county located in the middle of a vibrant metropolitan area surrounded by other wealthy counties that are also diverse and growing. Situated between Washington D.C. and Baltimore, Howard County is in the heart of one of the largest regional economies in the United States. There is much activity and movement with commuters coming

into and leaving the County every day. The diverse economy attracts jobs and industries of all types, from basic services and retail to manufacturing and warehousing, to the high-tech jobs of the future.

Despite being the center of all this activity and regional growth, a large portion of Howard County remains rural with its western half made up of low-density housing and acres of farmland and natural resources, much of which is permanently preserved. The County's eastern half consists of higher density housing, including many apartment and townhome communities, and a significant number of jobs. The diversity of housing draws a diverse population made up of many races who speak a variety of languages.

Given the high quality of its school system, Howard County attracts many families with children. As a result, it has a higher proportion of families with children compare to Maryland and the U.S. However, like most places around the U.S., Howard County's population is rapidly aging, with increasing numbers of residents living alone and with disabilities.

This diversity in people and workers and household types, all of which are constantly changing over time, requires a flexible emergency response system. The leaders of OEM are keenly aware of this, and it is the goal of this Plan to put in place an emergency response system that will meet the needs of all County residents, job holders, and visitors.

Chapter 3: Planning Process

Requirements for the Planning Process

44 C.F.R. § 201.6(b): An open public involvement process is essential to the development of an effective plan. To develop a more comprehensive approach to reducing the effects of natural disasters, the planning process must include:

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

44 C.F.R. § 201.6(c)(1): [The Hazard Mitigation Plan must include] documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

44 C.F.R. § 201.6(d)(3): A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

What is Hazard Mitigation Planning?

A Hazard Mitigation Plan (HMP) is an all-encompassing plan that serves as a roadmap for a community's long-term strategy to reduce disaster losses and break the cycle of repeated destruction from all hazards. We refer to our all-encompassing plan as the HMP, and this includes the Natural Hazard Mitigation Plan (NHMP), and the following two annexes: Annex A: the Human-Caused Hazard Mitigation Plan (HCHMP), and Annex B: the Historical and Cultural Resources Mitigation Plan (HCRMP). This Plan is just the NHMP, which focuses on naturally occurring hazards and is required by FEMA to qualify for mitigation grant funding. The planning process used to develop an HMP involves risk-based decision making to reduce damage to people, property, and infrastructure from future disasters.

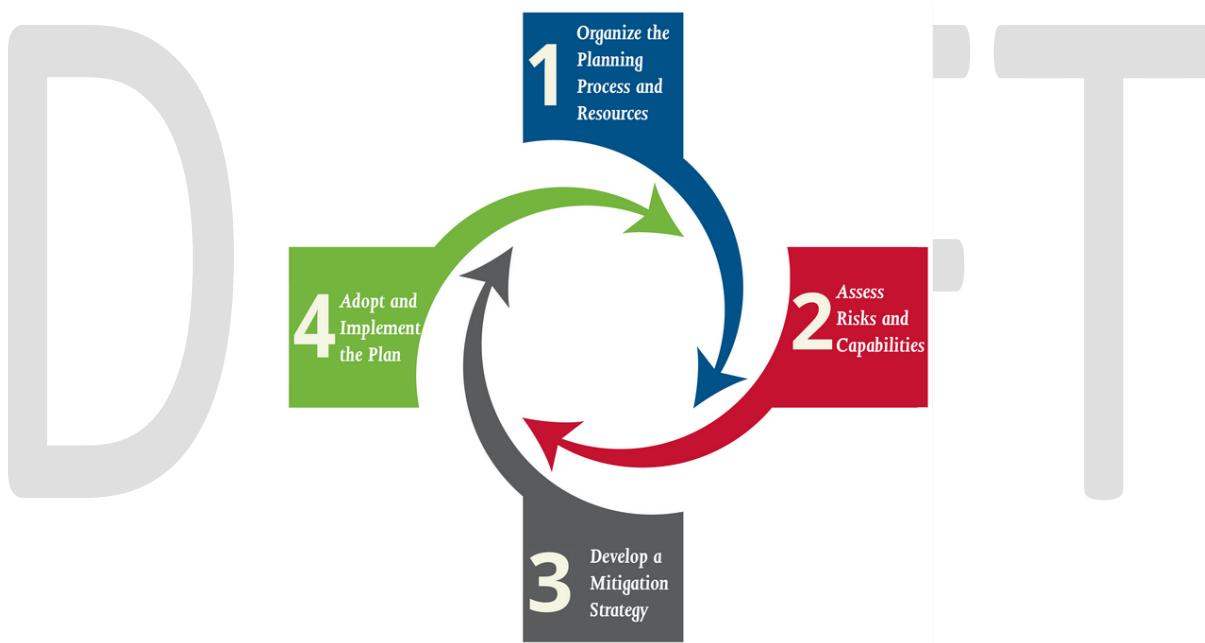
Hazard Mitigation Plan Update Process

Howard County first developed its NHMP in 2004 and has established its five-year planning cycle since conception. This iteration of the Plan will encompass the years 2024-2029. Howard County used an all-hazards approach when developing this Plan, which is a comprehensive and protective planning process. This Plan focuses on only natural hazards, but the County also developed and updated two other Annexes: Annex A: Human-Caused Hazards Mitigation Plan and Annex B: Cultural and Historical Hazard Mitigation Plan. The first Annex addresses human-caused hazards and the second addresses hazard that threaten cultural and historical elements in the County.

OEM began the 2024 Plan update in the fall of 2022 in coordination with and participation from internal and external stakeholders. OEM gathered supporting information from the County's 2023 HIRA update and integrated emerging trends in the causes and effects of natural hazards, such as the continuing threats of climate change and food insecurity in the 2022/2023 NHMP update. OEM adopted the same planning processes as required and defined by FEMA:⁹

- Organize the Planning Process and Resources;
- Assess Risks and Capabilities;
- Develop a Mitigation Strategy; and,
- Adopt and Implement the Plan.

FIGURE 26: HAZARD MITIGATION PLANNING PROCESS



Organize the Planning Process and Resources

Several entities at the local, State, and federal levels were involved in the planning process. Each of these groups was entrusted with specific responsibilities to ensure that outreach efforts were comprehensive and far-reaching.

- JSC NHMP/FMP – attendance at meetings, providing subject matter expertise, review of Plan sections and draft plan.
- Stakeholders – involvement in the NHMP's update progress via emails and through the County website.
- Public – plan input and attendance at the Public Outreach Meetings.
- Maryland Department of Emergency Management (MDEM) – plan review and approval.

⁹ Hazard Mitigation Planning Process, FEMA, <https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/create-hazard-plan/process> (last visited Feb. 10, 2023).

- FEMA – project funding, plan review, and approval.

Joint Steering Committee

This Committee is referred to as “Joint” since the same committee was used to update the FMP simultaneously. The JSC convened three times during the NHMP/FMP update process to review existing plans, update mitigation actions and goals, aid in developing new mitigation actions, and provide comments and feedback. The JSC is comprised of 52 representatives from several County departments, offices, and agencies as well as select County businesses and community representatives, such as the Columbia Association (CA), Howard EcoWorks, and Constellation Home (formerly BGE). The JSC is listed in detail in [Appendix E: Detailed Joint Steering Committee List](#).

Multiple NHMP/FMP JSC meetings were held during the Plan update process to maximize participation and provide an integrated and efficient planning process. Copies of the agendas, sign-in sheets, and meeting summaries for all meetings are included in [Appendix A: Meetings](#). All JSC members also received rough drafts to review throughout the process.

The first meeting was held on September 21, 2022, at the Howard County Emergency Operations Center (EOC) policy room in the Ligon Building in Ellicott City. OEM provided an overview of hazard mitigation planning, including the County’s mitigation plans and annexes, federal mitigation funding, the planning process, the goals and objectives of hazard mitigation, the roles and responsibilities of JSC members, and OEM’s milestone timeframe for the 2024 five-year update. After this introduction, the majority of the meeting focused on action item updates regarding natural hazard mitigation, human-caused hazard mitigation, and flood mitigation.

The second JSC meeting was held on February 1, 2023, at the County EOC. OEM updated the JSC on its progress updating the NHMP, including the status of each chapter. OEM recapped the first public meeting with a summary of the presentation and discussion. Next, OEM presented findings from the County’s newly updated 2023 Hazard Identification and Risk Assessment (HIRA) and discussed the elements to be incorporated into the NHMP, such as the recalculated risk rankings and two additional hazards, space weather and pest infestation/zoonotic infection. After presenting the anticipated timeline for remaining NHMP update milestones, OEM reviewed the prioritization rubric that JSC members used to re-rank all hazard mitigation action items and to rank new items. OEM then provided an overview of highlights from the prioritizations. Finally, OEM led a discussion about the integration of other County plans into the NHMP, such as the forthcoming Climate Action Plan.

The third JSC meeting was held on April 19, 2023, in virtual format. OEM updated the JSC on recent public meetings about the Natural Hazard Mitigation Plan and Flood Mitigation Plan held on March 22, 2023, and March 29, 2023. Next OEM discussed the feedback from JSC members and from the public regarding drafts of both plans, and how this feedback was incorporated into the final drafts. OEM discussed the addition of several new action items, as well as their descriptions and prioritization in the Implementation Plan; no JSC members dissented to these items. OEM also discussed FEMA’s regulatory requirements for Natural Hazard Mitigation Plan, and how the Plan includes a “Plan Review Checklist”

that identifies the sections and page numbers that satisfy each requirement. Finally, the JSC voted to approve both the NHMP and the FMP, authorizing their release to MDEM and FEMA for review.

Public Participation

Public input was solicited at three public meetings during the planning process. For the agendas and summaries of these meetings, please refer to [Appendix D: Press Releases, Notices, and Public Participation.](#)

This meeting was published through the Howard County Office of Public Information. All news releases went to local media outlets (TV, radio, and paper), as well as Howard County State Delegation. Additionally, the meeting notices were sent to fellow public information representatives in the HCPSS, Howard Community College (HCC), Howard County General Hospital (HCGH), etc. The meeting was also posted on the County's main social media pages.

In addition, the first draft was released for public comment on February 28, 2023, with the period ending on April 7, 2023. This was promoted on social media and through email distribution lists. In addition, an invitation to review was sent to the Baltimore Metropolitan Council, Offices of Emergency Management in Annapolis City, Anne Arundel County, Baltimore City, and Baltimore County. Please refer to [Appendix D: Press Releases, Notices, and Public Participation](#) to review this documentation.

Surveys

The Community Hazards Survey was developed for the HIRA to gather information from County's community members on their perception of natural hazard events and their confidence levels in their personal and communal readiness. The results of the surveys are published in [Appendix B: Survey Results.](#)

Additional short online surveys were developed for specific community meetings that OEM attended throughout the Plan update process. These meetings included the following:

- Howard County Rotary Club on January 13, 2023: OEM presented the survey as part of a community preparedness presentation. Participants were given access to the survey via physical copy (paper) and virtually (QR code and direct link).
- Oakland Mills Local Leadership Team 5th Annual Job and Career Fair on January 20, 2023: OEM set up a booth and provided participants with access to the survey via the same mechanisms detailed above.

Assess Risks and Capabilities

For this step, OEM reviewed data on local hazard events compiled in the 2023 HIRA. This information forms the basis for [Chapter 4: Hazard Identification, Profiling, and Risk Assessment](#) of the 2024 NHMP. Chapter 4 summarizes past occurrences, probability of future events, and estimates of potential losses due to identified hazards.

This NHMP also provides a general description of land uses and development trends in the County, so that mitigation options can be considered in future land use decisions. [Chapter 2: Community Profile](#)

describes land use in Howard County and [Chapter 5: Capability Assessment](#) includes a Plan Integration section that thoroughly reviews and analyzes current County plans and ordinances with consideration to hazard mitigation principles. This interdisciplinary approach enables Howard County to incorporate hazard mitigation principles into various County planning documents going forward.

Develop a Mitigation Strategy

In addition to a review and incorporation of hazard information from the 2023 HIRA, the JSC thoroughly examined and updated the 2018 NHMP and all associated annex goals and planned action items. Since the adoption of the initial Plan, several mitigation actions have been completed. As such, the JSC updated the prioritization of all action items by quantifying their life/safety impact, need for administrative or technical assistance, and project cost. This process is detailed further in [Chapter 6: Mitigation Strategy](#). Further, with help from department representatives, the JSC considered the need for new/additional mitigation actions and projects to reduce the effects of hazards on the County.

The 2024 NHMP includes actions in the following six categories:

- Preventative Measures – Zoning, floodplain, stormwater, and other ordinances;
- Structural Projects – Levees, dams, reservoirs, and channel improvements;
- Property Protection – Relocation, floodproofing, and insurance;
- Emergency Services – Warning systems, sandbagging, evacuation routes;
- Natural Resource Protection – Wetlands protection, sediment erosion control, and other best management practices; and
- Public Outreach and Education – Outreach projects, environmental education, and technical assistance.

Adopt and Implement the Plan

Plan implementation is discussed in-depth in [Chapter 7: Plan Monitoring and Maintenance](#). This Chapter describes the plan update process, plan distribution, plan monitoring and progress reports, circumstances that require plan review and update, benefit cost analysis, and continued public involvement. Moreover, plan funding and specific implementation of the mitigation actions items are discussed in [Chapter 6: Mitigation Strategy](#).

Chapter 4: Hazard Identification, Profiling, and Risk Assessment

Requirements for Hazard Identification, Profiling, and Risk Assessments

Federal Authorities:

44 C.F.R. § 201.6(c)(2)(i): the plan must include “a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards.” The “local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards,” including:

- (i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan must include information on previous occurrences of hazard events and on the probability of future hazard events.
- (ii) A description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description must include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008, must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
 - (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
 - (B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;
 - (C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Hazard Identification

Methodology for Hazard Identification

Hazard Identification and Risk Assessment Steering Committee

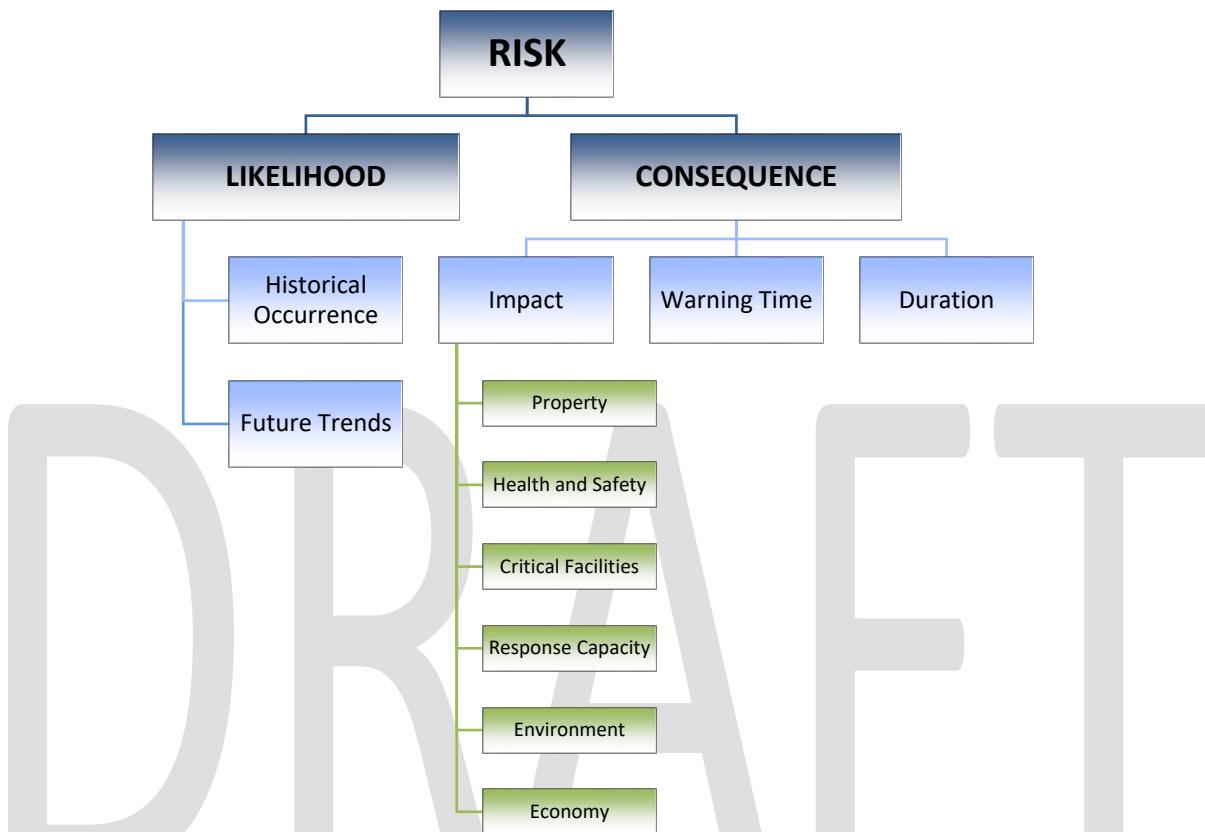
The County’s 2023 Hazard Identification and Risk Analysis (HIRA) identified eleven natural hazards facing the County and assigned risk scores to each one for both the most likely scenario and least likely scenario. Development of the 2023 HIRA was guided by a multidisciplinary steering committee, which utilized guidance from literature, industry accreditation standards, model programs, federal documents, a public survey, and Subject Matter Experts (SMEs) to craft an assessment that met or exceeded industry standards while remaining relevant and specific to the Howard County context.

Risk Formula

Risk is most easily understood by analyzing the component parts of risk. The HIRA defines the components of risk in the following manner: Risk is a function of *Likelihood* and *Consequence*. Likelihood is defined by historical occurrence and future trends. Consequence is defined by Warning Time,

Duration, and Impact. Impact itself is defined by impacts to Property, Health and Safety, Critical Facilities, Response Capacity, the Environment, the Economy, and Standard of Living/Quality of Life. The chart below demonstrates this relationship visually:

FIGURE 27: RISK FORMULA



In summary, the HIRA Steering Committee used the following formula to determine the risk score for each identified hazard: $RISK = LIKELIHOOD * CONSEQUENCE$.

Howard County Risk Tool

After the HIRA Steering Committee selected the hazards, the Howard County Risk Tool was used to convert hazard information into a set of numerical scores that allow for comparison across many hazard types. Every hazard is assigned a numerical score in each of the four risk assessment categories: Likelihood, Impact, Warning Time, and Duration. Numerical scores range from one to four based on criteria that are defined explicitly in the tool. The scores from each section are multiplied by the assigned weighting factor. Likelihood is weighted at 50% of the Risk Score. Consequence is made up of Impact (40%), Warning Time (5%), and Duration (5%) for a combined total of 50% of the Risk Score. Once multiplied by the weighting factor, the sum of the scores becomes the total Risk Score for the hazard. The Howard County Risk Tool can be seen on the next page.

HOWARD COUNTY RISK TOOL

LIKELIHOOD FACTORS

LIKELIHOOD

Estimated chance of a single hazard event occurring in a given year based on historical incidence and trend forecasting.

UNLIKELY (1)	INFREQUENT (2)	LIKELY (3)	VERY LIKELY (4)
No documented occurrence. Less than 1% chance of annual occurrence.	1-10% chance of annual occurrence.	11-30% chance of annual occurrence.	30+% chance of occurrence annually.

CONSEQUENCE FACTORS

IMPACT

Estimated effect of a single hazard event on property, health and safety, critical facility functioning, response capacity, the environment, the economy, and standard of living.

LIMITED (1)	SIGNIFICANT (2)	CRITICAL (3)	CATASTROPHIC (4)
<ul style="list-style-type: none"> ▪ Property damage is less than 5% of critical and non-critical infrastructure. ▪ Injuries are manageable with existing resources, no fatalities. ▪ Shutdown of critical facilities for less than 24 hours. ▪ Local resources are adequate to support the response. ▪ Little to no environmental impact. ▪ Little to no economic impact. ▪ Standard of living is only minimally disrupted. 	<ul style="list-style-type: none"> ▪ Property damage is 5-25% of critical and non-critical infrastructure. ▪ Injuries are manageable, may include at least one death. ▪ Critical facilities are down for 1-7 days. ▪ Local and mutual aid resources are adequate to perform response, with limited or no state assistance. ▪ Moderate environmental impact. ▪ Moderate economic impact. ▪ Standard of living is moderately affected. 	<ul style="list-style-type: none"> ▪ Property damage is between 26-50% of critical and non-critical infrastructure. ▪ Multiple deaths and serious injuries are probable. ▪ Shut down of critical facilities 1-4 weeks. ▪ Local resources are expended and require sustained support from mutual aid partners and/or the state/federal government. ▪ Serious environmental impact. ▪ Serious economic impact. ▪ Standard of living is seriously affected. 	<ul style="list-style-type: none"> ▪ Property damage is severe, greater than 50% of critical and non-critical infrastructure affected. ▪ Multiple deaths and serious injuries exceed jurisdiction response capacity. ▪ Shut down of critical facilities will be more than one month. ▪ Response capacity is overwhelmed and requires significant and long-lasting state and federal government support. ▪ Severe environmental impact. ▪ Severe economic impact. ▪ Standard of living is extremely impacted and may not be fully recoverable.

WARNING TIME

Estimated time of awareness prior to the onset of the hazard event.

VERY LONG (1)	LONG (2)	MODERATE (3)	SHORT (4)
More than 24 hours	12-24 hours	6-12 hours	Less than six hours

DURATION <i>Estimated time from onset to conclusion of the hazard event.</i>			
SHORT (1)	MODERATE (2)	LONG (3)	VERY LONG (4)
Less than six hours	6-24 hours	Less than one week	More than one week
RISK SCORE WEIGHTING			
LIKELIHOOD	IMPACT	WARNING TIME	DURATION
[50%]	[40%]	[5%]	[5%]
			
RISK = LIKELIHOOD + CONSEQUENCE			

Consequence Analysis Tables

In this chapter, each hazard's impacts are broken down into a Consequence Analysis Table. This table provides a detailed description of the hazard's anticipated impact to property, health and safety, critical facilities, response capacity, the environment, and the local economy. Each consequence sub-category is assigned a descriptive level to coincide with the associated score as specified in the Risk Tool. The information in this table reflects the data and experience of SMEs in each respective field.

Consequence Analysis					
Likely					
CATEGORY	RANKING	DESCRIPTION			
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> 0% damage to critical and non-critical infrastructure. 			
HEALTH and SAFETY	Limited	<ul style="list-style-type: none"> Zero deaths likely. 20 injuries likely 			
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – Shutdown unlikely. No effect on utilities. <u>Information/Communications</u> – Shutdown unlikely. <u>Transportation</u> – Traffic delays for less than one day. 			
RESPONSE CAPACITY	Significant	<ul style="list-style-type: none"> <u>Police</u> – Mutual aid needed. No great impact to response capability. <u>Fire and Rescue</u> – Moderate need for state or federal assistance. <u>Health</u> – Local resources adequate. Health Department operations will not be affected. <u>Hospitals</u> – Local resources adequate. No impact on the hospital system. <u>Emergency Management</u> – Local resources adequate. 			
ENVIRONMENTAL IMPACT	Limited	<ul style="list-style-type: none"> Limited to no environmental impact. Less than a day of clean-up. 			
ECONOMIC IMPACT	Limited	<ul style="list-style-type: none"> Minimal loss of economic output due to the limited area affected. Temporary business disruption in the area of the attack. Damage to image possible. 			
TOTAL IMPACT ¹⁰	Limited	<ul style="list-style-type: none"> Total Impact Score: 1 on a scale of 1 (Limited) to 4 (Catastrophic). 			
Limited		<table border="1"> <tr> <td>Significant</td> <td>Critical</td> <td>Catastrophic</td> </tr> </table>	Significant	Critical	Catastrophic
Significant	Critical	Catastrophic			

- Property Damage** details the anticipated percentage of Howard County critical and non-critical infrastructure that will suffer damage from the hazard and the type of damage that is expected.
- Health and Safety** details the number of deaths and injuries that are expected to result from the hazard and the types of deaths and injuries that are expected.
- Critical Facilities** details the expected shutdown duration of essential functions. Utilities, information/communication, and transportation are each assigned a descriptive level to coincide with the associated score as specified in the Risk Tool.

¹⁰ The total impact score is created by Subject Matter Experts weighing the importance of the economic impact, environmental impact, response capacity, critical facilities, health / safety, and property damage for each hazard. These factors are weighed differently, depending on the specific hazard. The subject matter experts were divided into groups where they created one total score per hazard. Those individual scores were then averaged together to create the total impact score you see on the graph.

- **Response Capacity** details the expected shutdown duration of essential response functions. Police, fire and rescue, health, hospitals, and emergency management are each assigned a descriptive level to coincide with the associated score as specified in the Risk Tool.
- **Environmental Impact** details the hazard's expected impact to the environment.
- **Economic Impact** details the hazard's impact to the economy of Howard County. Loss of economic output and job loss refer only to the hazard's anticipated effect on the gross domestic product of the jurisdiction as calculated by SME analysis. Information in this section does not include the costs associated with cleanup or healthcare for those affected.
- **The Total Impact Score** was determined by SME teams through extensive consideration of Consequence Analysis data and specifications outlined in the Risk Tool.

Final Risk Scores

The table below shows the new Risk Scores for each identified natural hazard. The Most-Likely score is for the Likely Hazard Scenario, which refers to the emergency-level hazard scenario that is most likely to occur within the County. An emergency-level hazard is any hazard that requires a response from at least two agencies. The Least Likely score is for the Worst-Case Hazard Scenario, which refers to the worst hazard scenario that could reasonably occur within the County.

FIGURE 28: MOST-LIKELY SCENARIO RISK SCORES FROM 2023 HIRA

Hazard	Most Likely Risk Score	Least Likely Risk Score
Extreme Temperature	2.6	3.1
Lightning	2.6	3.0
Severe Winter Weather	2.3	3.0
Flood	2.3	2.9
Tornado	2.1	2.9
Drought	2.0	2.5
Hurricane/Tropical Cyclone	1.8	2.6
Wildfire	1.7	2.1
Earthquake	1.7	2.8
Space Weather	1.3	2.0
Pest Infestation/Zoonotic Infection	1.2	1.3

In accordance with FEMA requirements, this Chapter profiles each of the hazards listed above (in order of Most Likely Risk Score) and addresses the County's vulnerabilities to these hazards and estimates the expected losses from their occurrences. There will be more data on certain hazards compared to others depending on records kept. For example, there will be a more in-depth analysis of the flood hazard that is drawn from Howard County's 2023 FMP.

Overview of Howard County's Natural Hazards History

This NHMP update uses the best available data to identify, describe, and explain the potential severity and extent of the impact of each hazard. While numerous agencies maintain records regarding natural hazard losses, no single source provides a definitive account of losses due to natural hazards. Although the data from different sources may not always align, this NHMP update relies heavily on data from the National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), the 2023 Howard County HIRA, and FEMA guidance. By analyzing this data, this Plan paints a comprehensive picture of the extent, severity, and impact a natural hazard event may have on the County.

To begin, this section will provide an overview of the presidentially declared emergency declarations and major disaster declarations in Howard County. When the magnitude of an incident exceeds the state's capability to respond and supplemental federal assistance is necessary to support response activities, the Governor may request a Presidential Disaster Declaration (PDD). These declarations result in the distribution of a wide range of federal aid to individuals and families, certain private nonprofit organizations, and public agencies.

The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (the Stafford Act) establishes a systematic way for a PDD to trigger financial and physical assistance for States and local jurisdictions. It is at the President's discretion to issue either a Major Disaster Declaration or an Emergency Declaration during an emergency. Both declaration types authorize the President to provide supplemental federal disaster assistance; however, the events related to the two different types of declaration and scope and amount of assistance differ. For example, major disaster declarations include hazard mitigation assistance, but emergency declarations do not; however, both declarations include Public Assistance (PA) programs and Individual Assistance (IA) programs. As part of the documentation process, FEMA maintains records of these types of declarations, along with federal expenditure records, on its website.³

The table below provides a summary of the past Emergency Declarations for the County, in which two have been severe winter weather related, and three have been hurricane/tropical cyclone related.

EMERGENCY DECLARATIONS IN HOWARD COUNTY (1993 TO 2022) ¹¹		
FEMA DISASTER # DATE	EVENT TYPE	EVENT DESCRIPTION
FEMA EM-3100 3/16/1993	Winter Storm	From March 13 - March 17, 1993, a snowstorm hit the State of Maryland. All counties in Maryland were eligible for FEMA PA (Category B – Emergency Protective Measures).
FEMA EM-3179 3/14/2003	Winter Storm	From February 14 -18, 2003, a storm brought three waves of wintery precipitation. Snowfall totals ranged from 20 to 32 inches across

¹¹ Disaster Information, FEMA, <https://www.fema.gov/disaster> (last accessed Feb. 27, 2023).

EMERGENCY DECLARATIONS IN HOWARD COUNTY (1993 TO 2022) ¹¹		
FEMA DISASTER # DATE	EVENT TYPE	EVENT DESCRIPTION
		northern and central Maryland and the Baltimore Metropolitan area. This was the heaviest snowfall event in the Baltimore region since records began in 1870 (the record will not be broken until the 2010 snowstorms).
FEMA EM-3251 9/13/2005	Hurricane Katrina Evacuation	Between August 29, 2005, and October 1, 2005, an Emergency was declared for the State of Maryland. This Emergency Declaration provided federal aid to State and local response efforts to assist evacuees after Hurricane Katrina.
FEMA EM-3335 8/27/2011	Hurricane Irene	DR-3335 was issued as a response to Hurricane Irene making landfall on the east coast, which brought tropical storm force winds and torrential rains to the region. While no IA was available, almost all Maryland counties with the exception of Garrett County, were eligible for FEMA PA (Category B – Emergency Protective Measures).
FEMA EM-3349 10/28/2012	Hurricane Sandy	From October 26, 2012 - November 8, 2012, an Emergency was declared for the State of Maryland in anticipation of Hurricane Sandy. A power outage at a water treatment plant in Howard County resulted in the release of wastewater. Water contamination became a significant threat to health and the environment for those downstream from the plant. Water mains feeding Howard County from the City of Baltimore failed, and the drinking water supply was limited for a period of one to two weeks.

Howard County has received 16 Major Disaster Declarations since 1962, which are summarized in the table below. Of the 16, seven were severe winter weather events, four were flooding/severe storm-related events, and five were hurricanes/tropical storm events. These figures and events are discussed in more details in the hazard specific subsections that follow.

MAJOR DISASTER DECLARATION IN HOWARD COUNTY (1962 TO 2022) ¹²		
FEMA DISASTER # DATE	EVENT TYPE	EVENT DESCRIPTION
FEMA DR-127 3/12/1962	Severe storms/flooding	No information available.
FEMA DR-309 8/17/1971	Severe storms/flooding	On August 17, 1971, storms caused flooding to the Baltimore and Washington, D.C. metropolitan regions. Declarations were made for local jurisdictions from Harford County to Prince George's County for FEMA PA (Category B – Emergency Protective Measures).
FEMA DR-341 6/23/1972	Tropical Storm Agnes	Hurricane Agnes made landfall on the Florida Panhandle and traveled northwestward, bringing with it strong winds and heavy

¹² Disaster Information, FEMA, <https://www.fema.gov/disaster> (last accessed Feb. 27, 2023).

		rains. The Patuxent, Little Patuxent, and Patapsco Rivers all exceeded their 100-year flood levels. Eight people were killed, and 700 families were left unhoused.
FEMA DR-489 10/4/1975	Heavy rains/flooding	On October 4, 1975, heavy rains caused flooding and 14 counties were declared for FEMA PA (Category B - Emergency Protective Measures).
FEMA-DR-1081 1/11/1996	Blizzard	A winter storm known as the "Blizzard of '96" crippled most of Maryland during the first weekend of January 1996. In general, snow totals were as follows: 20 inches in lower southern Maryland, 20 to 26 inches in central Maryland to include Howard County, and 26 to 36 inches over the northern tier.
FEMA DR-1324 4/10/2000	Winter Storm	A low-pressure system off Cape Hatteras rapidly intensified on January 24, 2000. The storm soon developed into a nor'easter and began to track northward along the eastern shoreline. On January 25, 2000, the storm brought snowfall totals ranging from one inch to 20 inches across the State. The higher amounts of snow occurred around the Chesapeake Bay. A total of 11.5 inches of snow fell in Columbia, Maryland.
FEMA DR-1492 9/19/2003	Hurricane Isabel	On September 18, 2003, Hurricane Isabel made landfall on the North Carolina coast. Isabel raced inland, bringing rain and wind. The storm did not cause major flooding; however, many trees were toppled from the wind combined with the saturated ground. At one point, over 50% of the County was without power. Five homes suffered major damage and another eight suffered minor damage.
FEMA DR-1875 2/19/2010	Winter Storm	This was the first of two major blizzards that occurred during the 2009-2010 winter. On December 18, 2009, two low pressure systems merged to form a strong low-pressure system over the Mid-Atlantic. The new low was able to gather moisture from the Gulf of Mexico and the Atlantic Ocean, while the high-pressure system to the north kept the cold air in place. From December 18-20, 2009, between 14 and 17 inches of snow fell across the County.
FEMA DR-1910 5/5/2010	Winter Storms	On April 8, 2010, Governor Martin O'Malley requested a major disaster declaration due to severe winter storms and snowstorms during the period of February 5-11, 2010. The Governor requested a declaration for PA, including snow removal assistance; Crisis Counseling and Disaster Unemployment Assistance under the IA program; and Hazard Mitigation for all 24 jurisdictions in the state. During the period of March 22-April 7, 2010, joint federal, State, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below.
FEMA DR-4034 9/16/2011	Hurricane Irene	Hurricane Irene left more than 700,000 Marylanders without power. Damages were estimated at approximately \$16 million, with the most severe damages occurring in the eastern and southern portion of the State. A Presidential Disaster Declaration (FEMA-DR-4034) was declared for 13 of the 24 counties and all

		Maryland jurisdictions were eligible for the Hazard Mitigation Grant Program (HMGMP).
FEMA DR-4038 10/05/2011	Remnants of Tropical Storm Lee	Following Tropical Storm Lee, assessments show Howard County suffered approximately \$2 million worth of damage. Main Street in Historic Ellicott City was severely flooded, where 16 homes in the area sustained flood damage of various degrees. The Presidential Disaster Declaration (FEMA-DR-4038) was declared for the following counties: Anne Arundel, Baltimore County, Cecil County, Charles County, Harford County, Howard County, and Prince George's County.
FEMA DR-4091 11/20/2012	Hurricane Sandy	An Emergency Declaration had already been issued for the State on October 28, 2012. A power outage at a water treatment plant resulted in the release of wastewater. Water contamination became a significant threat to health and the environment for those downstream from the plant. Water mains feeding Howard County from the City of Baltimore failed, and the drinking water supply were limited for a period of one to two weeks. On November 20, 2012, President Obama declared that a major disaster exists in the State of Maryland. The Presidential Disaster Declaration (FEMA-DR-4091) was declared for the following counties: Allegany, Calvert, Caroline, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Queen Anne's, Somerset, St. Mary's, Talbot, Washington, Wicomico, and Worcester Counties and the Independent City of Baltimore.
FEMA DR-4170 4/10/2014	Maryland Snowstorm	On April 10, 2014, following a severe snowstorm, President Obama declared that a major disaster for Maryland. This declaration made emergency protective measures (Category B), including snow assistance under the PA program available to State and eligible local governments and certain private nonprofit organizations on a cost-sharing basis for emergency work due to the snowstorm. The Presidential Disaster Declaration (FEMA-DR-4170) was declared for the following counties: Baltimore, Carroll, and Howard Counties.
FEMA DR-4261 3/4/2016	Maryland Severe Winter Storm and Snowstorm	The Presidential Disaster Declaration (FEMA-DR-4261) was declared on March 4, 2016, for the following counties: Allegany, Anne Arundel, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Washington, and Worcester Counties and the Independent City of Baltimore. This declaration also authorized snow assistance for a period of 48 hours for the counties of Allegany, Anne Arundel, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, and Washington and the Independent City of Baltimore.

FEMA DR-4279 9/16/2016	Maryland Severe Storm and Flooding	A significant flooding event occurred on July 30, 2016, when a strong storm dropped six inches of rain over Ellicott City over a span of two hours. Massive flooding caused extensive damage to businesses and homes on Main Street in Old Town, Ellicott City. The July 2016 storm took two lives and caused at least \$22.4 million in estimated damages and caused extensive damage to 90 businesses and 107 homes. On September 16, 2016, President Obama declared that a major disaster exists in the State of Maryland.
FEMA DR-4376 7/2/2018	Maryland Severe Storm and Flooding	A flash flooding event occurred on May 27, 2018, when a strong storm dropped eight to 10 inches of rain over Ellicott City in a span of five hours. The rapid floodwaters took one life and caused extensive damage to businesses and homes on Main Street in Old Town, Ellicott City.

Overall Losses Due to Major Disasters

According to the NCDC database, Howard County has experienced four deaths and seven injuries from natural hazards from January of 1950 through November of 2022.¹³ Property damage from these natural hazards is estimated at slightly less than \$41 million, with no accounting for inflation. Crop damage during the same period is estimated to be roughly \$12,000.

As discussed above, no definitive record exists for all losses due to natural disasters in Howard County. In the United States, depending on the type of disaster, estimates for public and private costs of natural hazards range from \$2.3 billion to \$21 billion per event, according to the National Centers for Environmental Information.¹⁴ In most declared disasters, the Federal government reimburses 75% of the cleanup and recovery costs, whereas the remaining 25% is covered by the State and affected local jurisdictions.

¹³ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENVTL. INFO., <https://www.ncdc.noaa.gov/stormevents/> (last visited Feb. 27, 2023).

¹⁴ *U.S. Billion-Dollar Weather and Climate Disasters*, NOAA NAT'L CTRS. FOR ENVTL. INFO., <https://www.ncdc.noaa.gov/billions/> (last visited Feb. 27, 2023).

The estimated damages for the above listed major disasters are summarized in the table below.

ESTIMATED DAMAGES FOR FEDERALLY DECLARED DISASTERS IN HOWARD COUNTY, MARYLAND (1965 TO 2022) ¹⁵			
FEMA DISASTER #	EVENT DECLARATION DATE	EVENT TYPE	TOTAL ASSISTANCE OBLIGATED
FEMA DR-127	3/12/1962	Severe storms/flooding	No Information available
FEMA DR-309	8/17/1971	Severe storms/flooding	\$14,925,339
FEMA DR-341	6/23/1972	Tropical Storm Agnes	\$117,161,571
FEMA DR-489	10/4/1975	Heavy rains/flooding	\$6,112,771
FEMA DR-1081	1/11/1996	Blizzard	No information available
FEMA DR-1324	4/10/2000	Winter storm	\$16,744,243
FEMA DR-1492	9/19/2003	Hurricane Isabel	No information available
FEMA DR-1875	2/19/2005	Winter storm	No information available
FEMA DR-1910	5/5/2010	Winter storms	\$38,565,855
FEMA DR-4034	9/16/2011	Hurricane Irene	\$18,290,538
FEMA DR-4038	10/05/2011	Remnants of Hurricane Irene	\$25,302,710
FEMA DR-4091	11/20/2012	Hurricane Sandy	\$32,974,192.47
FEMA DR-4170	4/10/2014	Maryland Snowstorm	\$8,701,290.63
FEMA DR-4261	3/4/2016	Maryland Severe Winter Storm and Snowstorm	\$69,605,697.91
FEMA DR-4279	7/30/2016	Maryland Severe Storm and Flooding	\$7,079,614.80
FEMA DR-4376	5/27/2018	Maryland Severe Storm and Flooding	\$22,000,000.00

Please note that the “Total Assistance Obligated” is for the entire declared disaster area, not for individual counties or jurisdictions affected and may only represent initial estimates, and not modified or up to date obligations.

Risk Analysis and Assessment

In this section, the eleven hazards will be described in order of their most-likely risk scores, starting with the highest risk score. Each hazard section will be organized in the following order:

- Hazard Description;
- Hazard Location;
- Hazard Extent;
- Hazard Impacts;
- Hazard Previous Occurrences; and,
- Hazard Future Likelihood.

¹⁵ Disaster Information, FEMA, <https://www.fema.gov/disaster> (last visited Feb. 27, 2023).

Future likelihood will be broken into high, medium, and low probability for each hazard. The table below defines probability of each category in terms of its likelihood of future occurrence.

PROBABILITY	DEFINITION
High	Event is likely to occur more than once every five years
Medium	Event is likely to occur less than once every five years, but more often than once every 30 years
Low	Event is likely to occur less than once every 30 years

Extreme Temperature (Risk Score 2.6)

Hazard Description

An Extreme Temperature Hazard is the result of either extremely high or extremely low temperature variations. This hazard can present as either extreme heat or extreme cold hazards. Other environmental factors, such as wind speed or humidity, also factor into the impacts of the environment on the human body.

Generally, extreme heat “is a period of high heat and humidity with temperatures above 90°F for at least two to three days”.¹⁶ Extreme heat is a function of air temperature and humidity, which can exacerbate the impacts of high air temperatures. Exposure to direct sunlight also adds heat stress. Prolonged exposure to extreme heat can result in dehydration, heat exhaustion, and heat stroke, which can lead to death. Extreme cold conditions are generally those temperatures that approach freezing or below. Extreme cold is measured in wind chill, a function of air temperature and wind speed, that reflects how the human body perceives the cold. The most common injuries resulting from extreme cold exposure are hypothermia and frostbite. Prolonged hypothermia left untreated can result in death.

The following table presents the Risk Score for extreme temperature in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Extreme Temperature - Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
Likelihood		4 Very Likely		50%
Consequence	Impact	1 Limited	2.3 Significant-Critical	40%
	Warning Time	1 Very Long	1 Very Long	5%
	Duration	2 Moderate	3 Long	5%
TOTAL RISK SCORE		2.6	3.1	

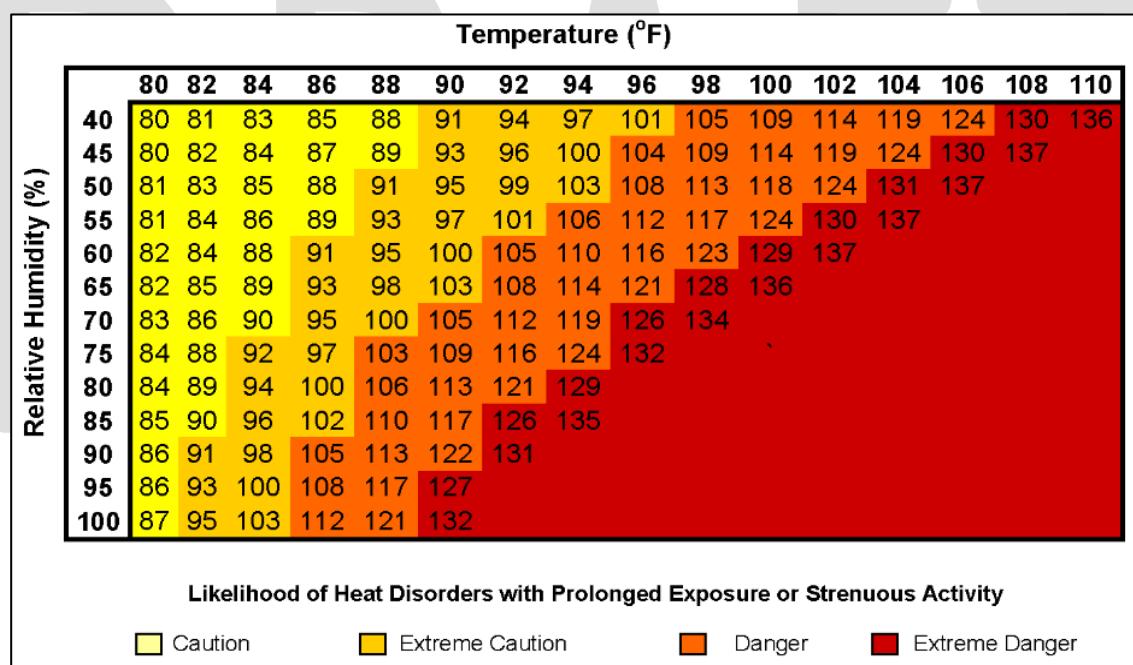
¹⁶ Extreme Heat, READY, <https://www.ready.gov/heat> (last visited Feb. 27, 2023).

Hazard Location

All of Howard County is susceptible to an extreme temperature hazard. As Howard County has a generally mild climate, less extreme temperature variations may produce an extreme temperature hazard, as Howard County is not as accustomed to those extremes.

Hazard Extent

The severity of extreme temperature events is measured by temperature, duration, and humidity. Most events last for less than a week on average. In Northeastern United States, periods of warmer than normal temperatures typically occur several times over a single summer. Extreme heat waves may occur about once every five years. The passing of a cold front usually moderates temperatures after a few days to a week. However, it is expected that the duration and frequency of such events will increase in the coming years due to climate change and overall warming trends¹⁷. Below is NOAA's Heat Index for determining "apparent temperature."



¹⁷ Climate Change and Extreme Heat: What You Can Do to Prepare, Environmental Protection Agency, <https://www.epa.gov/sites/default/files/2016-10/documents/extreme-heat-guidebook.pdf>, (last accessed July 27, 2023).

The next graphic depicts the National Weather Service's (NWS) description of each of the above classifications.

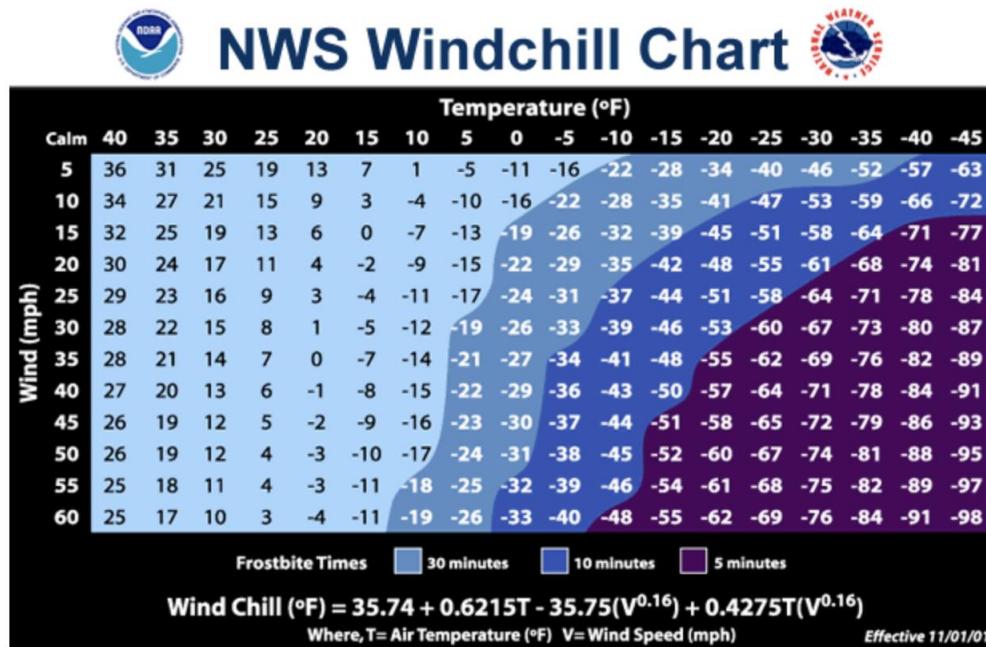
Classification	Heat Index	Effect on the body
Caution	80°F - 90°F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103°F - 124°F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125°F or higher	Heat stroke highly likely

When temperatures rise to these levels, the NWS issues three types of watches, warnings, and advisories to the public depending on the heat index value¹⁸.

Type of Product	Call to Action	Description
Excessive Heat Outlook	Be Aware!	Issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead-time to prepare for the event.
Excessive Heat Watch	Be Prepared!	Issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
Heat Advisory	Take Action!	Issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Advisory is when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. If you don't take precautions, you may become seriously ill or even die.
Excessive Heat Warning	Take Action!	Issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Warning is when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. If you don't take precautions immediately when conditions are extreme, you may become seriously ill or even die.

¹⁸ Heat Watch vs. Warning, National Weather Service, <https://www.weather.gov/safety/heat-wv>, (last accessed July 27, 2023).

The severity or extent of extreme cold temperatures can be measured using NWS's Windchill Chart. This chart helps the public determine the exposure time to certain temperatures that can be dangerous. This chart "takes into account heat loss from the human body to its surroundings during cold and windy weather. The calculation utilizes wind speed in miles per hour and temperatures in degrees Fahrenheit"¹⁹.



By looking at this chart, jurisdictions and the public can see how long it takes to reach frostbite when being exposed to certain wind speeds and temperatures.

When temperatures drop to certain levels, NWS will issue certain advisories, warnings, and watches. The table below summarizes these messages²⁰.

Type of Product	Call to Action	Description
Wind Chill Advisory	Be Aware!	Issued when seasonably cold wind chill values but not extremely cold values are expected or occurring. Be sure you and your loved ones are dress appropriately and cover exposed skin when venturing outdoors.
Wind Chill Watch	Be Prepared!	Issued when dangerously cold wind chill values are possible. As with a warning, adjust your plans to avoid being outside during the coldest parts of the day. Make sure your car has

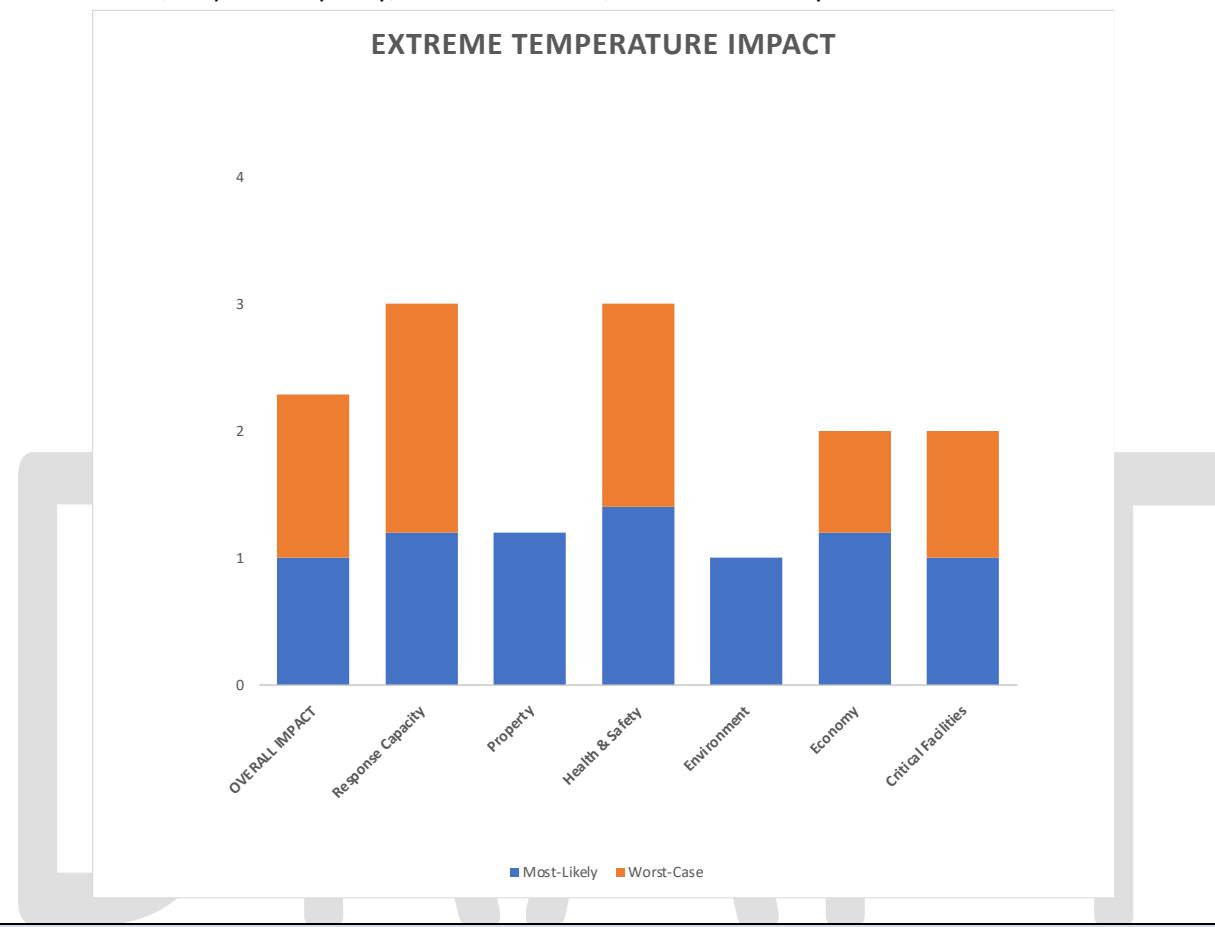
¹⁹ Wind Chill Safety, National Weather Service, <https://www.weather.gov/bou/windchill>, (last accessed July 27, 2023).

²⁰ Wind Chill Warning vs. Watch, National Weather Service, <https://www.weather.gov/safety/cold-wind-chill-warning>, (last accessed July 27, 2023).

		at least a half a tank of gas and update your winter survival kit.
Wind Chill Warning	Take Action!	Issued when dangerously cold wind chill values are expected or occurring. If you are in an area with a wind chill warning, avoid going outside during the coldest parts of the day. If you do go outside, dress in layers, cover exposed skin, and make sure at least one other person knows your whereabouts. Update them when you arrive safely at your destination.
Frost Advisory	Be Aware!	Issued when areas of frost are expected or occurring, posing a threat to sensitive vegetation.
Freeze Watch	Be Prepared!	Issued when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
Freeze Warning	Take Action!	Issued when temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.
Hard Freeze Warning	Take Action!	Issued when temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants.

Hazard Impacts

The figure and table below characterize extreme temperature impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Extreme Temperature - Consequence Analysis

Likely

CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited-Significant	<ul style="list-style-type: none"> Critical and non-critical infrastructure are not significantly damaged. Some frozen pipes may result in facilities being inaccessible/inoperable.
HEALTH AND SAFETY	Limited-Significant	<ul style="list-style-type: none"> Zero to three deaths are expected. Cold exposure is particularly concerning among vulnerable populations. Zero to ten injuries are expected. Frostbite and hypothermia are likely causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – Some water lines may freeze and/or burst. Localized power outages likely. Other outages unlikely. <u>Information/Communications</u> – No shutdown. No major impact on information or communications infrastructure. <u>Transportation</u> – Minor impacts to support shelter transportations.
RESPONSE CAPACITY	Limited-Significant	<ul style="list-style-type: none"> <u>Police</u> – Local resources adequate. <u>Fire and Rescue</u> – Local resources adequate. Potential delays in response times, due to increased calls for service. <u>Health</u> – Local resources adequate. Enhanced messaging to support vulnerable populations. <u>Public Works</u> – Local resources adequate.

ENVIRONMENTAL IMPACT	<i>Limited</i>	▪ Minimal environmental impact on air, water, and land is expected.
ECONOMIC IMPACT	<i>Limited-Significant</i>	▪ Business-school closings likely. Some reduced economic output expected.
TOTAL IMPACT	<i>Limited</i>	▪ Total Impact Score: 1 on a scale of 1 (Limited) to 4 (Catastrophic).
		<i>Limited</i> <i>Significant</i> <i>Critical</i> <i>Catastrophic</i>

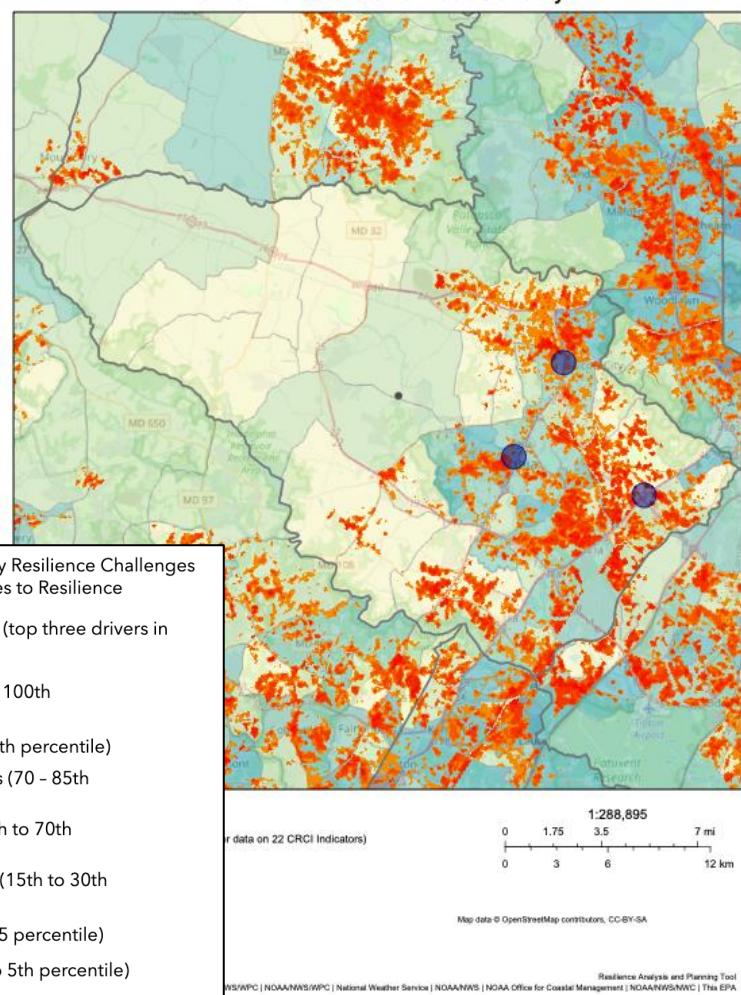
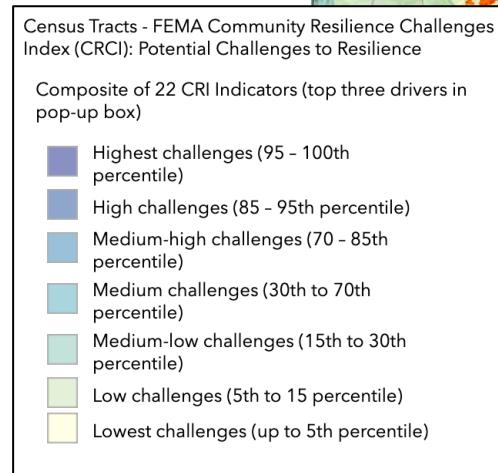
Vulnerability of County Assets

All Howard County is susceptible to extreme temperatures, whether that be extreme cold or extreme heat. Assets that are vulnerable are the following:

People

- People living in population centers, such as Ellicott City, Elkridge, and Columbia; and,
- People with challenges to resilience.

The map below shows how extreme heat typically affects more developed areas with less vegetation. This map utilizes the Heat Severity in the USA (2021) layer²¹ combined with FEMA's Community Resilience Index to show areas of high heat as well as those population that have more challenges to resilience. To review the indicators included in this index, please refer to [Chapter 2, section FEMA Community Resilience Index](#). Population centers are further highlighted below with purple circles. As can be seen in the map below, the severe heat areas fall in areas of Howard County with medium to medium-high challenges to resilience.

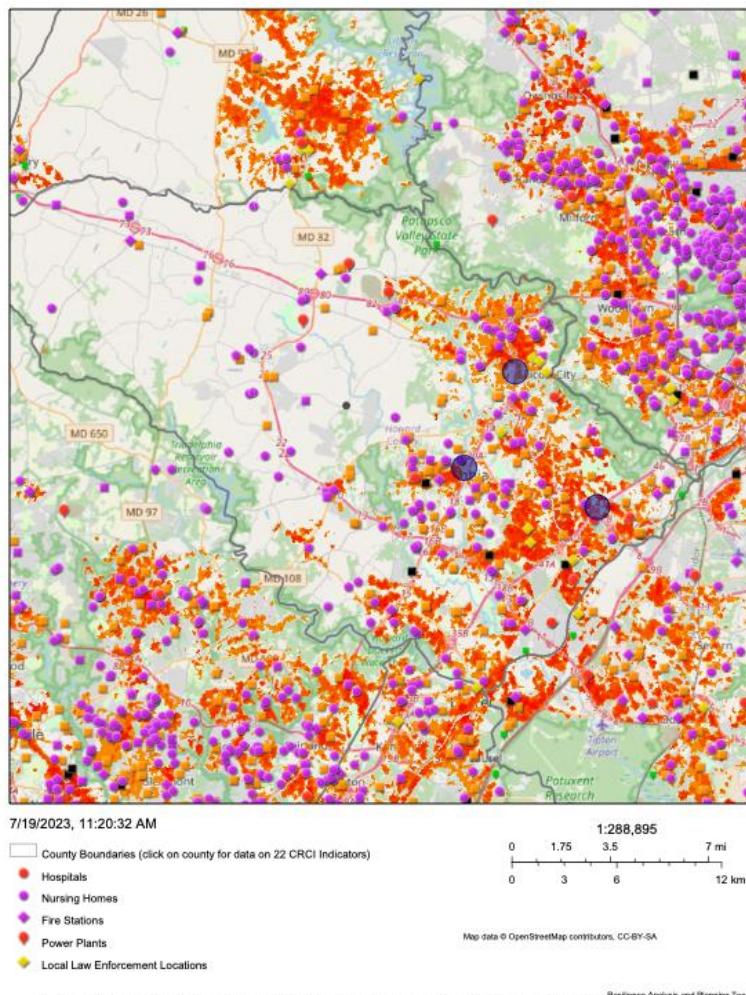


²¹ Heat Severity – USA 2021, Imagery Layer from The Trust for Public Land, <https://fema.maps.arcgis.com/home/item.html?id=cdd2ffd5a2fc414ca1a5e676f5fce3e3>. (last accessed July 19, 2023).

Structures

- All residential and commercial structures are vulnerable to severe heat and cold; and,
- Most County structural assets, such as nursing homes, hospitals, fire stations, power plants, law enforcement, universities, public and private schools, and utilities fall in severe heat areas as well. The map below demonstrates the general clusters of locations in these severe heat areas.

FIGURE 30: HEAT SEVERITY AND STRUCTURAL ASSETS



For extreme cold, a map similar to the one above was not available.

Systems

- Water Infrastructure (extreme cold will likely have more impacts on more densely populated areas due to water pipes bursting and affecting multiple areas).
- Communications (ice on cell towers or wires can bring communications lines down).
- Economy (extreme temperatures can kill important crops and plants that people rely on for their livelihoods).

Natural, Historic, and Cultural Resources

- Historic buildings throughout the County are all vulnerable to extreme heat and cold (Historic Ellicott City and Lawyers Hill).

- Extreme temperatures can cause outdoor cultural events to be canceled.

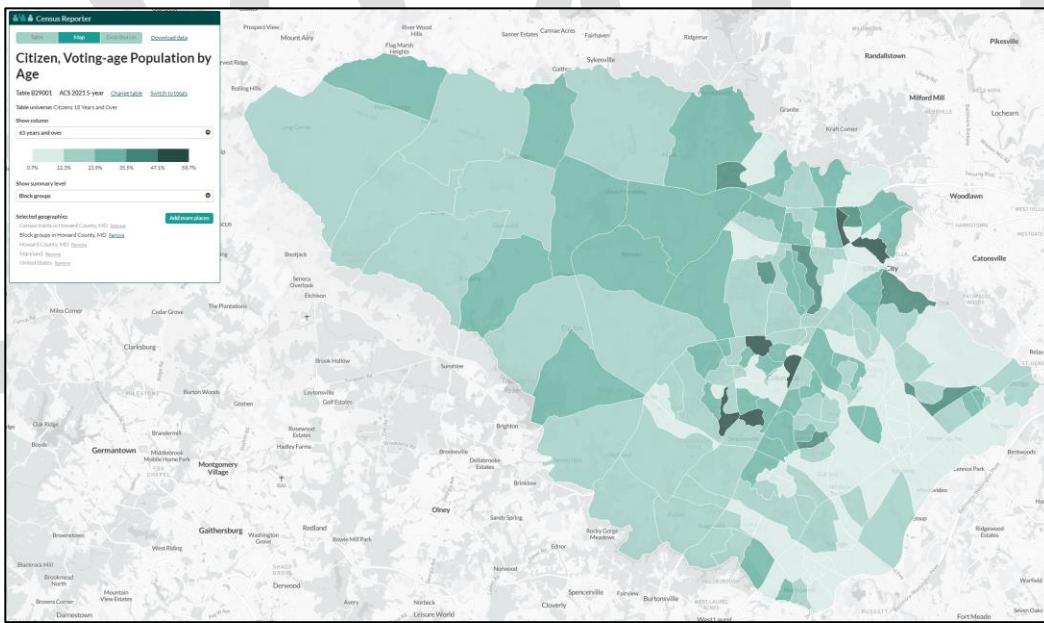
Activities that Have Value to the Community

- Camping and outdoor recreation (fish and wildlife can be harmed by extreme temperatures).

Effects of Population Change and Development in Hazard-Prone Areas

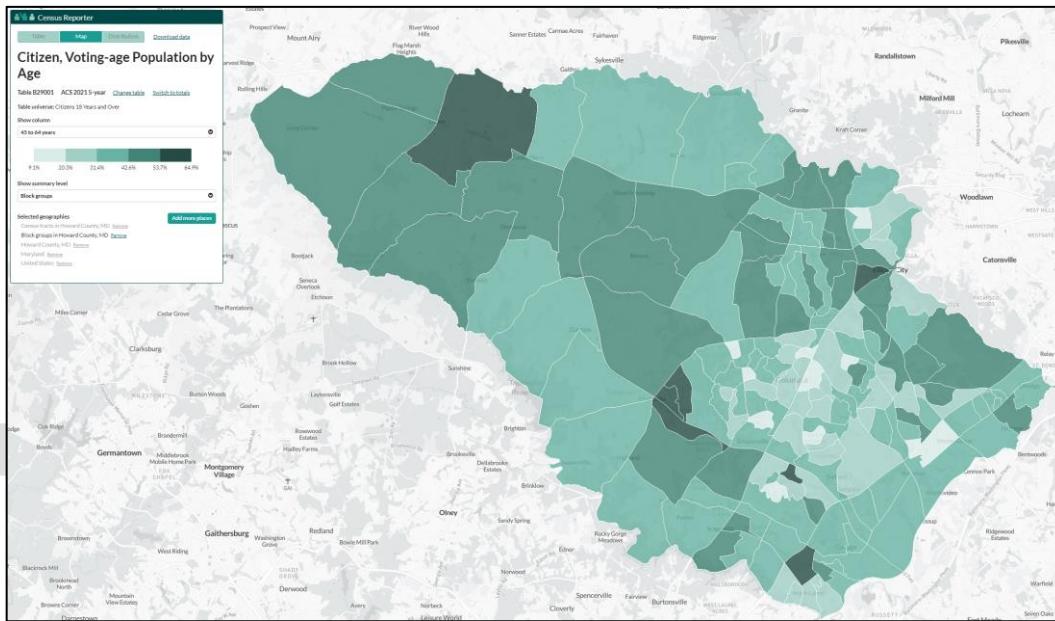
As noted in [Chapter 2](#), population density is not expected to change significantly by 2035. Densities will continue to stay in the Columbia and Ellicott City areas. However, the age of populations in those areas are likely to change. Currently, populations that are 65 years of age and older tend to live in more densely populated areas as can be shown in the map below. However, the next map that shows population densities for residents currently between 45 and 64 years old, shows population densities in more rural areas of the County. This observation suggests that older populations might be located in more rural areas in the next 20 years. Therefore, vulnerability of older individuals to extreme temperatures could decrease in the future as extreme temperatures tend to have more negative impacts on densely populated areas.

FIGURE 31: POPULATION DENSITIES OF RESIDENTS 65 YEARS AND OLDER



*Source: Department of Planning and Zoning, Research Division

FIGURE 32: RESIDENTS 45 TO 64 YEARS OLD



*Source: Department of Planning and Zoning, Research Division

Hazard Occurrences

Between 2017 and 2022, the NCDC has 16 recorded instances of extreme temperature hazards in Howard County. This includes three instances of extreme cold hazards and 13 instances of extreme heat hazards.²²

Hazard Future Likelihood- High

The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends. This high probability will likely continue as climate change has resulted in a greater occurrence of extreme weather events. A greater than 30% chance of annual occurrence corresponds to a hazard event occurring every one to three years.

Future Likelihood of an Extreme Temperature Hazard in Howard County	
Historical Average (time period)	13 extreme heat events (2017-2022) and 3 extreme cold events (2017-2022)
Historical Annual Probability	30%+ chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	30% + chance of annual occurrence

²² Storm Events Database: Search Results for Howard County, Maryland, NOAA NAT'L CTRS. FOR ENVTL. INFO., https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Cold%2FWind+Chill&eventType=%28Z%29+Excessive+Heat&eventType=%28Z%29+Extreme+Cold%2FWind+Chill&eventType=%28Z%29+Heat&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2017&endDate_mm=12&endDate_dd=31&endDate_yyyy=2022&county=HOWARD%3A27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND (last visited Feb. 27, 2023).

Future Likelihood Score	4.0 (Very Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Lightning (Risk Score 2.6)

Hazard Description

Lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges build up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning. The flash of lightning temporarily equalizes the charged regions in the atmosphere until the opposite charges build up again. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees Fahrenheit.²³

The following table presents the Risk Score for lightning in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Lightning Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	4.0 Very Likely		
Consequence	Impact	1 Limited	2 Significant	40%
	Warning Time	2 Long	2 Long	5%
	Duration	1 Short	1 Short	5%
TOTAL RISK SCORE		2.6	2.9	

Hazard Location

Although individual lightning strikes affect a relatively small geographic area, lightning has the potential to impact the entire County equally, particularly during the warmer months of the year. People and property are exposed to damage, injury, and loss of life from lightning in virtually the entire United

²³ Lightning Safety Tips and Resources, NOAA <https://www.weather.gov/safety/lightning> (last visited October 4, 2022); see also National Weather Service's Glossary, NOAA, <http://www.weather.gov/glossary/index.php?letter=l> (last visited October 4, 2022).

States. The United States has had 4,136 lightning fatalities from 1959-2017.²⁴ Of those fatalities, 126 occurred in Maryland, ranking tied for 10th for the greatest number of lightning fatalities within that time period in the United States.²⁵

Most lightning-related deaths and injuries occur when people are outdoors during summer afternoons and evenings. Lightning strikes occur when there are thunderstorms. Thunderstorms occur more often in the afternoon and evening “because in order for there to be high amounts of moisture in the air along with warm rising air, there must be instability in the atmosphere. During the warmer months the humidity is much higher.”²⁶

Hazard Extent

Lightning can occur anywhere within the planning area and reach around 50,000 degrees Fahrenheit. The lightning current can branch off to strike a person from a tree, pole, building, or other tall object. In addition, electrical currents may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or another tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture inside of a building. Lightning may damage property and can cause fires using similar processes as outlined above.

Lightning can cause a range of damages to property. The following damages from lightning reported for a range of years can provide an idea of the extent of the lightning hazard²⁷.

Year	Damages Reported
1996	\$750,000
2000	\$100,000
2001	\$100,000
2002	\$500,000
2004	\$55,000
2006	\$100,000

Hazard Impacts

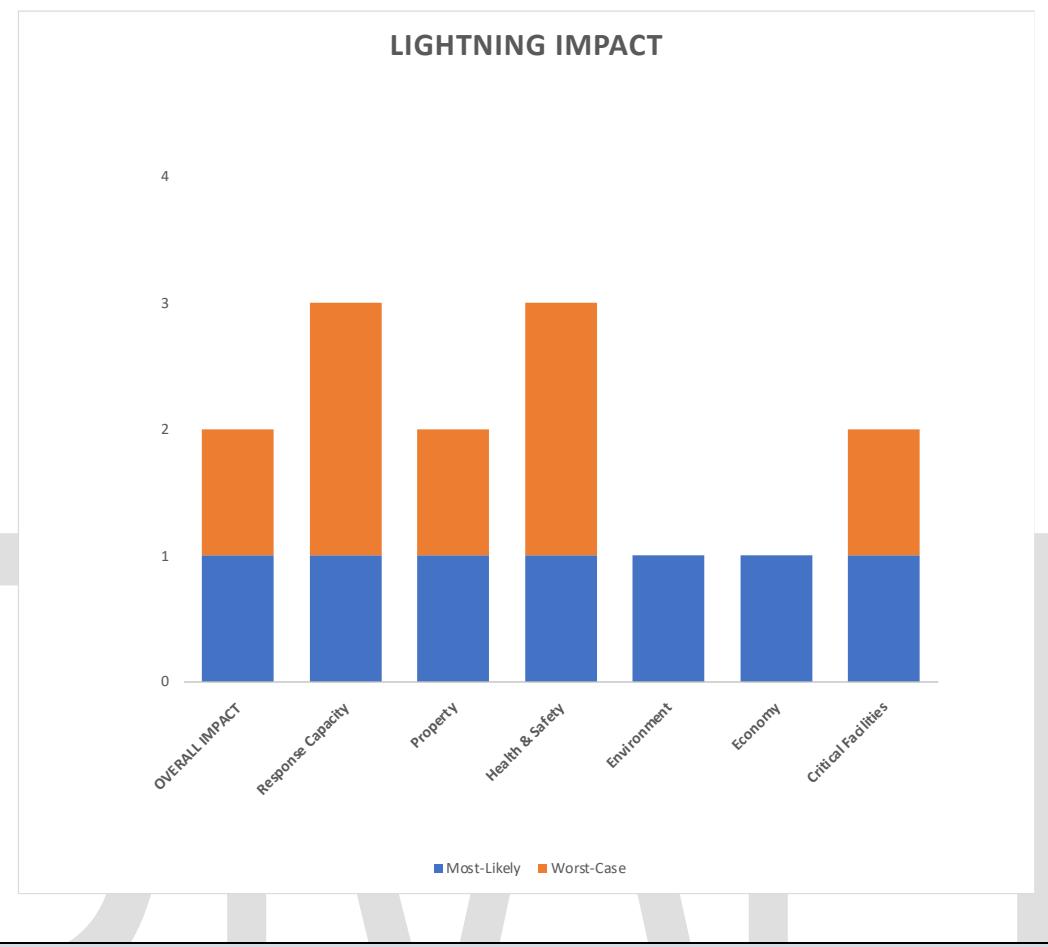
The figure and table below characterize lightning impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.

²⁴ Number of Lightning Deaths by State from 1959 to 2017, VAISALA, https://www.weather.gov/media/safety/59-17_State_Ltg_Fatality_Maps_lists.pdf (last visited Feb. 27, 2023).

²⁵ *Id.*

²⁶ Why Do Thunderstorms Often Occur On Summer Afternoons?, ALABAMAWx (Aug. 4, 2019), <https://www.alabamawx.com/?p=196429>.

²⁷ NCDC, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1980&endDate_mm=04&endDate_dd=30&endDate_yyyy=2023&county=HOWARD%3A27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND, (last accessed July 26, 2023).



Lightning - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> Up to 0.2% of critical and non-critical infrastructure will be damaged. Some electrical equipment and panel boxes burned, and some structural issues related to fires caused by lightning expected. Damaged trees and some traffic signals are expected. Electrical surge damage will be expected. Possible fires and possible damage to trees and structures are expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> Zero to three deaths are expected depending on the time of year. Electrocution is the most common cause of death. Zero to ten injuries are expected. Electrical shock, burns, or seizures are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – Shutdown or interruption of service is unlikely. <u>Information/Communications</u> – Shutdown or out of service is unlikely. Localized power outages. <u>Transportation</u> – Shutdown unlikely.
RESPONSE CAPACITY	Limited	<ul style="list-style-type: none"> <u>Police</u> – Local resources adequate. No impact to response capability or continuity of operations. <u>Fire and Rescue</u> – Local resources adequate. Limited impact to response capability and continuity of operations. There may be additional small wildfire and limited structure fires as a result of lightning strikes.

		<ul style="list-style-type: none"> ▪ <u>Health</u> – Local resources adequate. Clinical and administrative operations can be performed normally as long as the auxiliary power is properly maintained or will be moved to another location. ▪ <u>Public Works</u> – Local resources adequate. Minor impact on the response capability and continuity of operations.
ENVIRONMENTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Minimal impact.
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Limited amount loss in dollar value. ▪ Limited economic consequences.
TOTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1 on a scale of 1 (Limited) to 4 (Catastrophic).
	<i>Limited</i>	<div style="display: flex; justify-content: space-around; align-items: center;"> <i>Significant</i> <i>Critical</i> <i>Catastrophic</i> </div>

Vulnerability of County Assets

According to the National Risk Index Annualized Frequency of Lighting by County²⁸, Howard County has between 24 and 52 lightning events per year. This number represents the “average number of recorded lightning hazard occurrences (events) per year over a period of 22 years”²⁹. Data that shows all lightning occurrences in specific areas of Howard County are unavailable. However, lightning tends to occur more often during months with more instability in the atmosphere, such as the warmer months of late spring into summer and then in the early months of fall. All areas of Howard County are similarly susceptible to lightning strikes. In general, lightning strikes are more likely to strike taller objects, such as skyscrapers and trees³⁰, so areas of the County with taller buildings and trees could be more at risk. Assets that are vulnerable are the following:

People

- All people outdoors during summer afternoons and evenings during a thunderstorm are vulnerable.
- People more at risk could be unhoused populations, those without cell phones to receive weather alerts, those with occupations that mainly work outside, and those without a vehicle to quickly get to safety.

Structures

- All residential and commercial structures, especially taller structures, are vulnerable to lightning strikes.
- Utilities/Electric (Substations have been struck in the past by lightning, but they tend to be back in operation within a few hours).

²⁸ National Risk Index Annualized Frequency Lightning, FEMA National Risk Index, <https://fema.maps.arcgis.com/home/item.html?id=8dc5ab3181cd4ed5a6534ea3ffaff8bf>, (last accessed July 19, 2023).

²⁹ Lightning, National Risk Index, FEMA, <https://hazards.fema.gov/nri/lightning>, (last accessed July 19, 2023).

³⁰ Severe Weather 101- Lightning, NOAA National Severe Storms Laboratory, <https://www.nssl.noaa.gov/education/srvwx101/lightning/>, (last accessed July 19, 2023).

Systems

- Communication Systems (If lightning strikes cell towers or other antennae, it could affect communications of citizens and emergency services).

Natural, Historic, and Cultural Resources

- Historic buildings largely made of wood could be more at risk due to the risk of being set on fire by lightning (Historic Ellicott City, Lawyers Hill Historic District).

Activities that Have Value to the Community

- Outdoor events held during the summer months are more vulnerable to the effects of lightning.

Effects of Population Change and Development in Hazard-Prone Areas

Howard County's vulnerability to lightning will increase as the population grows and intensity of storms increases due to climate change. This population growth and density change can be seen primarily within the regions of Central and South-eastern portions of Howard County, as identified within Chapter 2, [Growth and Development](#) section of this Plan. Higher population density areas may see a greater concentration of individuals exposed to lightning risks, particularly during outdoor events and activities. Vulnerable populations, such as unhoused individuals, those without access to weather alerts, outdoor workers, and those lacking rapid access to shelter, could be more at risk in densely populated areas. Higher population density areas often require more robust utility and communication infrastructure. Substations and communication systems, critical for serving densely populated regions, are vulnerable to lightning strikes. A lightning strike on a substation can lead to temporary power outages, affecting both residential and commercial areas. Communication systems, including cell towers, could be compromised by lightning strikes, impacting emergency services and community connectivity.

With ongoing urbanization and population growth, densely populated areas in Howard County may witness an increase in the number of tall structures, such as buildings, communication towers, and utility poles. These structures can attract lightning strikes due to their height and metal components. As a result, the potential for lightning-related incidents, including fires, electrical surges, and structural damage, could rise in these urbanized zones. Changes in land use, such as the conversion of open spaces into residential, commercial, or industrial areas, can influence the county's vulnerability to lightning. Urban sprawl may introduce more concrete and asphalt surfaces, reducing natural lightning dissipation pathways. Moreover, alterations to the landscape can impact the local microclimate and atmospheric conditions, potentially influencing lightning formation and discharge patterns. Please refer to [Chapter 2, Growth and Development](#), and subsection [Future Development](#) to identify where these current and future development areas reside.

Hazard Occurrences

The NCDC database identified five lightning events in Howard County between 2000 and 2022. Like other hazards, the list appears to only account for events from 1950 onwards. The five events in the database listed occurred between 2000 and 2006. This indicates additional events outside this period are unlikely captured in the database. Although many more lightning events may have occurred, they were not reported to the NCDC. The table below summarizes the significant lighting events that have occurred in Howard County between 2000 and 2022. Dollar amounts have been adjusted for inflation and are detailed in 2022-dollar values.

Lightning Events, Howard County, 2000 – 2022

(Source: NOAA/NCDC)

Event ID	Location	Date	Event Type	Deaths	Injuries	Property Damage (\$)	Crop Damage (\$)
5173739	Columbia	8/7/2000	Lightning	0	0	\$172,886	0
5265439	Clarksville	8/11/2001	Lightning	0	0	\$168,198	0
5314399	Clarksville	8/3/2002	Lightning	0	0	\$827,434	0
5421712	Hanover	8/10/2004	Lightning	0	0	\$86,681	0
5515110	Ellicott City	6/1/2006	Lightning	0	0	\$147,674	0

Notable Incidents in Howard County

July 2019	Shortly In July 2019, a man was seriously injured by lightning strike on the Howard County/Baltimore County line while hiking in the Patapsco Valley State Park. That same day, a lightning strike caused damage to a home.
August 2022	A On August 3, 2002, a lightning strike destroyed a home in Clarksville along Talon Court. This event caused approximately \$827,434 in property damage.

Hazard Future Likelihood - High

The future likelihood of lightning has increased from the historical average from likely, to very likely. The future probability of lightning is 11-30%+ chance of annual occurrence or, one event every 3-9 years. This is partially because SMEs have deemed that patterns of storms are changing, storms are occurring more frequently, and are more intense. Based on historical data, the future probability of lightning strikes is reasonably high with a severe strike impacting the planning area every couple of years. However, the damage associated with these events is usually minor and not widespread. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Lightning in Howard County	
Historical Average (time period)	5 events (2000- 2022)
Historical Annual Probability	11-30% chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	Yes
Future Annual Probability	11-30%+ chance of annual occurrence
Future Likelihood Score	3.875 (Likely- Very Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Severe Winter Weather (Risk Score 2.3)

Hazard Description

Severe Winter Weather refers to a weather event that produces forms of precipitation caused by cold temperatures, such as snow, sleet, ice, and freezing rain, while ground temperatures are cold enough to cause precipitation to freeze. Windy conditions may also be present during a winter weather event. The accumulation of these forms of precipitation can immobilize the entire region, leaving roads impassable, triggering utility outages, causing flooding and storm surge, and may lead to the loss of lives. These impacts may be enhanced with the presence of windy conditions, which can lead to blizzard, whiteout conditions, and drifting of snow.³¹ Additionally, these conditions have the potential to cause transportation hazards.

The following table presents the Risk Score for severe winter weather in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Severe Winter Weather Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	3.75 Likely-Very Likely		50%
Consequence	Impact	1.1 Limited	2.3 Significant-Critical	40%
	Warning Time	2 Long	1 Very Long	5%
	Duration	1 Short	2 Moderate	5%
TOTAL RISK SCORE		2.4	2.9	

Hazard Location

Severe winter weather, including snowstorms, ice storms, and extreme cold, may affect any part of Howard County during winter. The annual snowfall for the County is approximately 24 inches, which is relatively moderate.³² Within Howard County, the risk to people and property from winter weather cannot be distinguished by area because of its central location. Counties in western Maryland experience significantly more annual snowfall, while counties closer to Maryland's eastern shore generally have a smaller annual snowfall total.

³¹ Weather Prediction Center, NOAA, <https://www.wpc.ncep.noaa.gov/#page=ovw>

(last visited Feb. 27, 2023); Severe Weather 101 – Winter Weather, NOAA NAT'L SEVERE STORMS LAB., <https://www.nssl.noaa.gov/education/srvwx101/winter/> (last visited Feb. 27, 2023).

³² Climate & Geography, HOWARD CTY. ECON. DEV. AUTH., <http://www.hceda.org/why-howard-county/living/climate-geography/> (last visited Feb. 27, 2023).

Hazard Extent

When it comes to winter storms, the National Weather Service (NWS) uses the Winter Storm Severity Index (WSSI) to provide the “general public with an indication of the level of winter precipitation (snow and ice) severity and its potential related societal impacts”³³. The Index shows severity by estimating damages that can be done to a community. The relative conditions of the area are considered, such as population, location, and storm characteristics. The WSSI classifies incoming storms using the impact levels shown below.

Potential Winter Storm Impacts	
	No Impacts Impacts not expected.
	Limited Impacts Rarely a direct threat to life and property. Typically results in little inconveniences.
	Minor Impacts Rarely a direct threat to life and property. Typically results in an inconvenience to daily life.
	Moderate Impacts Often threatening to life and property, some damage unavoidable. Typically results in disruptions to daily life.
	Major Impacts Extensive property damage likely, life saving actions needed. Will likely result in major disruptions to daily life.
	Extreme Impacts Extensive and widespread severe property damage, life saving actions will be needed. Results in extreme disruptions to daily life.

Typically, Howard County remains cool during the winter months. Heavy snow events can be common during certain years, with snow fall totals surpassing 12 to 18 inches. During other years, snowfall events could be considerably less. Generally, January is the coldest month, with an average temperature slightly above freezing at 33.3 degrees Fahrenheit. February commonly has the highest snow fall, with 9.61 inches of average snow fall.

It is possible for an occasional ice storm, freezing rain event, or sleet to impact the County. Winter storms along the Atlantic Coast can bring a wintery mix of precipitation—where the event may start out

³³ Winter Storm Severity Index (WSSI), National Weather Service, https://www.weather.gov/ict/WSSI_Overview, (last accessed July 27, 2023).

as rain and switch over to snow (or vice versa). A wintery mix event may cause more sustained damage than a single-precipitation winter event. For example, if a wintery mix started as snow and then switches over to rain, the weight of the fallen snow may bring down trees and electrical lines. Another possible characteristic of severe winter storms is extreme cold temperatures, where single digit temperatures and wind chills below zero are possible.

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

Hazard Impacts

Howard County's vulnerabilities include the prevalence of old buildings with roof structures that are not up to current standards. There are also many barns in Howard County which do not require permits and thus may be more susceptible to damage from winter weather events.

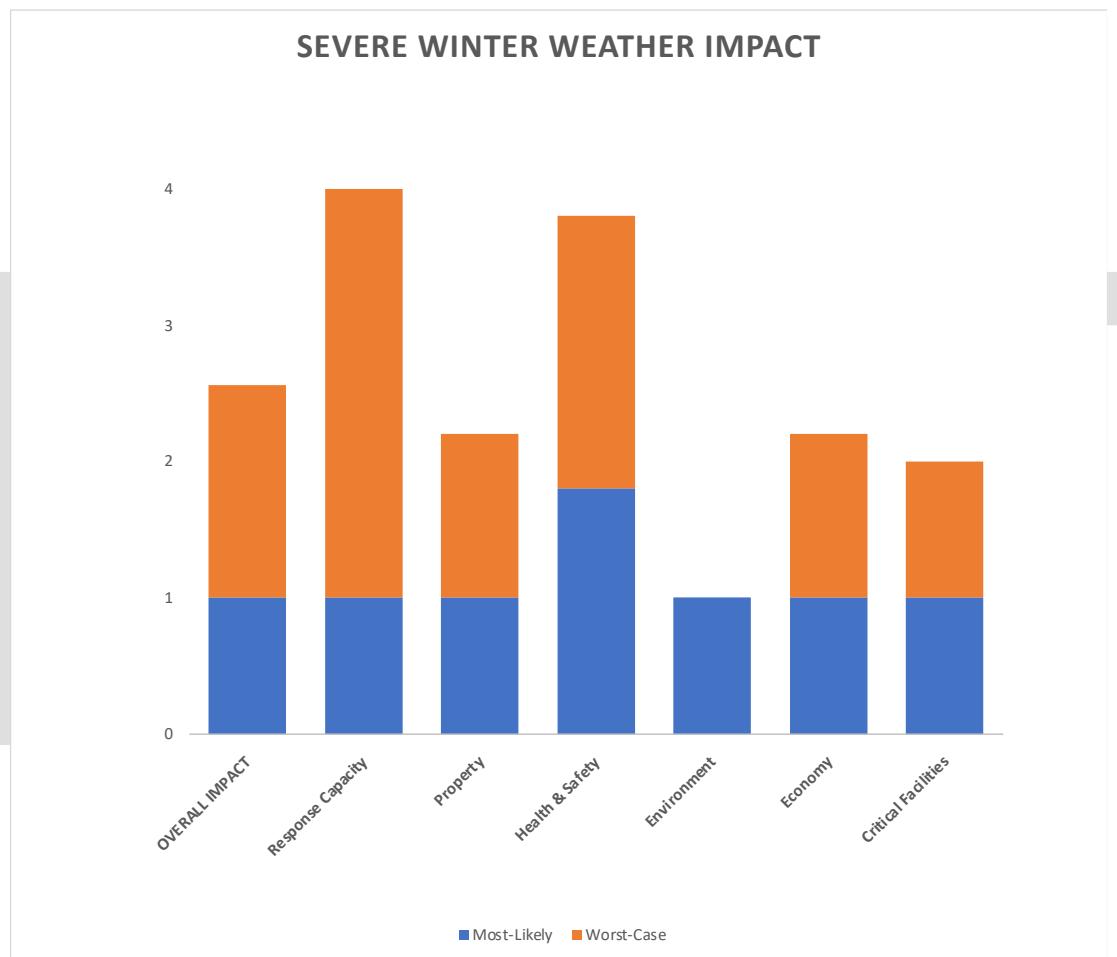
Winter weather events occur on an annual basis in the County, but significant improvements to building codes, maintenance to structures, and weather forecasting has dramatically decreased the threat to people and property. Even with these improvements, a risk of injury or death to individuals during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

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

County residents may also be affected physically by severe winter weather events. Individuals may injure themselves while walking on ice and snow or suffer heart attacks as a result of overexertion from shoveling snow. Although rare, carbon monoxide poisoning can occur during winter weather events

when heaters, automobile mufflers, or generators are not vented properly.³⁴ Frostbite and hypothermia may also lead to death or injury.

The figure and table below characterize severe winter weather impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



³⁴ See, e.g., 1 Dead, 2 Critical in Carbon Monoxide Poisoning, CBS BALTIMORE (Aug. 30, 2011), <https://www.cbsnews.com/baltimore/news/1-dead-2-critical-in-carbon-monoxide-poisoning/>.

Severe Winter Weather - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	<i>Limited</i>	<ul style="list-style-type: none"> Critical and non-critical infrastructure will not be damaged. No damage anticipated except icing on some roadways and bridges are expected. Downed power lines, vehicle accidents, and falling tree limbs are expected.
HEALTH AND SAFETY	<i>Limited-Significant</i>	<ul style="list-style-type: none"> Zero deaths are expected. Automobile accidents and hypothermia are the most common causes of death. Zero to five injuries are expected. Automobile accidents and cold weather injuries are the most common cause of injuries.
CRITICAL FACILITIES	<i>Limited</i>	<ul style="list-style-type: none"> <u>Utilities</u> – Minor disruption, shutdown unlikely. <u>Information/Communications</u> – minor power disruption, shutdown unlikely. <u>Transportation</u> – Transportation issues will occur and there will be vehicle accidents.
RESPONSE CAPACITY	<i>Limited</i>	<ul style="list-style-type: none"> <u>Police</u> – Emergency service disruption however, local resources adequate. No impact to response capability and continuity of operations. <u>Fire and Rescue</u> – Emergency service disruption however, local resources adequate. Limited impact to response capability. Increased call volume for vehicle accidents. <u>Health</u> – Local resources adequate. HD operations will not be affected. <u>Public Works</u> – Local resources adequate. <u>Government Services</u> – Reduced government services.
ENVIRONMENTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Minimal immediate impact. Repeated use of road salt impacts water resources. Increased Chloride levels are harmful to aquatic and human life. Loss of tree limbs and downed trees are likely.
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Traffic delays impact in economic consequences. Workforce reduction.
TOTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Total Impact Score: 1.0 on a scale of 1 (Limited) to 4 (Catastrophic).
		Significant
		Critical
		Catastrophic

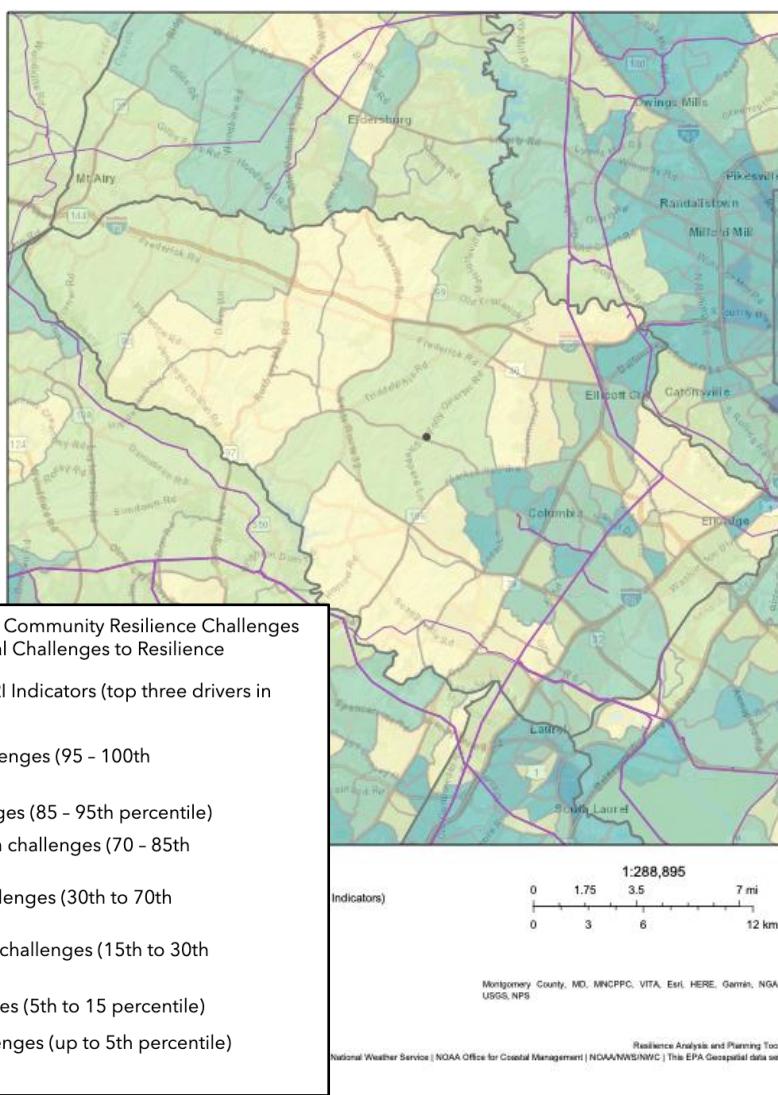
Vulnerability of County Assets

People

- Unhoused populations, people who live in lesser developed areas of the County due to slower snow plowing times, households without vehicles, and populations that might have trouble affording heating bills.
- People who rely on electricity for medical equipment.
- People who commute in and out of the County for work due to icy conditions.

As noted in [Chapter 2](#), Howard County has a large population of individuals who commute outside of the County for work (72,574) and into the County for work (74,590); therefore, many cars will continue to be on the roads, especially during rush hour. Populations with lower resilience (Census tract areas with less resilience will have limited means to respond and recover from this threat. These areas, shaded in darker blue, can be seen below in the map depicting FEMA's Community Resilience Index. Please refer to [Chapter 2, in the section named FEMA Community Resilience Index](#) to read more about the specific indicators for the County. This map also depicts County electrical transmission lines in purple and major roadways in red).

FIGURE 33: COMMUNITY RESILIENCE INDEX, MAJOR ROADWAYS, & TRANSMISSION LINES



Structures

- All residential and commercial buildings are vulnerable to severe winter weather.
- Electrical Infrastructure (buildup of ice on electrical transmission lines can also cause breakage and disruption of electricity to homes and businesses).

Systems

- Transportation (icy roads).
- Communications (ice buildup or strong winds could hinder cell tower communication).
- Economy (ice buildup on important roadways, such as Interstate 95, Interstate 70, U.S. Route 40, and U.S. Route 29 could slow down commerce).

Natural, Historic, and Cultural Resources

- Historic buildings in Historic Ellicott City, Lawyers Hill, and throughout the County are vulnerable to severe winter weather, especially if made of wood.

- Outdoor cultural events.

Activities that Have Value to the Community

- Outdoor activities, holiday activities, holiday travel.

Effects of Population Change and Development in Hazard-Prone Areas

As Howard County anticipates future changes in population density, it's important to consider how these demographic shifts could influence the county's vulnerability to severe winter weather hazards. This population growth and density change can be seen primarily within the regions of Central and South-eastern portions of Howard County, please refer to Chapter 2, [Growth and Development](#) section of this Plan to identify where these current and future populations density areas are/expected to be. The interaction between population density and severe winter weather can have significant implications for public safety, emergency response, infrastructure, and community resilience. Analyzing the potential impact of future population density on vulnerability to severe winter weather is essential. Higher population density can lead to increased demand for essential services during severe winter weather events. Densely populated areas may experience more significant transportation challenges during severe winter weather. Public transit systems may face operational disruptions, affecting the mobility of residents who rely on these services. Higher population density areas could experience greater strain on infrastructure during severe winter weather, potentially leading to more frequent utility disruptions, road closures, and increased wear and tear on transportation systems.

Future development may lead to changes in land use patterns, such as increased urbanization and expansion of impervious surfaces like roads and parking lots. These changes can affect local drainage systems and water runoff, potentially leading to more rapid accumulation of snow and ice during winter storms. Areas with increased impervious surfaces may experience more localized flooding as snow and ice melt. Future development could influence building codes and standards for insulation and energy efficiency. While these improvements are positive for energy conservation, they might impact a building's ability to retain heat during extreme cold events. Additionally, increased urbanization can contribute to the urban heat island effect, where developed areas experience higher temperatures due to heat-absorbing surfaces. This can affect the onset and duration of snow and ice accumulation. Expansion of utility networks to serve growing populations might increase vulnerability to severe winter weather. Power lines, substations, and communication infrastructure could be exposed to ice accumulation and falling tree limbs during winter storms, leading to power outages and disruptions in essential services. According to [Chapter 2, Growth and Development](#), and subsection [Future Development](#), future development, Growth and Revitalization areas are not going to expand much further west and north. Areas already surrounded by established community will receive more development and improvement. Overall, future development can make the County more vulnerable to severe winter weather simply because there will be more roads, pipe infrastructure, and power lines that will be vulnerable to this hazard.

Hazard Occurrences

Generally, the winter storm season for the eastern portion of Maryland runs from November to mid-March, while the western counties experience longer winters. Severe winter weather has occurred as early as October and as late as May in eastern portions of the State.

The NCDC database reports Howard County has experienced 66 severe winter weather hazard events between 2014 and 2022.³⁵ This includes 11 occurrences of winter storms and 55 occurrences of winter weather.

Notable Incidents in Howard County

**The damage figures have been adjusted for inflation and are detailed in 2022-dollar values

February 1899	In February 1899, a storm produced approximately 20 inches of snow across the region. Also known as the “Great Eastern Blizzard of 1899,” it is one of the earliest documented severe winter storm events in the area.
January-February 1912	Between January 5, 1912 – February 12 th , 1912, extreme cold was recorded across the region. In Howard County, reports showed that temperatures fell close to 20 degrees below zero and resulted in freeze across the area. This was referred to as the “Great Cold Wave” of January 1912.
January 1922	Between January 27 th , 1922 – January 28 th , 1922, a nor’easter brought between 30-32 inches of snow across the County. Its high winds also brought blizzard and whiteout conditions across the region. It is also known as the Knickerbocker Storm”.
March 1942	Between March 29 th , 1942 – March 30 th , 1942, the “Palm Sunday Snowstorm” was the heaviest March snowstorm on record in Maryland. The storm dropped over 20 inches of heavy, wet snow in Howard County.
February 1979	On February 18 th , 1979, the “Presidents’ Day Storm” brought the second greatest amount of snow fall in Howard County, bringing snow of up to 20 inches over the Northern Virginia and Maryland region. At times, snow was falling two to three inches an hour, and temperatures fell to the single digits.
February 1983	Between February 11 th , 1983 – February 12 th , 1983, the “Blizzard of 1983” was the second greatest snow fall in the region. Over two feet of snow covered the County. During certain periods, snow fell at a rate of 3.5 inches per hour.
January 1996	The snowstorm of January 7 th , 1996 – January 13 th , 1996, commonly known as the “Blizzard of ‘96” brought between 18-30 inches of snow to Howard County on January 8 th . On the 9 th , an “Alberta Clipper” left an additional three to five inches of snow throughout the region. A third storm brought another four to six inches of snow. The County had two to three feet of snow by the end of the week.
January 1999	On January 14 th , 1999, an arctic cold front moved over Central Maryland and brought snow and freezing rain to the region. The snow turned to freezing rain while the ground remained below freezing, which, in turn, created hazardous conditions. Ice accumulations ranged from $\frac{1}{4}$ to $\frac{1}{2}$ inch with winds gusting over 40 mph, resulting in fallen trees and power outages across the County. At one point, as many as 39,000

³⁵ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENVTL. INFO., <https://www.ncdc.noaa.gov/stormevents/> (last visited Feb. 27, 2023).

	households were without power. The Governor of Maryland declared a State of Emergency for Howard County and the surrounding counties.
December 2000	On December 11 th , 2000, a low-pressure system produced between one to two inches of rain. However, the rain then turned to ice as temperatures dropped below freezing. In some locations, ice accumulated to $\frac{1}{4}$ of an inch thick. In Howard County, 22 people were treated for slip and fall injuries related to the ice accumulation.
February 2003	The NCDC database indicates that one of the most severe winter storms resulting in property damage and loss of life occurred on February 14 th , 2003, and lasted until February 18th, 2003. The system brought three waves of wintery precipitation to the region. The first line of precipitation started to fall on the evening of the 14 th as a mix of light to moderate snow or rain. The next round, on the 16 th and 17 th , took the form of heavy wet snow and sleet. The event ended with snow showers tapering off on the 18 th . When the winter storm ended, snowfall totals ranged from 20 to 32 inches across the Baltimore Metropolitan area. Estimated regional property damages from the storm were \$9.7 million. In Howard County, a barn, warehouse, store awning, tennis bubble dome, greenhouse, and shed collapsed under the weight of the snow.
February 2006	Between February 11 th , 2006 – February 12 th , 2006, approximately 14-22.5 inches of snow fell across the Washington, D.C., and Baltimore Metropolitan regions, with Howard County suffering a direct hit from the storm. The highest snowfall total occurred in Columbia Hills, which is in the north-east part of the County. In that region, snowfall of up to 22.5 inches was recorded. There were numerous reports of downed trees and power outages in the County. NCDC database estimated property damage to be \$334,015 for the entire storm.
February 2008	On February 12 th , 2008, a wintery mix of snow and ice produced roughly an inch of snow and between 0.1-0.3 inches of ice. The central and eastern portions of Maryland saw a quick change from snow to ice, which froze just before the evening commute. As road conditions deteriorated, several accidents were reported across the region.
Winter 2009-2010	The 2009-2010 winter season brought the highest snowfall on record in the region. Several waves of severe snow events dropped over a foot of snow each in the County. The first low pressure system arrived on the night of December 18 th , 2009. The system strengthened on the 19 th , as moisture from the south pushed northward while the cold air remained in place. Snowfall totals ranged from 14-17 inches across the County. As a result of this event, a Presidential Disaster Declaration (DR-1875) was issued for the State of Maryland on February 19 th , 2010, for the December storms. Before the Presidential Disaster Declaration was even issued for the December storms, the State was hammered yet again by a line of severe winter storms from February 5 th -11 th , 2010 and produced a snowfall of 10-20 inches across the County. Certain parts of the County had even higher localized amounts. As a result of this event, another Statewide Presidential Disaster Declaration (FEMA DR-1910) was declared on May 6 th , 2010, for the February storms.
January 2011	Between January 26 th , 2011 – January 27 th , 2011, a snowfall event produced between eight to thirteen inches of snow across the County. The heavy, wet snow brought trees and power lines down and left thousands without power. Unfortunately, the storm

	coincided with the evening rush hour which resulted in numerous car accidents and roadway shutdowns. There were also several reports of tractor trailers jackknifing due to the slick road conditions.
January 2016	On January 22 nd , 2016, then County Executive Kittleman declared a State of Emergency in Howard County. The blizzard caused “snow totals ranging from 24 inches near Columbia to more than 30 inches in western parts of the county. Snow drifts in some areas reached five to six feet high. Additionally, the National Guard deployed to the County to complete 56 missions. This storm resulted in a Presidential Disaster Declaration.

Hazard Future Likelihood - High

The future annual probability of the hazard is 11-30%+ chance of annual occurrence, or one event every 3-9 years. An expected increase in extreme storms may result in a slight increase in the likelihood of severe winter weather in Howard County.³⁶ Other considerations include the impact climate change will have on the severity and frequency of these storms. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Severe Winter Weather in Howard County	
Historical Average (time period)	66 events (2014-2022)
Historical Annual Probability	30%+ chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	11-30%+ chance of annual occurrence
Future Likelihood Score	3.5 (Likely- Very Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Flood (Risk Score 2.3)

Hazard Description

A flood is defined as an accumulation of water that exceeds a physical barrier or collects in a low-lying area that leads to the inundation of an area. Flooding typically results from large scale weather systems that generate prolonged or highly impactful rainfall. Other conditions such as winter snow thaws, over-saturated soil, ice jams breaking apart, and urbanization can cause flooding as well. Floods can happen during heavy rains, when the ocean or tidal waters rise over shoreline communities, when snow melts quickly, or when dams or levees break. Damaging flooding may happen with only a few inches of water, or it may cover a house to the rooftop. Floods can occur within minutes or over a long period, and may last days, weeks, or longer. The flow of floodwaters can be rapid whitewater, or a more tranquil, but still damaging, inundation. Floods are the most common and widespread of all weather-related natural disasters.

³⁶ Third National Climate Assessment, U.S. GLOB. CHANGE RESEARCH PROGRAM, <https://nca2014.globalchange.gov/> (last visited Feb. 27, 2023).

Widespread flooding typically results from large-scale weather systems that generate prolonged rainfall. But more localized but still often deadly flooding can happen from individual slow-moving thunderstorms. Other conditions such as rapid winter snow thaws, over-saturated soil, ice jams on rivers that break apart, and urbanization can cause flooding. In Howard County, flooding can follow weather events, including, but not limited to, tropical systems, thunderstorms (individual storms, or lines of storms), heavy rain events, winter storms, spring thaws, or a combination of these events.

Flooding is a natural event for rivers and streams. Howard County can be impacted by two different types of flooding; Flooding and Flash Flooding

Flooding, in its most common form, occurs when the land and embedded small rivers, creeks, streams, reservoirs, and drainage systems receive too much water in a short time span. This leads to the excess flow of water over river/stream/drainage banks onto the adjacent floodplains. It also leads to water over roadways in low areas, as well as flooding of structures and residences. The flow of water in more typical flooding is less rapid, but it can be very damaging, especially if over a widespread populated area.

Flash flooding is one of the County's greatest weather threats to life safety. It can be caused by several things, including dam or levee breaks and mudslides, but is most often due to extremely heavy rainfall from thunderstorms. Flash Flooding is also defined by the timeframe in which it occurs: beginning within six hours, though often within three hours, of heavy rainfall or other cause. "The intensity of the rainfall, the location and distribution of the rainfall, the land use and topography, vegetation types and growth/density, soil type, and soil water-content all determine just how quickly the flash flooding may occur, and influence where it may occur."³⁷ Urbanized areas are usually more prone to flooding in short timespans. Often, rainfall over an urbanized area will cause flooding faster and more severe than in the suburbs or countryside. The impervious surfaces in the urbanized areas do not allow water to infiltrate the ground, and the water runs off to the low spots very quickly.

The following table presents the Risk Score for the flood hazard in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Flood - Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
Likelihood	3.1 Likely-Very Likely			50%
CON	Impact	1.4 Limited-Significant	2.9 Significant-Critical	40%

³⁷ *Flash Flooding Definition*, NAT'L WEATHER SERV., <https://www.weather.gov/phi/FlashFloodingDefinition> (last visited Feb. 27, 2023).

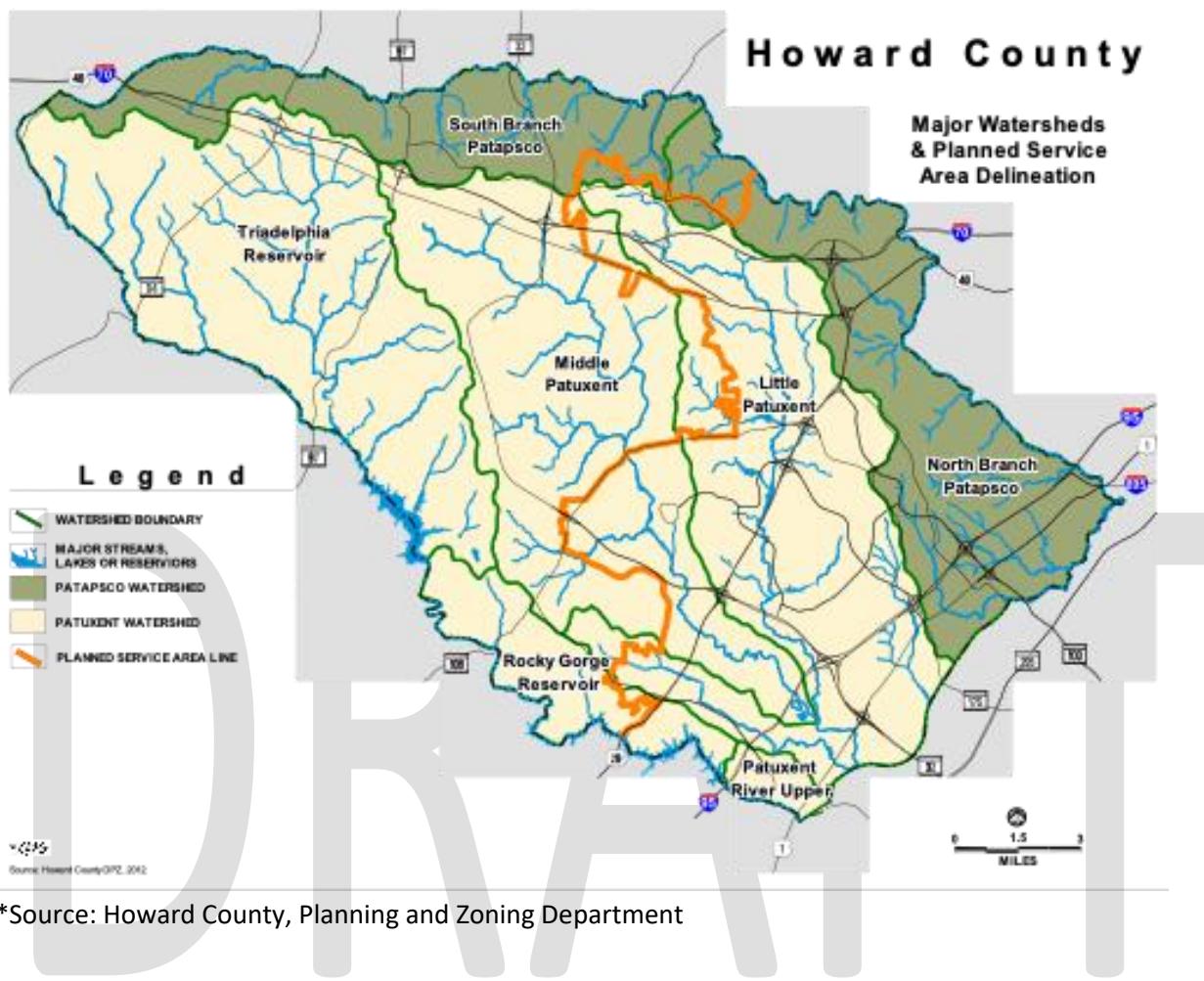
	Warning Time	2 Long	1 Very Long	5%
	Duration	1 Short	3 Long	5%
TOTAL RISK SCORE		2.3	2.9	

Hazard Location

Howard County's two major rivers (and their tributaries) are often the origin of riverine flooding in the County. These rivers are the Patuxent, which borders Prince George's and Montgomery Counties to the Southwest, and the Patapsco, which borders Carroll and Baltimore Counties to the north and northeast. Both rivers are tributaries to the Chesapeake Bay.

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

FIGURE 34: HOWARD COUNTY MAJOR WATERSHEDS



*Source: Howard County, Planning and Zoning Department

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

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

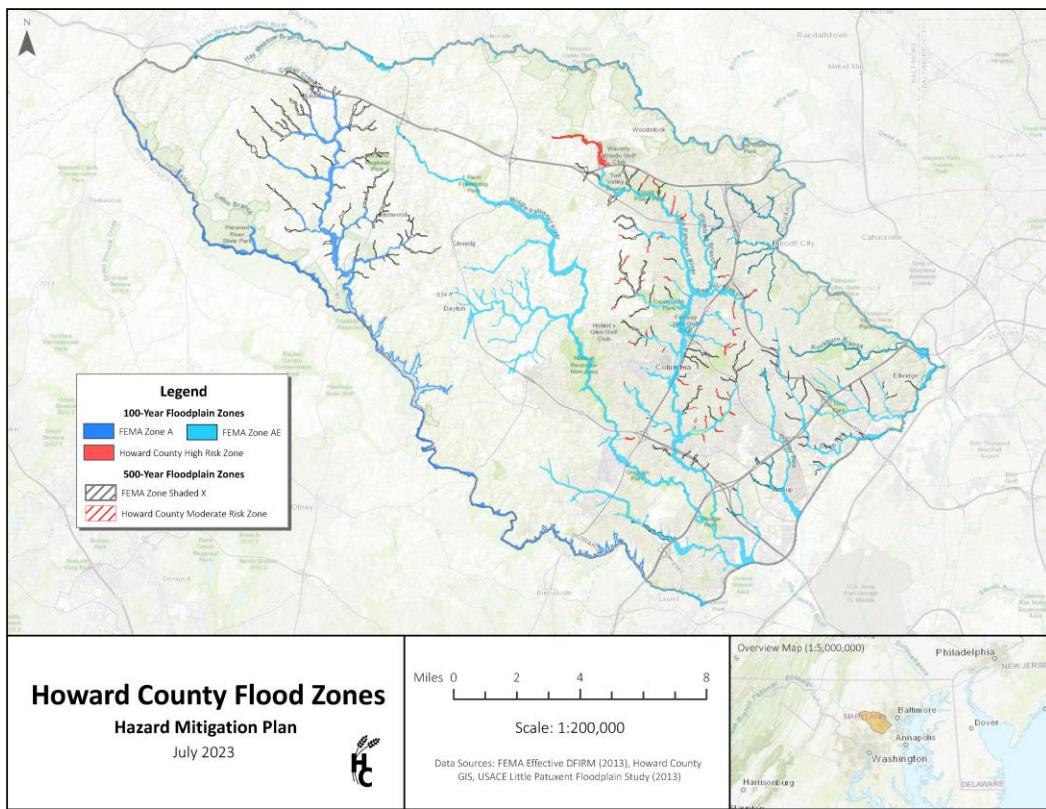
Hazard Extent

Flood severity is measured in various ways, including frequency, depth, velocity, duration, and contamination. In Howard County, the severity of the flood hazard depends on the part of the County considered, but severity issues are generally correlated with frequency of occurrence. Flooding along the three major rivers of the County usually occurs during the summer and early fall, mainly as a result of severe thunderstorms and tropical cyclones. These events force smaller tributaries of the County to overflow and flood from the top down. The events of the 2016 Ellicott City flood caused over \$10 million

in damages and claimed two lives, and the 2018 Ellicott City flood caused around \$20 million in damages³⁸.

As the figure below illustrates, the majority of flood-prone areas are located in the eastern, and more urbanized, portion of the County. The Howard County Flood Mitigation Plan (FMP) states that 5.1% of the County's land area is susceptible to riverine, flash, and urban flooding.³⁹ Howard County has vulnerabilities to floods; some of the major cities in the County, such as Ellicott City, Elkrige, and the Allview neighborhood in Columbia are in low-lying areas. The aforementioned dams, low-lying roads, and railways also present another challenge in the County.

FIGURE 35: HOWARD COUNTY FLOOD ZONES



40

³⁸ Howard Announces \$8.1M Grant to Repair Damage from 2018 Flash Flood, 2019, Maryland Association of Counties, <https://conduitstreet.mdcounties.org/2019/08/08/howard-announces-8-1m-grant-to-repair-damage-from-2018-flash-flood/>, (last accessed July 26, 2023).

³⁹ 2024 FLOOD MITIGATION PLAN UPDATE, HOWARD CTY., MD., (February 16, 2023).

⁴⁰ Howard County Department of Public Works Storm Water Management Division. For detailed maps of local areas and their flood zones, please visit https://data.howardcountymd.gov/gdfirm/main_Web.aspx.

Howard County Flood Zone Definitions⁴¹

FEMA Zone A	The flood insurance rate zone that corresponds to the 100-year floodplain that is determined in the Flood Insurance Study by approximate methods. Mandatory flood insurance purchase requirements apply here, as well. Because detailed hydraulic analyses are not performed for these areas, no Base Flood Elevations or depths are shown within this zone on FEMA's FIRMs.
FEMA Zone AE	The flood insurance rate zone that corresponds to the 100-year floodplain that is determined in the Flood Insurance Study by detailed methods. Mandatory flood insurance purchase requirements apply. In most instances, the Base Flood Elevations derived from the detailed hydraulic analyses at selected intervals within this zone (the cross sections) are shown on FEMA's Flood Insurance Rate Maps (FIRM).
Howard County High Risk Zone	The 100-year floodplain for drainage areas of 30 acres or greater as defined in Chapter 6 of the Howard County Design Manual, Volume 1. Mandatory flood insurance purchase requirements do not apply here. County development restrictions apply. If overlaps occur with the DFIRM, the FEMA DFIRM applies.
FEMA Zone Shaded X	The areas of 0.2% annual chance flood (the 500-year floodplain); areas of 1% chance of flood with average depths of less than 1 foot; or with drainage areas less than 1 square mile and areas protected by levees from 1% annual chance flood. Mandatory flood insurance purchase requirements do not apply here. County development restrictions apply.
Howard County Moderate Risk Zone	The 500-year floodplains for drainage areas of 30 acres or greater as defined in Chapter 6 of the Howard County Design Manual, Volume 1. Mandatory flood insurance purchase requirements do not apply here. County development restrictions apply. If overlaps occur with the DFIRM, the FEMA DFIRM applies.

⁴¹ https://data.howardcountymd.gov/gdfirm/Floodplain%20Website%20Updates%20-%20flood%20zones_v3.pdf

According to the 2024 Howard County Flood Mitigation Plan, 548 out of 82,102 (0.6%) structures in the County are vulnerable to flooding. The map below depicts the 100-year Floodplain Special Hazard Zone, which are areas with special flood, mudflow, or flood-related erosion hazards.⁴² The following figure provide statistics regarding estimated building exposure and estimated building losses for a 100-year flood hazard, a magnitude flood event that has a 1% annual probability of occurring, if all exposed buildings were damaged.⁴³

Study Area	Exposed and Damaged Buildings	Exposed and Damaged Residential Buildings	Exposed and Damaged Commercial Buildings
Columbia	144	134	10
Elkridge	76	56	20
Ellicott City	214	143	71
Other Areas	114	37	77
County Total	548	370	178

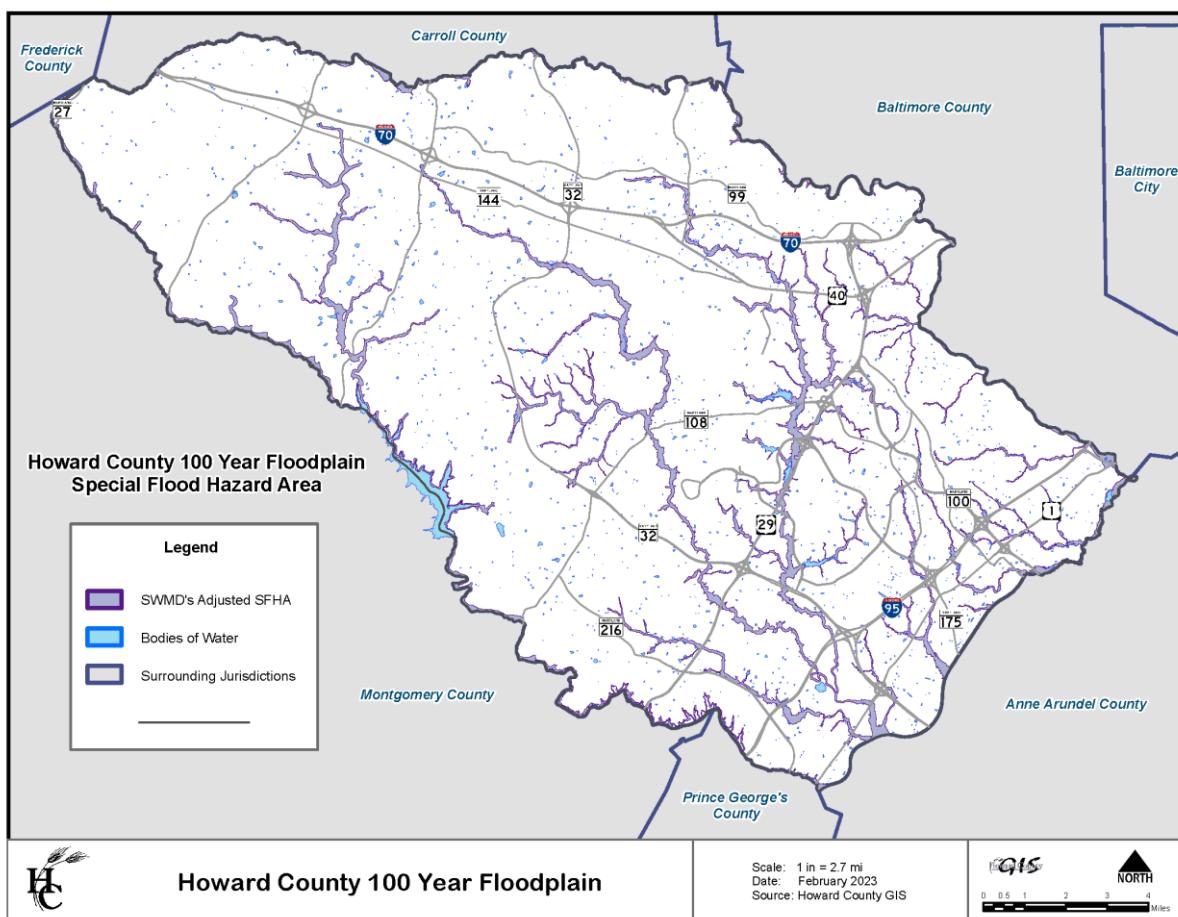
Study Area	Residential Building Loss	Commercial Building Loss	Total Building Loss
Columbia	\$ 289,020,100.00	\$ 45,119,800.00	\$ 334,139,900.00
Elkridge	\$ 7,741,200.00	\$ 9,237,900.00	\$ 16,979,100.00
Ellicott City	\$ 30,288,100.00	\$ 26,820,300.00	\$ 57,108,400.00
Other Areas	\$ 37,649,800.00	\$ 386,273,000.00	\$ 423,922,800.00
County Total	\$ 364,699,200.00	\$ 467,451,000.00	\$ 832,150,200.00

In the 2024 Howard County FMP, a flood vulnerability assessment was executed that examined critical facilities and their locations in the 100-year flood zone. The following facilities were included in this analysis: fire stations, police stations, schools, government buildings, wastewater treatment facilities, and other utilities infrastructure, senior centers, assisted housing, hospitals, and nursing homes. Only five critical facilities were determined to be in the modeled flooded area as can be seen below.

⁴² See Hazard Definitions Appendix G for all definitions.

⁴³ See Hazard Definitions Appendix G for all definitions.

FIGURE 36: HOWARD COUNTY 100 YEAR FLOODPLAIN SPECIAL FLOOD HAZARD AREA



*Source: Howard County Department of Technology and Communication Services, GIS Division

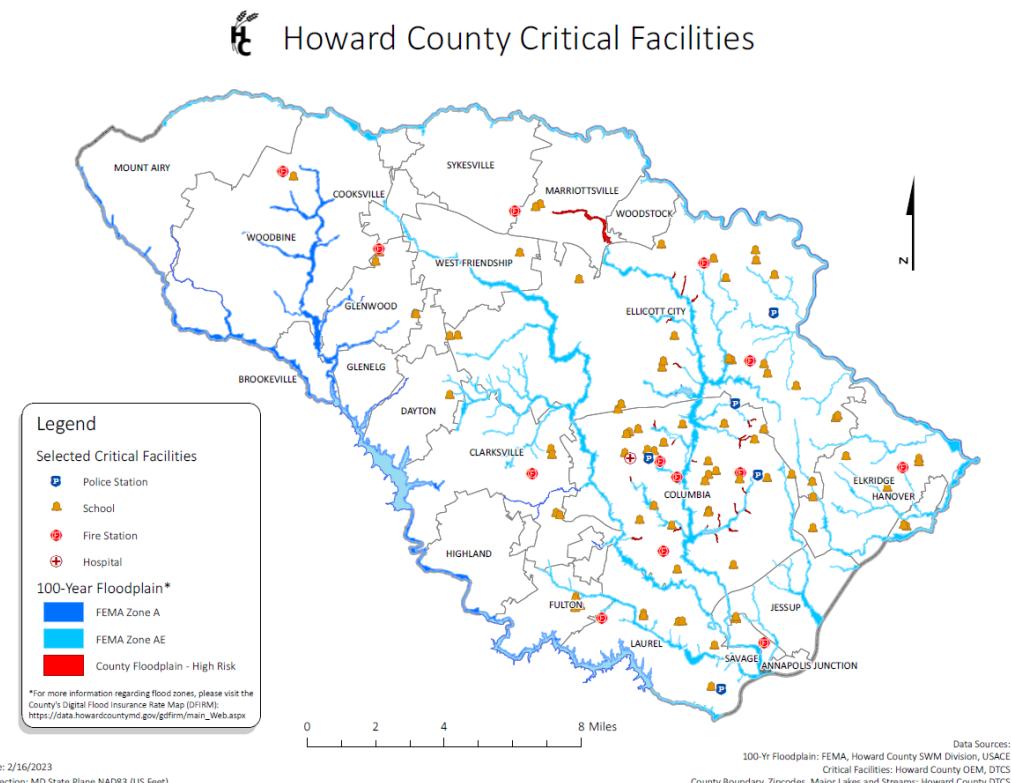
Critical Facilities in the 100-Year Flood Zone

Facility Type	Name
Wastewater Treatment Plant (WWTP)	Little Patuxent Water Reclamation Plant
School	Clemens Crossing Elementary School
Pumping Station – Sewer	NLRL
Pumping Station – Sewer	RT40
Pumping Station – Sewer	R108

Hazard Impacts

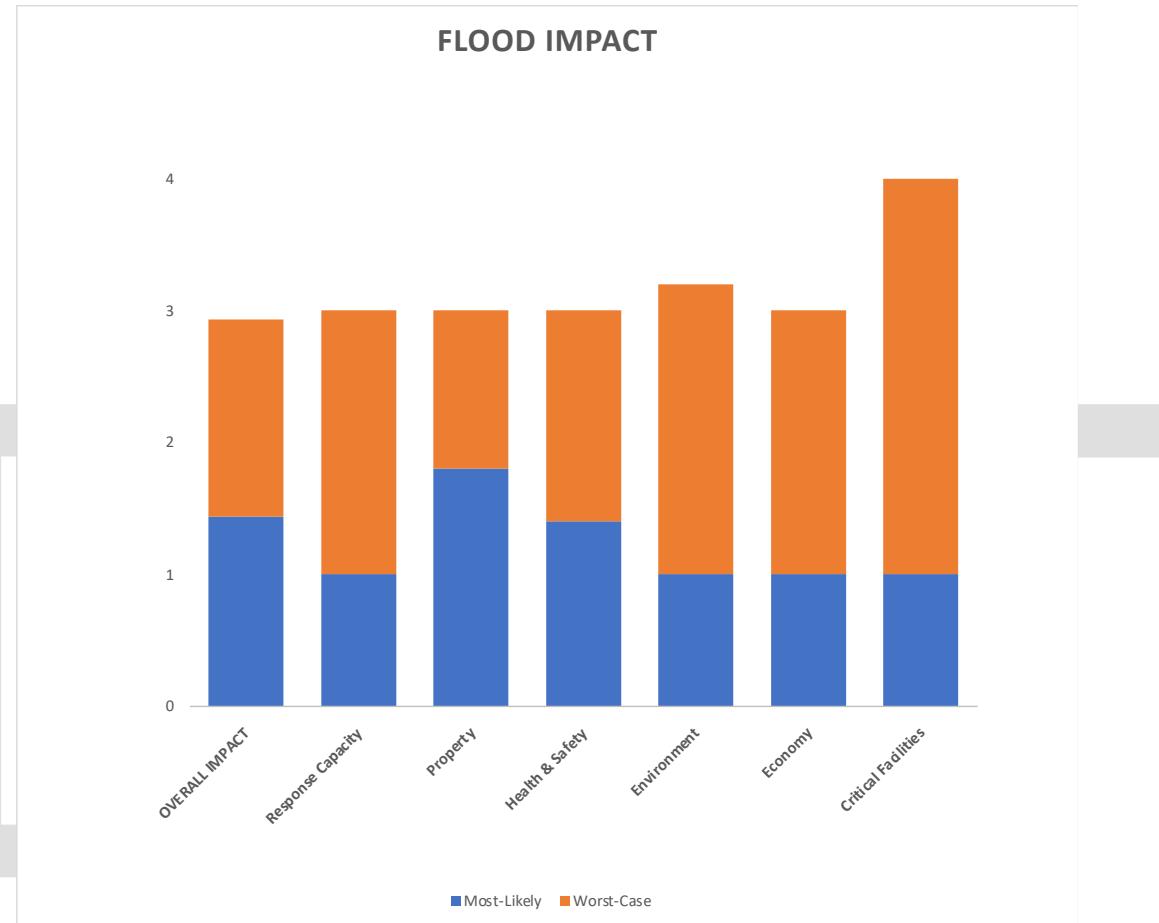
Due to the tremendous power of moving water, flash flooding can easily cause loss of life and significant damage, including uprooting of trees, undermining of buildings and bridges, and scouring new channels. According to the 2024 Howard County FMP, although the number of people killed or injured nationally during floods each year is relatively small, Howard County suffered three flood-related deaths between 2016 and 2018. It is the built environment within the floodplain, however, which is most likely to bear the brunt of a flood's impact. Whether the water is moving or standing, the exposure of buildings to floodwater could cause a great deal of damage. If the water is moving, the hydraulic pressure variation between the inside of the building and the 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 could become saturated with floodwater as the floodwater is absorbed (a process 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 objects have become wet but the sediment, contaminants, and chemicals from the floodwaters that could make it impossible to recover all but the most precious/heirloom items.

FIGURE 37: HOWARD COUNTY CRITICAL FACILITIES



In Figure 37, the High-Risk County Floodplain is part of the 100-year floodplain for drainage areas of 30 acres or greater.

The figure and table below characterize flood impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Flood - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Limited critical and non-critical infrastructure damage. ▪ Debris on the roadway is expected. ▪ Limited washouts at road edges and around some culverts are expected to be damaged.
HEALTH AND SAFETY	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Zero deaths are expected. Vehicle in water and attempting to escape, walking near water, or electrocution are the most common causes of death. ▪ Two injuries are expected. Vehicle collisions and stranded drivers trying to escape are the most common causes of injuries.
CRITICAL FACILITIES	<i>Limited</i>	<ul style="list-style-type: none"> ▪ <u>Utilities</u> – shutdown unlikely. ▪ <u>Information/Communications</u> – Outage unlikely. ▪ <u>Transportation</u> – Minor flooding on roadways, blocking traffic and causing the need for rescue of a few individuals who became stranded while trying to cross through the flood waters. Several flooded roadways, fast moving water, impact traffic, and law enforcement and public works required to block roads and recover.

RESPONSE CAPACITY	<i>Limited</i>	<ul style="list-style-type: none"> ▪ <u>Police</u> – Local resources adequate. ▪ <u>Fire and Rescue</u> – Local resources adequate. Limited impact to response capability. Additional personnel will be necessary to assist with stranded motorists. ▪ <u>Health</u> – Local resources adequate. HD has COOP plans in place to ensure essential functions continue either on site (if possible) or at an alternate location. ▪ <u>Public Works</u> – Local resources adequate. Minimal Impact on response capability and continuity of operations.
ENVIRONMENTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Minimal impact with a possible short-term spike in water pollution. ▪ Mudslides or fallen trees can cause serious erosion or sediment pollution to the local water resource.
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Millions of losses in dollar value in low lying areas. ▪ Structural and business loss and disruption of transportation network in economic consequences.
TOTAL IMPACT	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1.4 on a scale of 1 (Limited) to 4 (Catastrophic).
<i>Limited</i>		Significant Critical Catastrophic

Vulnerability of County Assets

Howard County's 2024-2029 Flood Mitigation Plan conducted a flood vulnerability assessment and included examining the Equity Emphasis Area Index (EEAI) score in flood-prone areas⁴⁴. This section includes the results of this assessment.

The EEAI score is determined based on the Baltimore Metropolitan Council's Vulnerable Population Index (VPI) methodology⁴⁵, which considers the following vulnerable population groups:

- Poverty;
- Non-Hispanic, Non-White;
- Hispanic;
- Limited English Proficiency (LEP);
- Disabled;
- Elderly ; and,
- Carless.

Census tracts receive scores from zero to eleven, and the higher the score, the more vulnerable the population. The maps below show the EEAI score for each census tract in Howard County and a comparison of the distribution of buildings in flood hazard areas (100-year floodplain) and EEAI scores. Columbia, Ellicott City, and parts of Elkridge and Laurel appear to have areas with both higher EEAI scores (more vulnerable populations) and higher densities of buildings in flood hazard areas. The western side of the County generally has lower EEAI scores (less vulnerable populations) and sporadic instances of buildings in the floodplain.

⁴⁴ Howard County 2024-2029 Flood Mitigation Plan Update, Howard County Department of Public Works, (Draft form)

⁴⁵ Vulnerable Population Index: Considering the Transportation Needs of Vulnerable Populations, 2018, Baltimore Metropolitan Council,

https://www.baltometro.org/sites/default/files/bmc_documents/data%26maps/transportation/vpi/VPI-white-paper-2018_web.pdf, (last accessed July 24, 2023).

FIGURE 38: HOWARD COUNTY EEAI BY CENSUS TRACT

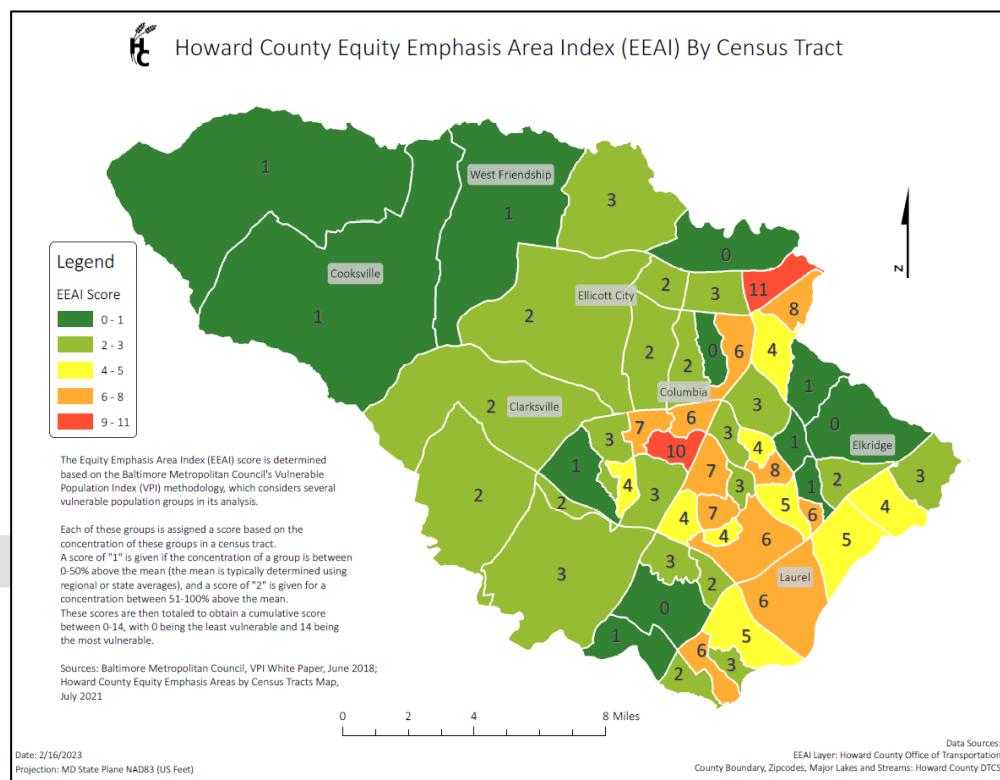
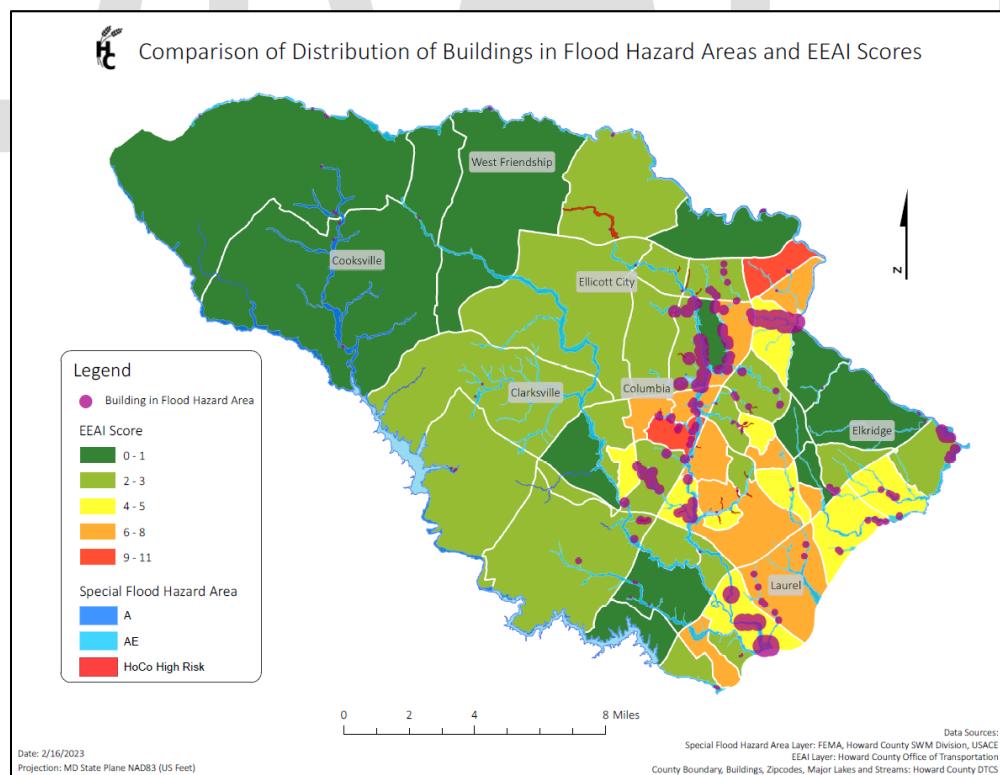


FIGURE 39: COMPARISON OF DISTRIBUTION OF BUILDINGS IN FLOOD HAZARD AREAS & EEAI SCORES



Effects of Population Change and Development in Hazard-Prone Areas

More information on how Howard County is enforcing strict development regulations on mapped floodplains and other mitigation flood mitigation activities, please refer to [Chapter 2, section Development in Hazard-Prone Areas.](#)

High population density areas may experience faster urban runoff during intense rainfall events, leading to quicker onset of flash floods. The combination of impervious surfaces and insufficient drainage can result in rapid and dangerous flooding. While the risk of flash flooding might be lower in low population density areas, it's important to note that even rural or less developed regions can still experience flash floods, especially if topography, soil type, or other factors contribute to rapid runoff. High population density areas may require more extensive infrastructure development, such as roads, bridges, and stormwater management systems. Inadequate or outdated infrastructure can contribute to localized flooding by restricting water flow and causing backups.

As Howard County, Maryland, looks towards the future and experiences continued development and urbanization, it is imperative to assess how these changes may influence the county's vulnerability to flooding. This assessment is particularly critical in areas that are inherently prone to flooding due to their geographical and hydrological characteristics. Future development is likely to introduce additional impervious surfaces such as roads, parking lots, and buildings. These surfaces hinder the natural infiltration of rainwater into the soil, leading to increased surface runoff during precipitation events. In areas already susceptible to flooding, this heightened runoff can exacerbate flood risks by overwhelming drainage systems and watercourses. Coastal and waterfront development introduces an additional layer of flood vulnerability due to sea-level rise, storm surges, and tidal fluctuations. As these areas are exposed to both riverine and coastal flooding, development without proper consideration of these factors can escalate flood risks. While development contributes to economic growth, rapid expansion can strain existing infrastructure such as drainage systems, culverts, and sewage networks. Inadequate infrastructure can hinder efficient water management and escalate flooding concerns, particularly during heavy rainfall events. Both population growth, density, and future development can be seen primarily within the regions of Central and South-eastern portions of Howard County, please refer to Chapter 2, [Growth and Development](#) section, and subsection [Future Development](#) of this Plan to identify where these current and future populations density areas are/expected to be and where future development is expected to be.

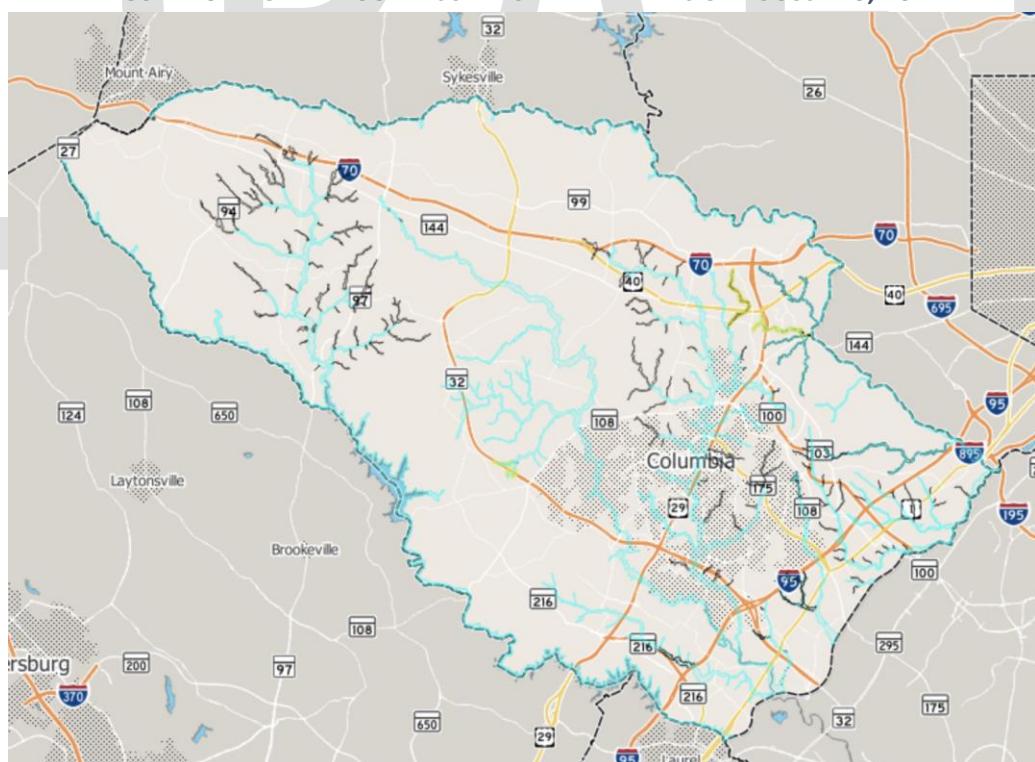
National Flood Insurance Program Data Analysis

National Flood Insurance Program (NFIP) data claim statistics can help paint a picture of a community's flood vulnerability and risk. The NFIP is a federal program that enables property owners in participating communities to purchase insurance to protect against flood losses. To participate, communities must develop and continuously implement floodplain management regulations that will reduce future flood damages. If a community adopts and enforces floodplain management ordinances, the federal government will ensure flood insurance is available to those in the community.

FEMA prepares and makes available to the public Flood Insurance Rate Maps (FIRMs), which provide an overview of flood risk and identify County land that is vulnerable to flooding. FIRMs are used to regulate new development and control the substantial improvement or repair of substantially damaged buildings. Flood Insurance Studies (FIS), often developed in conjunction with FIRMs, contain a narrative of the flood history of a community and discuss the engineering methods used to develop the FIRMs. The study also contains flood profiles for studied flooding sources and can be used to determine Base Flood Elevations (BFE) for some areas.⁴⁶

The most recent, Volume three, Howard County FIS is dated November 6th, 2013, and compiles previous flood information and data on numerous waterways.⁴⁷ The 2024 updated FMP for Howard County states that Preliminary Digital Flood Insurance Rate Maps (DFIRMs) were updated. These updates include incorporating the results of any new flood studies into the new DFIRMs and reconciling the new DFIRM data with the flood data in the FMP. These DFIRMs are made in response to the changing conditions affecting the County, including changes in land use, weather events, and improved techniques for assessing floodplains.

FIGURE 40: DIGITAL FLOOD INSURANCE RATE MAP AS OF AUGUST 26, 2022



*Source: https://data.howardcountymd.gov/gdfirm/main_Web.aspx

⁴⁶ *Base Flood Elevation (BFE)*, FEMA, <https://www.fema.gov/base-flood-elevation> (last visited Feb. 27, 2023) (defining BFE as “[t]he elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year.” The BFE serves as the regulatory requirement for the elevation or flood-proofing of structures, which determines the flood insurance premium.).

⁴⁷ FLOOD INSURANCE STUDY, HOWARD CTY., MD. AND INCORPORATED AREAS (Vol. 3 of 3, Nov. 6, 2013), https://data.howardcountymd.gov/scannedpdf/Environmental_Services/EffectiveFirmDocs/24027CV003A.pdf.

According to the 2024 Howard County Flood Mitigation Plan, as of May 2022, FEMA reports that there are 53 Repetitive Loss (RL) properties in Howard County, four of which are Severe Repetitive Loss (SRL) properties. A RL property is defined as any insurable building for which two or more claims of more than \$1,000 were paid by the NFIP within any rolling 10-year period, since 1978. A SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over \$5,000 each; or,
- 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.

Five of the RL properties are mitigated RL properties, which were acquired by the County, and their buildings were demolished. Mitigation for two of the demolished buildings used FEMA funds. The five lots are now open space. The County has filed the proper paperwork to update the RL list to remove these five mitigated properties. FEMA produces loss and claim statistics for all National Flood Insurance Program communities throughout the Country. The three following tables provide data on the loss and policy statistics respectively for Howard County between 1977 and December 1, 2022, as well as land use types for the RL and SRL Properties.

RL and SRL Land Use Counts	
Low-Density Residential	18, 1 of which is SRL
Commercial	16 total, 2 of which are SRL
Mixed-Use	5
Parks & Open Space	12, 1 of which is SRL
Medium-Density Residential	2

Howard County Loss Statistics⁴⁸

Area	Losses	Total Payments
Howard County	394	\$15,717,563

Howard County NFIP Policy Statistics⁴⁹

Area	Policies in Force	Insurance in Force	Whole Written Premiums in Force
Howard County	960	\$ 287,289,000	\$ 891,524

⁴⁸ Source: <https://bsa.nfipstat.fema.gov/reports/1040.htm#24> as of 6/30/2018.

⁴⁹ Source: <https://bsa.nfipstat.fema.gov/reports/1011.htm#MDT> as of 6/30/2018.

Hazard Occurrences

The NCDC indicates there have been 36 flooding events in Howard County from 2002 to 2022.⁵⁰ The NCDC separately categorized flash flooding events. Between 2002 and 2022, the NCDC reports that there were 32 flash flood events.⁵¹

Howard County has had numerous flooding incidents, including major events such as Tropical Storm Agnes in 1972, Hurricane Eloise in 1975, Hurricane Floyd in 1999, Tropical Storm Lee in 2011, and most recently, the Ellicott City flash flooding events on July 30th, 2016, and May 27th, 2018. Most incidents are the result of tropical systems, nor'easters, or flash flooding from sudden, short-lived rainstorms. To develop the following flood history narratives, information was pulled from FIS for Howard County and the NCDC database. Detailed descriptions of these events can be found below.

Notable Incidents in Howard County

**The damage figures have been adjusted for inflation and are detailed in 2022-dollar values

July 1868	On July 24 th , 1868, 18 inches of rain fell in Howard County, causing the Patapsco River to overflow. Witnesses noted that the river rose approximately 30 feet in 30 minutes. The flood resulted in 37 fatalities and caused an estimated \$5.6 million in damage.
May 1894	The Patapsco River flooded, causing extensive property damage. The flood resulted in approximately \$203,740 in damage.
September 1952	On Labor Day weekend, Hurricane Able's heavy rains swept through Howard County. A destructive flash flood caused a log jam in the mouth of the Tiber River and resulted in approximately \$5.4 million worth of damage.
August 1971	August 1 st – 4 th , 1971, heavy rain and flooding caused numerous road closures and damaged several homes. The Patuxent River rose 25 feet in 30 minutes and mud slides damaged roads and bridges. Roads that were flooded and/or damaged included: Owen Brown Road, Morgan Road, Carroll's Mill Road, River Road, Mullinix Mill Road, Howard Chapel Road, Furnace Avenue, Mink Hollow Road, Route 108, Route 32, Centennial Lane, Bethany Lane, and Old Annapolis Road. An estimated \$799,244 in County property damage was reported.
June 1972	Another notorious and destructive flooding event in Howard County was caused by Tropical Storm Agnes from June 21 st – 23 rd , 1972. The Howard County FIS estimates the total property damage from the storm to be as high as \$56.2 million. The majority of the damage occurred along the Patapsco River in the Ellicott City and Elkridge areas. The total damage along the Patapsco River was estimated to be approximately \$49.1 million. Property damages along the Little Patuxent River totaled about \$3.2 million and damages along the Patuxent and Middle Patuxent totaled roughly \$699,031. An estimated \$1.5 million worth of damages occurred to roads and bridges throughout the County. Meanwhile, the Spatial Hazard Events and Losses Database for the United States (SHEDLUS) database estimates the total property damage from Tropical Storm Agnes to be

⁵⁰ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO., <https://www.ncdc.noaa.gov/stormevents/> (last visited Feb. 27, 2023).

⁵¹ *Id.*

	roughly \$15.2 million. This massive flood caused at least three fatalities. The photograph below shows the flooding that occurred along Main Street in downtown Ellicott City.
September 1975	September 22 nd – 26 th , 1975, the remnants of Hurricane Eloise, coupled with snow from a previous storm, resulted in over 12 inches of rain in four days and caused both the Patuxent and Patapsco Rivers to overflow up to 24 feet above normal. Much of Ellicott City and Elkridge were again flooded, as some businesses had just reopened after recovering from the extensive damage caused by Hurricane Agnes. Mud and debris covered the landscape, and homes and businesses were declared unsafe.
June 1996	On June 19 th , 1996, storms poured 5.5 inches of rain into Howard County and flooded roads, bridges, and properties. Seneca Creek and Bennett Creek overflowed their banks, causing several roads to be temporarily closed. Two fatalities occurred when a couple rafting in the Patapsco River was swept over a dam in the raging current. \$112,636 in property damage was reported.
September 1996	On September 6 th , 1996, the remnants of Hurricane Fran dropped up to five inches of rain in parts of the County and caused physical damage to the County with 40 mph sustained winds. Minor flooding occurred, 36,300 residents of Howard County lost power, and \$46,829 of property damage was recorded.
September 1999	On September 9 th , 1999, a thunderstorm moved through the County, producing damaging winds and heavy rainfall across the area. Flooding occurred in Ellicott City, Dorsey, Columbia, and Elkridge. Portions of Route 1 flooded, and cars became trapped by the surrounding water. Water infiltrated homes near Columbia and Dorsey. Precipitation measurements showed 7.39 inches of rain near Columbia and 5.98 inches near Elkridge.
September 1999	On September 16 th , 1999, the remnants of Hurricane Floyd produced high winds and heavy rains that closed 200 roads and streets countywide. Businesses were threatened by the raging waters of the Patapsco River as its banks overflowed in Ellicott City. Rainfall measurements of two to five inches were reported throughout the day. County officials reported 17 homes were damaged, 350 basements were flooded, two people were rescued, and the Howard Country Fair was shut down for the first time in its 47-year history.
Floods of 2003	Howard County experienced several floods in 2003. First, on February 22 nd , widespread flooding was caused by both melting snow from the snowstorm of February 14 th – 18 th , 2003 combined with one and a half to three inches of rain. Several roads closed, including Route 108, Race Road, Furnace Avenue, Triadelphia Mill Road, and Toll House Road and 30 basements flooded. A few months later, from June 7 th -20 th , 2003, storm systems moved across the region, causing roads and waterways repeatedly to flood for nearly two weeks. River and stream levels remained high throughout this period, fed by up to five inches of rain per day. Several roads were closed multiple times including Furnace Avenue, South Entrance Road, Carris Mill Road, Warfield Road, Route 108, and Lime Kiln Road. On September 23 rd , a few days after Hurricane Isabel brought rain to the region, a heavy rainstorm brought two and a half inches of rain in one day and flooded parts of the County. On November 19 th , a strong line of thunderstorms brought two to four inches of rainfall, which resulted in the closure of several roads. Finally, on December 11 th , a heavy overnight rainfall averaging two to three inches fell on snow-covered grounds, melting the snow. This led to the heightening of rivers and streams as well as the closure of several roads due to rising water.

October 2005	On October 8 th , 2005, remnants of Tropical Strom Tammy caused prolonged heavy rainfall that measured seven inches in two days. 10 roads in the County flooded, two homes were damaged by the influx of mud, and a water rescue was conducted in Ellicott City.
June 2006	On June 23 rd – 26 th , 2006, a storm system moving from the south caused torrential rain that continued for four days. The ground was saturated, and low-lying areas flooded as the area accumulated more than 10 inches of rain. A two-to-three-foot storm surge, coupled with flood water, washed away part of the Vollmerhausen Road bridge and forced the closing of minor roads. Main Street in Ellicott City flooded, causing a broken sewer line.
July 2008	On July 23 rd , 2008, a slow-moving cold front produced a wave of heavy showers in the afternoon and evening. Flash flooding occurred, closing several roads including I-95, the nation's main thoroughfare on the East Coast, near Elkridge.
July 2016	On July 30 th , 2016, a significant flooding event occurred when a strong storm dropped six inches of rain over Ellicott City over a span of two hours. Significant flash flooding caused extensive damage to businesses and homes on Main Street and in the West End neighborhood of Historic Ellicott City. The storm took two lives and caused at least \$27.7 million in estimated damages. The storm caused extensive damage to 90 businesses and 107 homes. The images below are from the July 2016 flooding.
May 2018	On May 27 th , 2018, a series of heavy thunderstorms caused excessive rainfall in short period of time, resulting in flash flooding. This event occurred just 22 months after the 2016 flooding in Ellicott City and Catonsville. According to the NOAA, "The heavy rainfall, between six to 12 inches in the heaviest band, caused catastrophic damage, especially in Historic Ellicott City." There was flood damage to buildings, infrastructure, and vehicles. Roads washed out, land eroded, and there were localized landslides. Emergency swift-water rescue operations were performed. There was one fatality during the flood. The graphs below show the rainfall totals through the evening and associated water levels.

Hazard Future Likelihood – Medium-High

The future annual probability of a Flood is 11-30% + chance of annual occurrence, or one event every 1-9 years. There is an increased risk of flood events going forward based on the National Climate Assessment, which projects increased frequency of severe storms and rain. An expected increase in rainfall levels and extreme storms may result in a slight increase in the likelihood of flooding.⁵² Aging dam infrastructure may also contribute to a slight increase in the likelihood of flooding in the future. Other considerations include existing buildings in the floodplain and continued development.

The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Flood in Howard County	
Historical Average (time period)	36 flood events between (2002-2022) and 32 flash flood events between (2002-2022)
Historical Annual Probability	30%+ chance of annual occurrence

⁵² Fourth National Climate Assessment, U.S. GLOB. CHANGE RESEARCH PROGRAM, <https://nca2018.globalchange.gov> (last visited Feb. 27, 2023).

Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	11-30% + chance of annual occurrence
Future Likelihood Score	3.1 (Likely- Very Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Tornado/Windstorm (Risk Score 2.1)

Hazard Description

Windstorms and Tornadoes are grouped together as one hazard but are defined separately. Windstorms fall within two categories: thunderstorm winds, and high wind events. These types of events will be discussed separately within this hazard profile. A tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud."⁵³ Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye.

Damaging winds are often called "straight-line" winds to differentiate the damage they cause from tornado damage. Strong thunderstorm winds can come from several different processes. Most thunderstorm winds that cause damage at the ground are a result of outflow generated by a thunderstorm downdraft. Damaging winds are classified as those exceeding 50-60 mph.

Windstorms are categorized in the NCDC database as thunderstorm winds and high wind events. Within these windstorm events are two basic types of winds that may affect Howard County: Mesoscale and Microscale winds. Either type of windstorm event may result in property damage and loss of life. Mesoscale winds are high winds that are long-lasting and occur over a large area. They are typically associated with a cold frontal passage or a nor'easter. Microscale winds last a short time period and are confined to a small area. Microscale winds are commonly associated with thunderstorms. When a thunderstorm produces winds over 50 kts (roughly 58 mph), that thunderstorm is considered severe.

A downburst is "the general term used to broadly describe macro and microbursts."⁵⁴ Downbursts result from a sudden descent of cold air hitting the ground and spreading outward, thus creating a high wind event. A downburst can have devastating effects. According to NOAA, there are two types of downbursts; a microburst and a macroburst. A microburst is a small downburst that brings damaging winds up to 168 mph, over an area of two and a half miles, and lasts five to fifteen minutes. A

⁵³ *Glossary of Meteorology*, AM. METEOROLOGICAL SOC'Y (2000), <http://www.spc.noaa.gov/faq/tornado/> (last visited Feb. 27, 2023).

⁵⁴ *Severe Weather 101 – Damaging Winds*, NOAA NAT'L SEVERE STORMS LAB., <https://www.nssl.noaa.gov/education/srvwx101/wind/> (last visited Feb. 27, 2023).

macroburst is a large downburst that causes tornado-like damage, where winds can reach 134 mph, over an area of two and a half miles, and lasts five to thirty minutes.

The following table presents the Risk Score for Tornado/Windstorms in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Tornado/Windstorm Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	3.0 Likely		50%
Consequence	Impact	1.0 Limited	2.8 Significant-Critical	40%
	Warning Time	3 Moderate	4 Short	5%
	Duration	1 Short	1 Short	5%
TOTAL RISK SCORE		2.1	2.9	

Hazard Location

Tornadoes can form at any time, in any location with the Nation's season of greatest activity running from March to August. The peak of tornado activity usually occurs in April, May, and June in the United States. Tornadoes can occur at any time of the day, although they are more likely to occur between 4 p.m. and 9 p.m.⁵⁵ This is because "by this time the sun has heated the ground and the atmosphere enough to produce thunderstorms."⁵⁶

Within Howard County, the risk to people and property from tornadoes cannot be distinguished by area; the hazard has a uniform probability of occurrence across the County. Although the impact of a tornado event will be different in different parts of the County, all people and assets are considered to have the same degree of exposure. This is the same for mesoscale and microscale wind events. The figures below show how the frequency and strength of extreme windstorms can vary across the United States.

⁵⁵ Severe Weather 101 – Tornadoes, NOAA NAT'L SEVERE STORMS LAB., <https://www.nssl.noaa.gov/education/srvwx101/tornadoes/>, (last visited Feb. 27, 2023).

⁵⁶ Tornadoes, explained, NAT'L GEOGRAPHIC (Aug. 28, 2019), <https://www.nationalgeographic.com/environment/natural-disasters/tornadoes/>.

FIGURE 41: UNITED STATES WIND ZONES MAP

United States Wind Zones Map

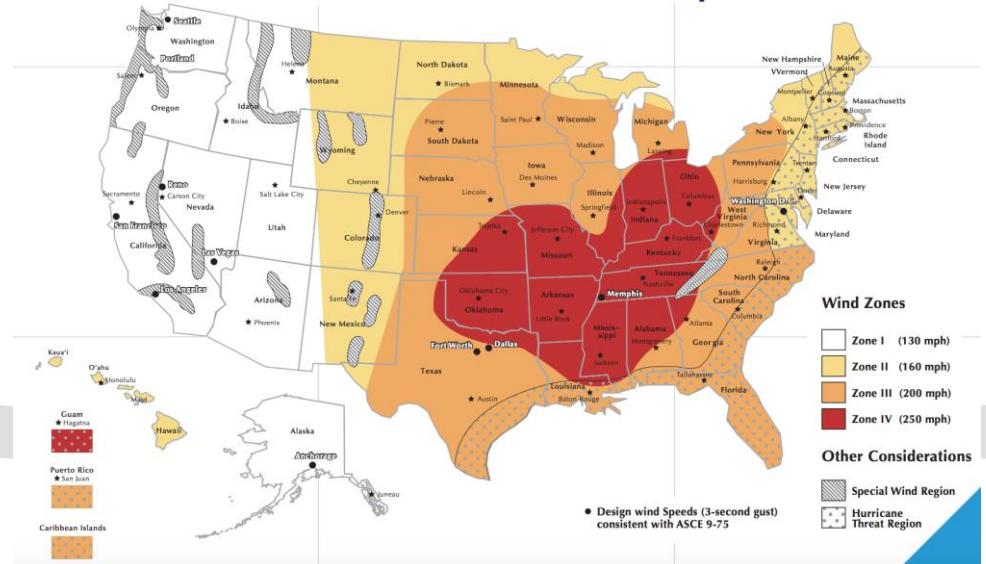
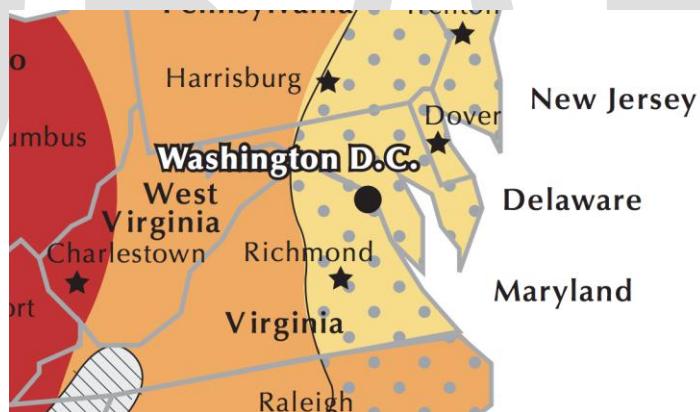


FIGURE 42: UNITED STATES WIND ZONES ZOOMED-IN IMAGE OF MARYLAND⁵⁷



Hazard Extent

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale (EF-Scale), named after Dr. T. Theodore Fujita, who introduced the scale in 1971. This scale is a set of wind estimates based on observed damages after a tornado. It uses three-second gusts estimated at the point of damage. It is also based on a judgment of eight levels of damage and 28 indicators that include various commercial and residential building types, transmission towers, poles, and trees. Similar to the original scale, the new EF-Scale includes five classes ranging from EF0 to EF5. The table below displays the wind speed ranges of the EF-Scale that has been in use since February 2007.

⁵⁷ Chapter 5 – Risk Assessment Maps - United-States – Seismic and Wind Zones, ONTARIO CNTY., NY, <https://www.co.ontario.ny.us/DocumentCenter/View/3445/Chapter-5---Risk-Assessment-Maps---United-States---Seismic-and-Wind-Zones> (last visited Apr. 6, 2023).

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

Within the planning area, it is possible for a tornado of any magnitude to occur, with the probability decreasing as the intensity scale increases. Tornadoes can impact all part of Howard County equally and uniformly. Although the NCDC indicates the strongest historical tornado in Howard County was rated F2 on the F-Scale, the potential for extreme atmospheric instability, especially with climate change, allows for the possibility that tornadoes in the planning area could reach EF-4 or EF-5 severity. For example, on April 28, 2022, an F4 tornado struck La Plata in Charles County, which killed three, injured 122 people, and caused over \$100 million in damages⁵⁸. Charles County's proximity suggests that a similar tornado may occur within the County. A tornado of similar magnitude could potentially cause catastrophic damages to the affected area in Howard County. Later in this section, a list of tornado occurrences in Howard County appears in the "Occurrences" section along with the magnitude or F/EF Scale rating of each.

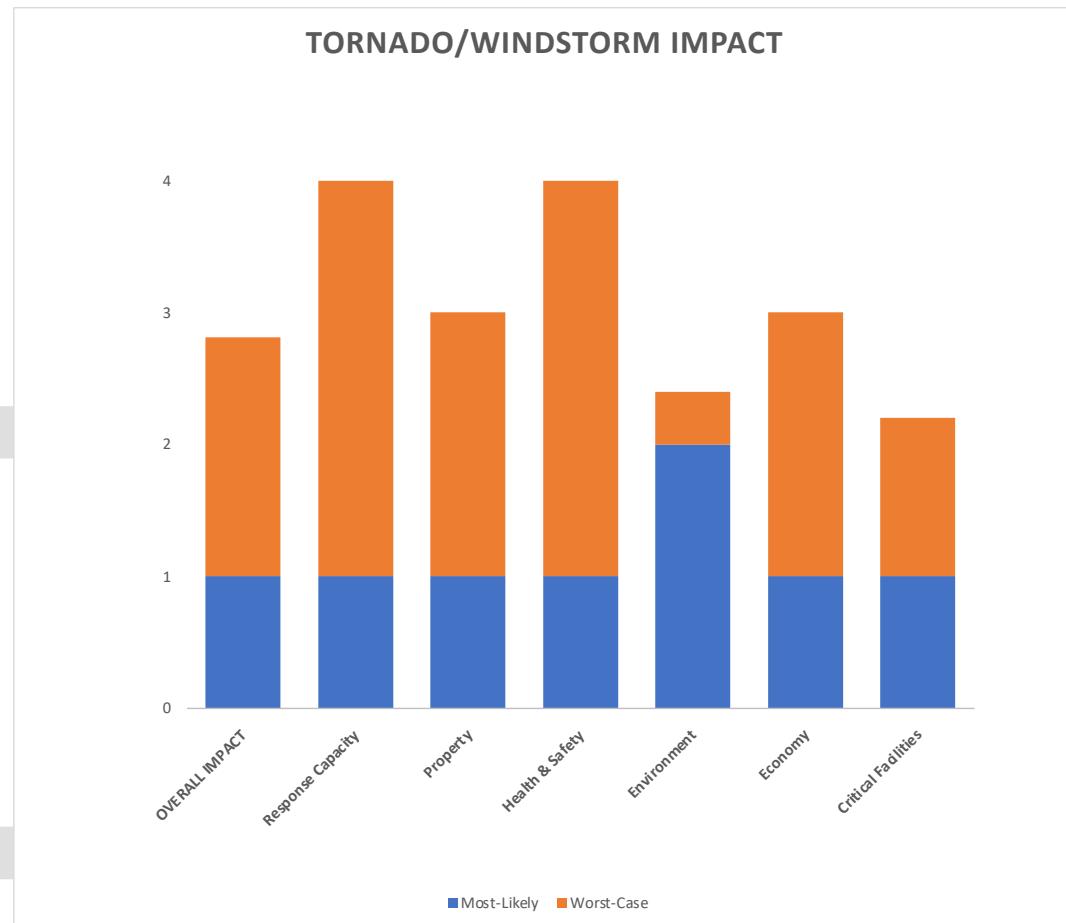
Hazard Impacts

Damage from severe thunderstorm winds account for half of all severe reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles.⁵⁹ As mentioned above, although the impact of a tornado event will be different in different parts of the County, all people and assets are considered to

⁵⁸ *La Plata MD F4 Tornado—20 Years Later, 2022, National Weather Service, https://www.weather.gov/lwx/events_20020428, (last accessed July 26, 2023).*

⁵⁹ *Severe Weather 101 – Damaging Winds, NOAA NAT'L SEVERE STORMS LAB., <https://www.nssl.noaa.gov/education/svrwx101/wind/> (last visited Apr. 3, 2023).*

have the same degree of exposure. This is the same for mesoscale and microscale wind events. The figure and table below characterize extreme temperature impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Tornado/Windstorm - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> Up to 1% of critical and non-critical infrastructure will be damaged. Some roof shingles and downed trees expected- some roads impassable. There is a need for temporary shelter.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> Zero deaths are expected. Automobile accidents, flying debris, or sheltering in an unsafe location are the most common causes of death. Zero to five injuries are expected. Automobile accidents, flying debris, or sheltering in an unsafe location are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – No critical facilities or essential functions will be out of service. <u>Information/Communications</u> – No critical facilities or essential functions will be out of service. Minor disruption to power. <u>Transportation</u> – Possible temporary road closures due to downed trees. Minor disruption to transportation.

RESPONSE CAPACITY	<i>Limited</i>	<ul style="list-style-type: none"> ▪ <u>Police</u> – Local resources adequate. Low impact to response capability or COOP. ▪ <u>Fire and Rescue</u> – Local resources adequate. ▪ <u>Health</u> – Local resources adequate. HD operations will not be affected. ▪ <u>Public Works</u> – Local resources adequate. No impact response capability and continuity of operations.
ENVIRONMENTAL IMPACT	<i>Significant</i>	<ul style="list-style-type: none"> ▪ Downed trees throughout area expected.
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Limited amount loss in dollar value.
TOTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1.0 on a scale of 1 (Limited) to 4 (Catastrophic).
	<i>Limited</i>	Significant Critical Catastrophic

Vulnerability of County Assets

According to the table above, the Tornado/Windstorm hazard event that is most likely to occur has limited impacts on County assets, except for the impacts on the environment, which are significant. Assets that are vulnerable are the following:

People

- Populations with challenges to resilience will be more vulnerable to this hazard. To review this map as well as its indicators, please refer to [Chapter 2, section FEMA's Community Resilience Index](#).
- Populations without home, car, and health insurance to recover from tornado/windstorm damages.

Structures

- All residential and commercial buildings are vulnerable to this hazard.
- Mobile homes (there are eight mobile home parks in southeastern Howard County ranging in size from small (51-100) to large (>100)). The map below depicts the locations of these mobile parks.
- Roadways (strong winds could cause trees to block important roadways).
- Critical Facilities (strong winds can level buildings, cause trees to fall on important facilities, or cause projectiles to damage buildings).
 - Areas with more vulnerability would include those important roads or structures with tree canopies over them. Taken from an assessment of Howard County's tree canopy in April 2022⁶⁰, the below map depicts these areas with bright red portions being structures with tree canopy and dark red being roads with a tree canopy covering them. The health and stability of the trees in these locations must be monitored by owners to prevent the downing or breaking of unhealthy or overgrown trees.

Systems

- Economy (fallen trees or buildings could block important roadways, such as Interstate 70 and Interstate 95).

⁶⁰ Assessment of Howard County, Maryland's Tree Canopy and Forest Cover, University of Maryland Baltimore County, Dr. Matthew Baker, April 2022, https://livegreenhoward.com/wp-content/uploads/2022/10/2018-HC-Tree-Canopy-Report_OCS UMBC-4.22.22.pdf, (last accessed July 24, 2023).

- Communications (strong winds could knock over cell towers/radio antennae).
- Emergency Services (strong winds can hinder the travel of emergency vehicles, such as ambulances and fire engines).

Natural, Historic, and Cultural Resources

- Tree Canopy (strong winds can knock down trees).
- Historic buildings in historic districts (Ellicott City and Lawyers Hill).

Activities that Have Value to the Community

- Outdoor activities, such as concerts, festivals, sports events.

This hazard causes downed trees that can damage power lines, block roads, damage homes and vehicles, and harm individuals.

FIGURE 43: MOBILE HOME PARKS IN HOWARD COUNTY

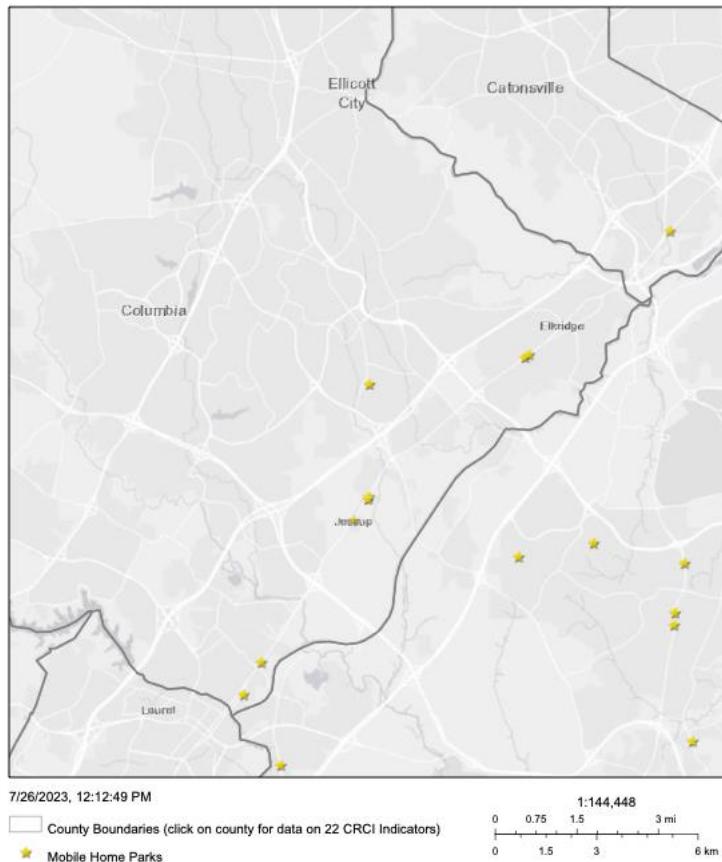
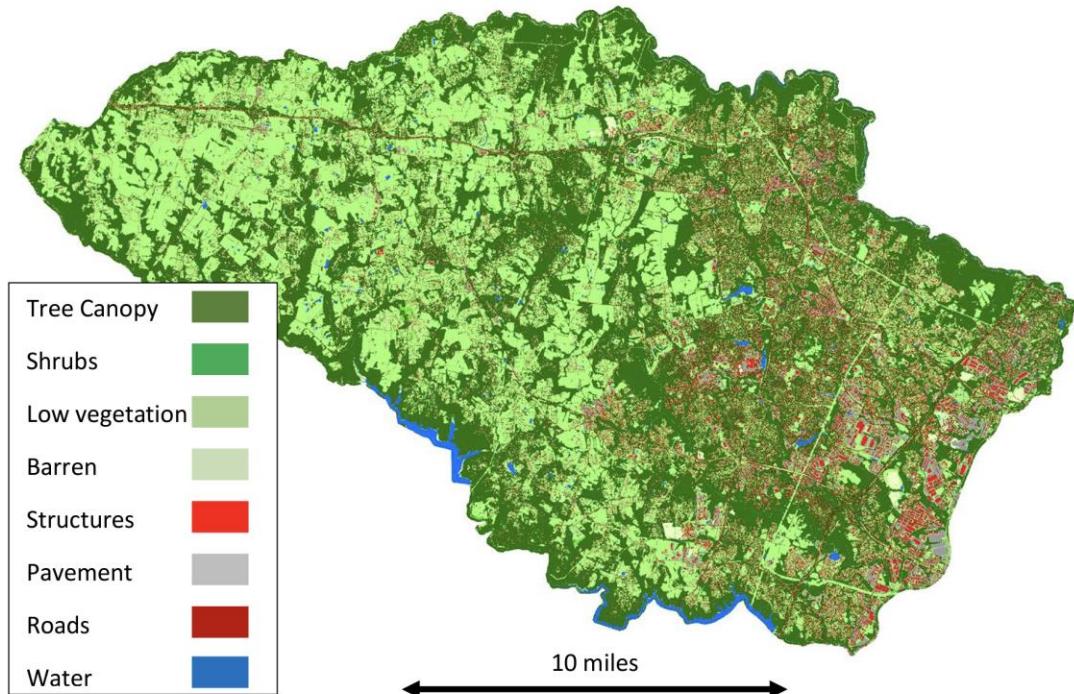


FIGURE 44: TREE CANOPIES, VEGETATION, STRUCTURES, ROADS, WATER, AND PAVEMENT MAP



Effects of Population Change and Development in Hazard-Prone Areas

As Howard County, Maryland, anticipates changes in future population density, more specifically in the Central and South-eastern portions of the County, it's important to evaluate how these demographic shifts could influence the County's vulnerability to tornadoes and wind storms. Population density can significantly impact the vulnerability and consequences of these extreme weather events, affecting public safety, infrastructure, emergency response, and community resilience. Areas with lower population density might experience fewer developments and less extensive infrastructure. This could lead to fewer buildings and structures at risk of direct impact from tornadoes and windstorms, potentially resulting in fewer casualties and less property damage. While higher population density often translates to more buildings, structures, and critical infrastructure in concentrated areas. This can elevate the potential for widespread damage and destruction during tornadoes and windstorms, leading to higher economic losses and increased recovery challenges.

Anticipating future development, particularly in areas prone to tornadoes and wind storms, requires careful consideration of how demographic shifts and urban growth could influence the County's vulnerability to these extreme weather events. Future development can lead to increased exposure of people and assets to tornadoes and wind storms. As more residential and commercial structures are built, the potential for casualties, property damage, and economic losses due to tornado impacts rises. This heightened exposure amplifies the risk posed by severe weather events. Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as

anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). The maps in Chapter 2 of this Plan show where existing high population densities are located and where future developmental activities are anticipated.

Hazard Occurrences

Tornado Events

The NCDC database reports that 18 tornadoes have occurred in Howard County between 1975 and 2022.⁶¹ The table below summarizes the 18 tornadoes that have occurred within Howard County. With a total of 18 tornado events between 1975 and 2019 Howard County experiences, on average, 1.5 tornadoes every four years. Based on this information, it is possible to infer an approximate 38% annual probability of occurrence countywide. Depending on atmospheric conditions, it is possible for any number of tornadoes to occur in any given year.

Howard County Tornado Events 1975-2022
(Source: NOAA/NCDC)

<u>Location</u>	<u>County/Zone</u>	<u>St.</u>	<u>Date</u>	<u>Time</u>	<u>T.Z.</u>	<u>Type</u>	<u>Mag</u>	<u>Dth</u>	<u>Inj</u>	<u>PrD</u>	<u>CrD</u>
Totals:								0	3	4.048M	0.00K
HOWARD CO.	HOWARD CO.	MD	07/03/1975	15:35	CST	Tornado	F0	0	0	0.00K	0.00K
HOWARD CO.	HOWARD CO.	MD	07/31/1978	19:15	CST	Tornado	F2	0	0	250.00K	0.00K
HOWARD CO.	HOWARD CO.	MD	08/28/1992	15:00	CST	Tornado	F1	0	2	2.500M	0.00K
HOWARD CO.	HOWARD CO.	MD	08/28/1992	15:20	CST	Tornado	F0	0	0	2.50K	0.00K
West Friendship	HOWARD CO.	MD	07/06/1995	16:07	EST	Tornado	F0	0	0	75.00K	0.00K
COLUMBIA	HOWARD CO.	MD	08/27/1996	13:50	EST	Tornado	F0	0	0	15.00K	0.00K
SAVAGE	HOWARD CO.	MD	07/10/2000	16:30	EST	Tornado	F1	0	0	50.00K	0.00K
NORTH LAUREL	HOWARD CO.	MD	09/24/2001	16:41	EST	Tornado	F2	0	0	1.000M	0.00K
ALPHA	HOWARD CO.	MD	07/31/2009	13:42	EST-5	Tornado	EF1	0	0	0.00K	0.00K
WATERSVILLE JCT	HOWARD CO.	MD	06/01/2012	13:52	EST-5	Tornado	EF1	0	0	5.00K	0.00K
SCAGGSVILLE	HOWARD CO.	MD	06/01/2012	15:29	EST-5	Tornado	EF0	0	0	100.00K	0.00K
SAVAGE	HOWARD CO.	MD	10/15/2014	12:13	EST-5	Tornado	EF0	0	0	0.00K	0.00K
SAVAGE	HOWARD CO.	MD	09/29/2015	21:05	EST-5	Tornado	EF0	0	0	0.00K	0.00K
FLORENCE	HOWARD CO.	MD	06/21/2016	12:29	EST-5	Tornado	EF0	0	0	0.00K	0.00K
LONG CORNER	HOWARD CO.	MD	11/02/2018	19:19	EST-5	Tornado	EF1	0	0	0.00K	0.00K
HIGHLAND	HOWARD CO.	MD	05/23/2019	14:27	EST-5	Tornado	EF1	0	1	0.00K	0.00K
KNOLLWOOD	HOWARD CO.	MD	05/30/2019	14:20	EST-5	Tornado	EF1	0	0	0.00K	0.00K
GUILFORD	HOWARD CO.	MD	07/29/2021	16:07	EST-5	Tornado	EF0	0	0	50.00K	0.00K
Totals:								0	3	4.048M	0.00K

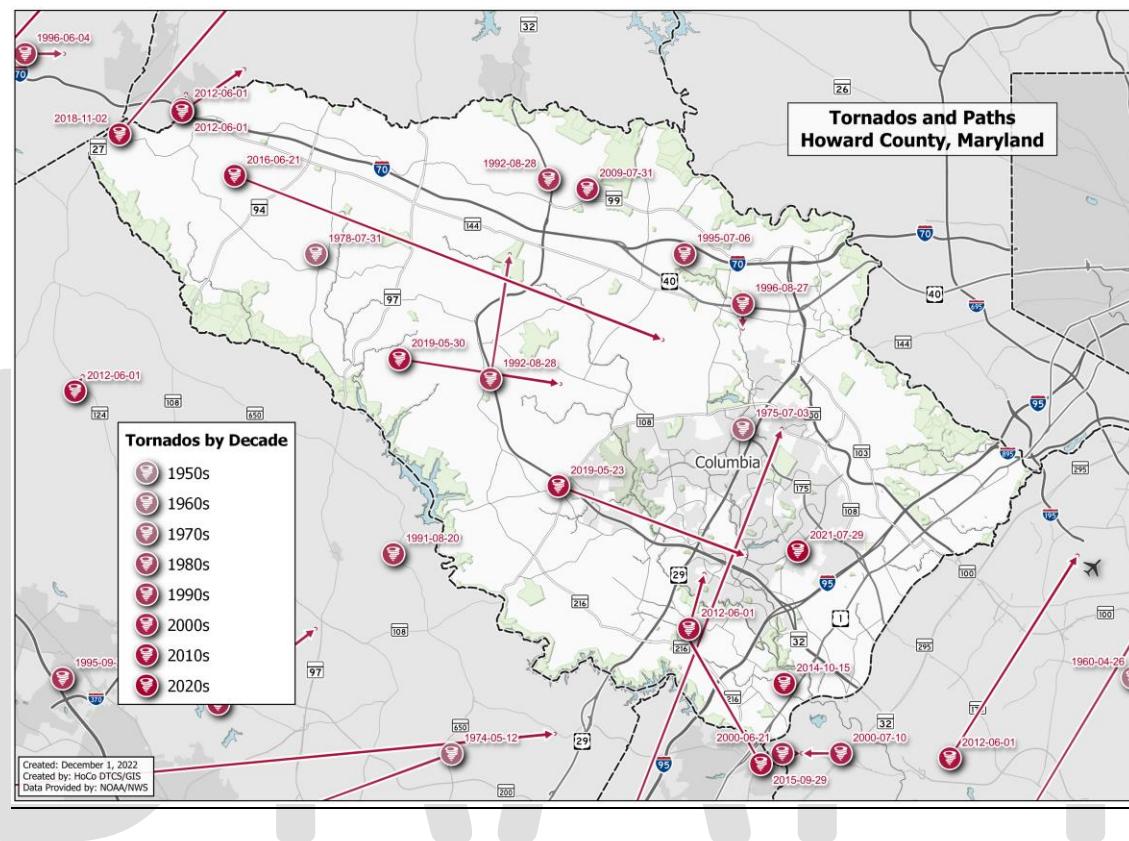
⁶¹ *Storm Events Database*. NOAA NAT'L CTRS. FOR ENV'T INFO.,

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=9999&endDate_mm=12&endDate_dd=31&endDate_yyyy=9999&county=HOWARD%3A27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND (last visited Apr. 3, 2023).

The figure below identifies the tornado tracks for Howard County and the surrounding area between 1950 and 2022.⁶²

FIGURE 45: TORNADO TRACKS FOR HOWARD COUNTY AND SURROUNDING AREA, 1950-2022

(Source: NOAA, Howard County GIS)



Notable Tornado Incidents in Howard County

**The damage figures have been adjusted for inflation and are detailed in 2022-dollar values

July 1978	On July 31 st , 1978 (EF2), a tornado was estimated to be 40 yards wide and travelled for a length of $\frac{8}{10}$ mile, causing \$1.2 million in damage.
July 1996	On July 6 th , 1996 (EF0), a small tornado briefly touched down in a wooded area, just south of Interstate 70 near the Marriottsville Road Exit. The tornado was only 20 yards wide and traveled $\frac{1}{10}$ mile. One house between Marriottsville and Ellicott City was heavily damaged by a falling tree. In total, an estimated \$192,982 in property damage occurred.
August 1996	On August 27 th , 1996 (EF0), a small tornado caused damage to several subdivisions along Frederick Road north of Columbia. A total of four trees were knocked down, including two trees that were blown into a home on Pine Bluffs Drive. The NCDC database estimates that there was \$38,558 in property damages.
July 2000	On July 10 th , 2000 (EF1), the tornado touched down three miles southeast of Savage. It brought down several trees and power lines. It also blew over two trailers and three

⁶² This data does not contain Howard County's most recent tornadoes, including tornadoes that occurred after 2015.

	semi-tractor trailers. In Howard County, the tornado was 100 yards wide and traveled $\frac{6}{10}$ mile before moving into Anne Arundel County. The tornado resulted in \$106,763 in property damage.
September 2001	On September 24 th , 2001 (EF2-EF3), a tornado originated in Prince George's County as an EF3 and travelled north-northeast from Hyattsville, through College Park, and into Laurel. Along its destructive path, the tornado killed two and injured 55. Just before the tornado crossed into Howard County, it weakened from an EF3 to an EF2 tornado. In Howard County, the tornado caused severe damage to several townhomes in Settler's Landing, a subdivision in North Laurel. As the tornado continued northward, it slowly dissipated and ended one mile east-southeast of Columbia. The tornado traveled a total distance of six miles in Howard County and had a width of 100 yards. Along its destructive path, the tornado uprooted trees, blew off rooftops, and blew out car windows. Many homes were deemed unsafe for a period, and one was severely damaged. Property damage in Howard County was estimated at \$166.1 million. The figure below shows the College Park tornado track as it moved northeast from Beltsville to Laurel.
June 2012	On June 1 st , 2012 (EF1), a tornado traveled 2.07 miles in Watersville Junction. Property damage totaled to \$6,395. Roughly, 30-40 large hardwood trees were uprooted or snapped
June 2012	On June 1 st , 2012 (EF0), a tornado traveled 1.58 miles in Scaggsville. It brought down several trees, caused roof damage to several homes, and a Day Care Center's chimney blew over. The property damage totaled to \$127,915 according to the NCDC/NOAA database.
June 2016	On June 30 th , 2016 (EF0), a tornado traveled nearly 13 miles through Western Howard County. There were no injuries or deaths associated, hundreds of trees were knocked down and several homes had serious damage from falling debris. The path of debris was over 500 yards wide at some points.
November 2018	On November 2 nd , 2018 (EF1), a tornado traveled 0.59 miles through Long Corner. There were no deaths or injuries reported, however, several wooden power poles were snapped along Penn Shop Road according to the NCDC/NOAA database.
May 2019	On May 23 rd , 2019 (EF1), a tornado traveled 5.53 miles through Highland, near Clarksville. There was one injury reported and no deaths according to the NCDC/NOAA database. Several trees were uprooted or snapped, one falling onto the roof of a house. Additionally, an office building lost part of its roof.
May 2019	On May 30 th , 2019 (EF1), a tornado traveled 4.49 miles through Knollwood. There were no deaths or injuries reported according to the NCDC/NOAA database. The tornado ripped sections of roofing desk from homes, ripped off barn roofing, uprooted trees, and downed powerlines. Additionally, the tornado damaged the Howard County highway maintenance facility. At the facility, the tornado ripped off its tin roofing, damaged some roof framing, tore a large section of fabric from a salt dome, destroyed garage bay doors, and damaged fencing.

Windstorm Events

Windstorms are broken down into two categories, thunderstorm winds and high wind events based on how data is recorded in the NCDC. The NCDC database reports that 232 thunderstorm and high wind event(s) have occurred in Howard County between 1969 and September 2019.⁶³ Of the 232 events, 37 included winds of 60 kts (69 mph) or greater.⁶⁴

The database indicates that there were eight thunderstorm wind events that caused at least \$50,000 damages since 1950. On May 15th, 1994, a thunderstorm, with winds exceeding 50 kts, damaged several homes and knocked down numerous trees in the central and eastern portions of the County. The total impact was estimated to be \$85,301 in property damages. On May 13th, 2002, a 75-mph downburst occurred within a 10 square block area Northwest of Ellicott City. Numerous trees were downed, and the downburst caused widespread power outages. Two homes were heavily damaged by downed trees. The estimated total property damage for the downburst was \$212,488.

With a total of 232 thunderstorm/high wind events between 1969 and 2019, Howard County experiences on average 4.6 thunderstorm/high wind events per year. With about five per year, there is a 100% annual probability of a thunderstorm wind event occurring in Howard County. Based on the history of past thunderstorm/high wind events, there is a high probability of these events occurring in Howard County in the future. Although the probability is high, the impact on life and property in the County will probably be minimal as compared to other hazards. The table below summarizes the seven thunderstorm/high wind Events in Howard County with greater than 60 kt winds since 2017.

⁶³ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO., [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=\(C\)+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1969&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27a&ndhailfilter=0.00&dtornfilter=0&windfilter=000&sort=D&submitbutton=Search&statefips=24,MARYLAND](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=(C)+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1969&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27a&ndhailfilter=0.00&dtornfilter=0&windfilter=000&sort=D&submitbutton=Search&statefips=24,MARYLAND) (last visited Apr. 3, 2023).

⁶⁴ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO., [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=\(C\)+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1969&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27a&ndhailfilter=0.00&dtornfilter=0&windfilter=000&sort=D&submitbutton=Search&statefips=24,MARYLAND](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=(C)+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1969&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27a&ndhailfilter=0.00&dtornfilter=0&windfilter=000&sort=D&submitbutton=Search&statefips=24,MARYLAND) (last visited Apr. 3, 2023).

**Howard County: Thunderstorm Wind Events Over 60 Knots,
Excluding Tornado Winds, 2017 – 2022**
(Source: NOAA/NCDC)

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	1.170M	0.00K
LISBON	HOWARD CO.	MD	03/01/2017	13:40	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
LONG CORNER	HOWARD CO.	MD	11/02/2018	19:18	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
HIGHLAND	HOWARD CO.	MD	05/23/2019	14:23	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
CLARKSVILLE	HOWARD CO.	MD	05/23/2019	14:30	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
GLENELG	HOWARD CO.	MD	05/23/2019	14:30	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
SAVAGE	HOWARD CO.	MD	05/23/2019	14:32	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
SAVAGE	HOWARD CO.	MD	05/23/2019	14:36	EST-5	Thunderstorm Wind	70 kts. EG	0	0	0.00K	0.00K
ALPHA	HOWARD CO.	MD	05/26/2019	20:13	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
MC ALPINE	HOWARD CO.	MD	06/22/2020	16:45	EST-5	Thunderstorm Wind	60 kts. EG	0	0	150.00K	0.00K
DAISY	HOWARD CO.	MD	08/13/2021	15:45	EST-5	Thunderstorm Wind	60 kts. EG	0	0	20.00K	0.00K
OAKLAND MILLS	HOWARD CO.	MD	06/08/2022	18:50	EST-5	Thunderstorm Wind	65 kts. EG	0	0	1.000M	0.00K
Totals:								0	0	1.170M	0.00K

65

Additional Significant thunderstorm/windstorm events that have impacted Howard County are described below. For purpose of this document a significant thunderstorm/high wind event is an event over 60 kt wind speeds.

Notable Windstorm Incidents in Howard County

**The damage figures have been adjusted for inflation and are detailed in 2022-dollar values

July 1996	On July 30th, 1996, a severe thunderstorm moved from east to west across the County. The storm brought down trees and power lines and caused an estimated \$24,237 in property damage and another \$3,635 in crop damage.
August 2003	On August 26 th , 2003, a line of severe thunderstorms with winds up to 78 mph moved across the County during the afternoon hours. There were numerous reports of downed trees and power lines throughout the County and caused an estimated \$23,838 in property damage.
June 2006	On June 1 st , 2006, a strong storm system moved through the area. The winds from these storms caused \$36,364 in damage.
September 2006	On September 28 th , 2006, as a cold front moved into the region during the afternoon, it spawned several thunderstorms. The most intense thunderstorm occurred along the Interstate 95 Corridor. In total, the storms caused an estimated \$50,910 in property damage.
June 2012	On June 29 th , 2012, a linear formation of strong thunderstorms, known as a derecho, traveled from the Midwest (Indiana) to the Mid-Atlantic region, impacting the County. The straight-line winds related to this event were above 60 mph, with reports of winds exceeding 80 mph. the damage to trees and electric power infrastructure was extensive and widespread. In total, the storms caused \$37,494 in reported property damage.

⁶⁵ Storm Events Database, NOAA NAT'L CTRS. FOR ENV'T INFO., https://www.ncdc.noaa.gov/stormevents/listevents.jsp?windfilter=060&sort=DT&statefips=24%2CMARYLAND&county=HOWARD%2A27&eventType=%28C%29+Thunderstorm+Wind&beginDate_yyyy=2017&beginDate_mm=01&beginDate_dd=01&endDate_yyyy=2022&endDate_mm=12&endDate_dd=31 (last visited Apr. 3, 2023).

NOAA categorized high wind events separately on their database. There were eight high wind events reported between 1950 and October 2019 in Howard County. Additionally, there was only one significant high wind event reported between 1950 and October 2019. That event occurred in Long Corner, Howard County, Maryland, on November 2nd, 1997, causing \$1,598 in property damage.⁶⁶

Howard County: High Winds from 1950 to October of 2019 (Source: NOAA/NCDC)

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	0.00K	0.00K
CENTRAL AND SOUTHEAST HOWARD (...)	CENTRAL AND SOUTHEAST HOWARD (...)	MD	02/14/2015	11:15	EST-5	High Wind	50 kts. MG	0	0	0.00K	0.00K
CENTRAL AND SOUTHEAST HOWARD (...)	CENTRAL AND SOUTHEAST HOWARD (...)	MD	04/03/2016	09:08	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
NORTHWEST HOWARD (ZONE)	NORTHWEST HOWARD (ZONE)	MD	02/12/2017	22:55	EST-5	High Wind	52 kts. EG	0	0	0.00K	0.00K
CENTRAL AND SOUTHEAST HOWARD (...)	CENTRAL AND SOUTHEAST HOWARD (...)	MD	02/12/2017	22:58	EST-5	High Wind	52 kts. EG	0	0	0.00K	0.00K
CENTRAL AND SOUTHEAST HOWARD (...)	CENTRAL AND SOUTHEAST HOWARD (...)	MD	03/02/2018	05:00	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
NORTHWEST HOWARD (ZONE)	NORTHWEST HOWARD (ZONE)	MD	03/02/2018	05:00	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
NORTHWEST HOWARD (ZONE)	NORTHWEST HOWARD (ZONE)	MD	02/25/2019	04:21	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
CENTRAL AND SOUTHEAST HOWARD (...)	CENTRAL AND SOUTHEAST HOWARD (...)	MD	02/25/2019	04:21	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
Totals:								0	0	0.00K	0.00K

67

Hazard Future Likelihood- High

SMEs considered that the future likelihood of tornadoes occurring within the County may increase due to climate change and the recent pattern of the storms occurring more frequently within the County. The future annual probability of the event is 11-30% chance of annual occurrence, or one event every three to nine years. Based on the history of tornadoes in Howard County there is a high probability of future tornadoes occurring in the County.

The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

⁶⁶ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO.,

[https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=\(Z\)+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24,MARYLAND](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=(Z)+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24,MARYLAND) (last visited Apr. 3, 2023).

⁶⁷ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO.,

[https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=\(Z\)+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24,MARYLAND](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=(Z)+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=10&endDate_dd=01&endDate_yyyy=2019&county=HOWARD:27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24,MARYLAND) (last visited Apr. 3, 2023).

Future Likelihood of a Tornado/Windstorm in Howard County	
Historical Average (time period)	18 events (1975-2022)
Historical Annual Probability	30%+ chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	11-30% chance of annual occurrence
Future Likelihood Score	3 (Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Drought (Risk Score 2.0)

Hazard Description

According to NOAA, Drought is a complex phenomenon which is difficult to monitor and define. Drought is the *absence* of water. It is a creeping phenomenon that slowly sneaks up and impacts many sectors of the economy and operates on many different time scales. Drought usually refers to a period of below-normal rainfall but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. The climatological community has defined four types of drought:⁶⁸

- Meteorological drought - happens when dry weather patterns dominate an area.
- Hydrological drought- occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought.
- Agricultural drought - happens when crops become affected.
- Socioeconomic drought - relates the supply and demand of various commodities to drought.

The following table presents the Risk Score for drought in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Drought Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
Likelihood		2.4 Infrequent-Likely		50%
Impact		1.3 Limited-Significant	2.7 Significant-Critical	40%
Warning Time		1	1	5%

⁶⁸ Definition of Drought, NOAA NAT'L CTRS. FOR ENV'T INFO., <https://www.ncdc.noaa.gov/monitoring-references/dyk/drought-definition> (last accessed Mar. 22, 2023).

	Very Long	Very Long	
Duration	4 Very Long	4 Very Long	5%
TOTAL RISK SCORE	2.0	2.5	

Hazard Location

Drought is a recurring feature of nearly all the world's climatic regions, and it may occur anywhere in the United States.⁶⁹ Different regions may be affected by drought conditions differently, depending on normal meteorological conditions (such as precipitation and temperature) and geological conditions (such as soil type and subsurface water levels).

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

Hazard Extent

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other factors, such as high temperatures, high winds, and low humidity. This can also increase the risk of wildfires. Due to its multi-dimensional nature, drought is difficult to define in exact terms, which makes comprehensive risk assessments difficult. One method used by scientists to calculate the severity and duration of a drought is the Palmer Drought Severity Index (PDSI). The PDSI "uses readily available temperature and precipitation data to estimate relative dryness⁷⁰. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather⁷¹.

The equation for the PDSI was empirically derived from the monthly temperature and precipitation scenarios of 13 instances of extreme drought in Western Kansas and Central Iowa and by assigning an index value of -4 for these cases. Conversely, a +4 represents extremely wet conditions. From these values, seven categories of wet and dry conditions can be defined. The table below identifies when values used to define the PDSI.

⁶⁹ For additional information about droughts, visit the National Integrated Drought Information System (NIDIS), www.drought.gov (last accessed September 24, 2022).

⁷⁰ Climate Data Palmer Drought Severity Index (PDSI), NCAR Climate Data Guide, <https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi>, (last accessed July 25, 2023).

⁷¹ Explanation, National Weather Service Climate Prediction Center, https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/wpdanote.shtml, last accessed July 25, 2023).

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

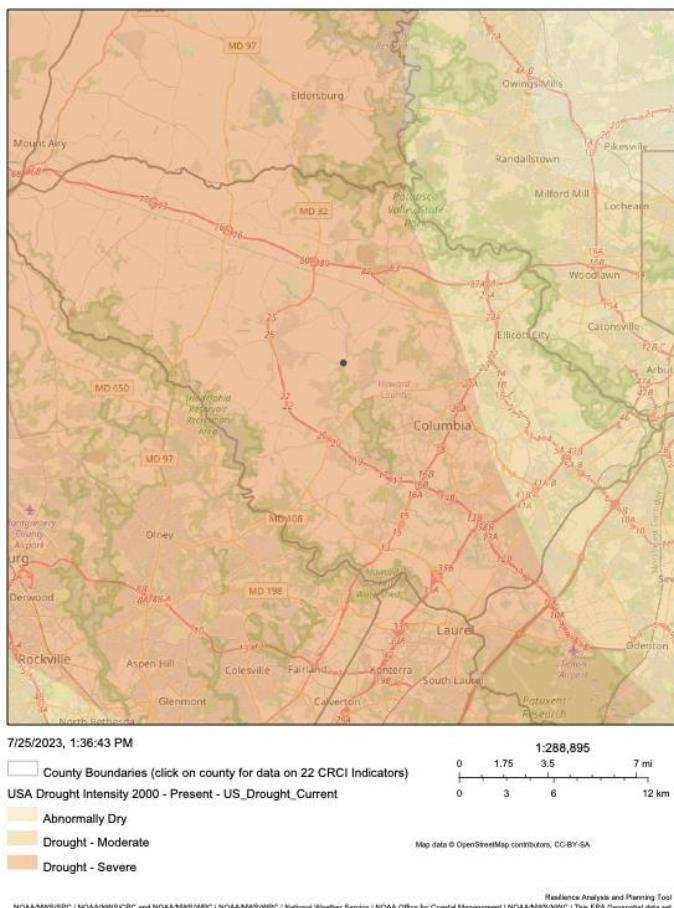
Another tool to measure drought intensity is the U.S. Drought Monitor's GIS layer managed by Esri "USA Drought Intensity 2000-Present". This layer incorporates weekly updates gathered since the year 2000 on drought conditions and classifies drought intensity according to the "deviation of precipitation, stream flow, and soil moisture content from historically established norms, in addition to subjective observations and reported impacts from more than 350 partners across the country"⁷². The Drought Classification Categories that this layer uses are the following:

Class	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slows growth of crops/pastures. Coming out of drought: some lingering water deficits; drops/pastures not fully recovered.
D1	Moderate Drought	Some damage to crops/pastures; streams, reservoirs, or wells are low with some water shortages developing or imminent; voluntary water-use restrictions requested.
D2	Severe Drought	Crop/pasture losses are likely; water shortages are common and water restrictions are imposed.
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions.
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies.

⁷² USA Drought Intensity 2000-Present, Esri,
<https://fema.maps.arcgis.com/home/item.html?id=9731f9062af45f2be7b3bf2e050fbfa>, (last accessed July 24, 2023).

The map below depicts this layer for Howard County. Most of Howard County falls into the “D2: Severe Drought” red shaded area, whereas a small portion of the eastern part of the County falls into “D1: Moderate Drought”. This means that when drought occurs in the eastern portion of the County, it tends to be severe, and when it occurs in the western portion, it tends to be moderate.

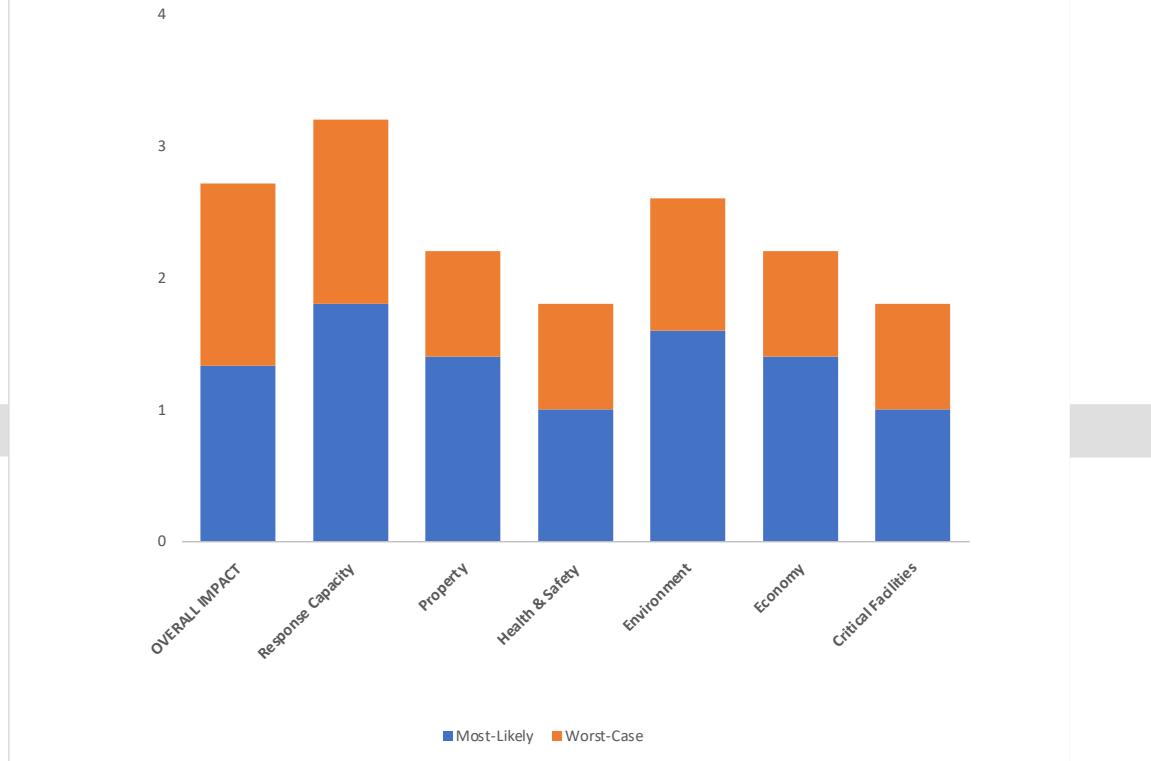
FIGURE 46: DROUGHT INTENSITY 2000-PRESENT (2023)



Hazard Impacts

The figure and table below characterize drought impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.

DROUGHT IMPACT



Drought - Consequence Analysis

Likely

CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited-Significant	<ul style="list-style-type: none"> 0% of critical and non-critical infrastructure damage if water service is uninterrupted. Damaged landscaping is expected and farmers experience crop pasture loss.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> Zero to five injuries are expected. Dehydration, heat exhaustion, and heat stroke are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – No facility shut down or out of service is expected. Voluntary restrictions may be imposed. <u>Information/Communications</u> – No shutdown. No major impact on information or communications infrastructure. <u>Transportation</u> – No delays or shutdowns expected.
RESPONSE CAPACITY	Limited-Significant	<ul style="list-style-type: none"> <u>Police</u> – Local resources adequate. Minimal impact to response capability by law enforcement. <u>Fire and Rescue</u> – Local resources adequate. Limited impact on the response capability, primarily to allow rehabilitation for crews working extended operations. Some stress on fire suppression operations, particularly in western end of the County where drafting is required for water access. <u>Health</u> – Local resources adequate. HD operations will not be affected and will monitor the extreme heat incident from the Health Department Operations Center (HDOC).

ENVIRONMENTAL IMPACT	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Temporary spike in air pollution. ▪ There may be slightly higher levels of water pollution as decreased water levels lead to increased concentrations of contaminants. 	
ECONOMIC IMPACT	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Limited economic consequences. Probable shift in hours of construction projects and other outdoor projects. ▪ Farmers within the County experience crop pasture loss which may result in higher prices for produce. 	
TOTAL IMPACT	<i>Limited-Significant</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1.3 on a scale of 1 (Limited) to 4 (Catastrophic). 	
<i>Limited</i>	<i>Significant</i>	<i>Critical</i>	<i>Catastrophic</i>

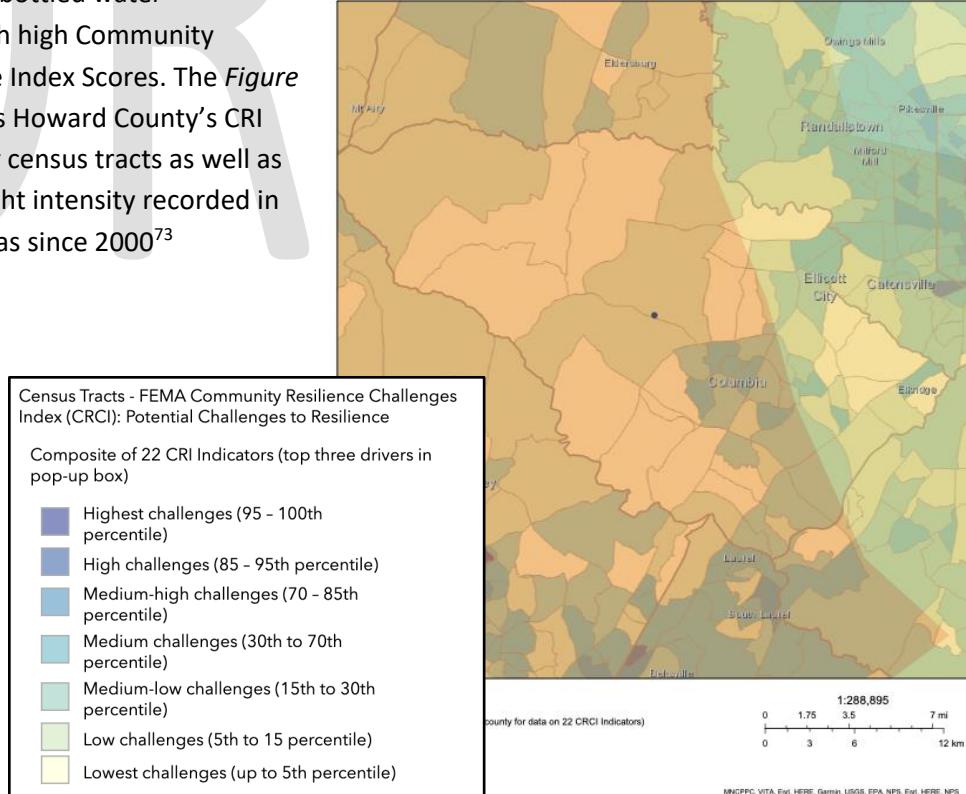
Vulnerability of County Assets

Drought can impact multiple County assets depending on its intensity. Assets that are vulnerable are the following:

People

- Farmers (most farms located in western Howard County)
- People with agriculture-based livelihoods
- Households without vehicles to access bottled water
- Areas with high Community Resilience Index Scores. The Figure 47 depicts Howard County's CRI scores for census tracts as well as the drought intensity recorded in these areas since 2000⁷³

**FIGURE 47: COMMUNITY RESILIENCE INDEX & DROUGHT INTENSITY
2000- 2023**



⁷³ USA Drought Intensity 2000-Present, Esri,

<https://fema.maps.arcgis.com/home/item.html?id=9731f9062af45f2be7b3bf2e050fbfa>, (last accessed July 24, 2023).

Structures

- All residential and commercial buildings are affected by drought.
- Water supply (Washington Suburban Sanitary Commission in Laurel and Baltimore City)
- Water treatment (Little Patuxent Water Reclamation Plant).

Systems

- Firefighting capabilities in areas where water must be shuttled to the location.
- Economic capabilities (reduced crop productivity).

Natural, Historic, and Cultural Resources

- Outdoor cultural activities could be hindered or canceled due to weather conditions as droughts are associated with increased temperatures and heat-related illness.

Activities that Have Value to the Community

- Lakes for recreation, such as Lake Kittamaqundi, Centennial Lake, Lake Elkhorn, Scott's Cove Recreation Area, Triadelphia Reservoir, and Wilde Lake (lower water depth, damage to fish habitat, damage to wildlife).
- Camping activities in Patapsco State Park (damage to wildlife, closed off camping areas, higher risk for fires).

Effects of Population Change and Development in Hazard-Prone Areas

As Howard County, Maryland, anticipates changes in future population density, particularly with noticeable growth projected in central and south-eastern regions, it's important to assess how these demographic shifts could influence the County's vulnerability to drought. Population density can significantly impact water demand, supply, and management, affecting the severity and consequences of drought events. The higher population densities, especially around Columbia and Ellicott City, can stress local water sources, including rivers, reservoirs, and groundwater aquifers. As more water is withdrawn to meet the needs of a growing population, these sources may become more vulnerable to depletion during droughts, impacting both water availability and quality. Higher population density areas require robust water infrastructure to ensure equitable and reliable water distribution. During droughts, increased demand can stress distribution systems, potentially leading to water shortages, pressure fluctuations, and challenges in providing adequate water to all residents. Vulnerable communities, such as low-income households or those with chronic health conditions, may face challenges in accessing clean water resources during droughts.

Future development can alter natural hydrological processes by increasing impervious surfaces such as roads, buildings, and parking lots. This reduces the ability of the land to absorb rainwater, leading to increased runoff and reduced groundwater recharge. These changes can exacerbate drought conditions by disrupting the natural water cycle. Developments in drought-prone areas require resilient water infrastructure to ensure consistent water supply. During droughts, higher water demand from newly developed areas can stress distribution systems, leading to pressure fluctuations, potential water shortages, and challenges in providing adequate water to residents. Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future

development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). These sections help identify where existing high population densities are located and where future developmental activities are anticipated.

Hazard Occurrences

According to the NCDC database, Howard County experienced 12 drought events from 1997 to 2022. All 13 events occurred before 2007. The database does not show any drought events occurring in Howard County since 2007.⁷⁴ The U.S. Drought Monitor lists an additional 11 events since 2007 where some part of Howard County was in a D1 drought stage. For nine of those events since 2007, more than 50% of the County was in at least a D1 drought stage.⁷⁵

The graph below depicts occurrences of drought in Maryland from 2000 to 2022. The graph also shows the severity of the droughts using the U.S. Drought Monitor's⁷⁶ drought ratings:

D0 - Abnormally Dry	<ul style="list-style-type: none">• Short-term dryness slowing planting, growth of crops• Some lingering water deficits• Pastures or crops not fully recovered
D1 – Moderate Drought	<ul style="list-style-type: none">• Some damage to crops, pastures• Some water shortages developing• Voluntary water-use restrictions requested
D2 – Severe Drought	<ul style="list-style-type: none">• Crop or pasture loss likely• Water shortages common• Water restrictions imposed
D3 – Extreme Drought	<ul style="list-style-type: none">• Major crop/pasture losses• Widespread water shortages or restrictions
D4 – Exceptional Drought	<ul style="list-style-type: none">• Exceptional and widespread crop/pasture losses• Shortages of water creating water emergencies

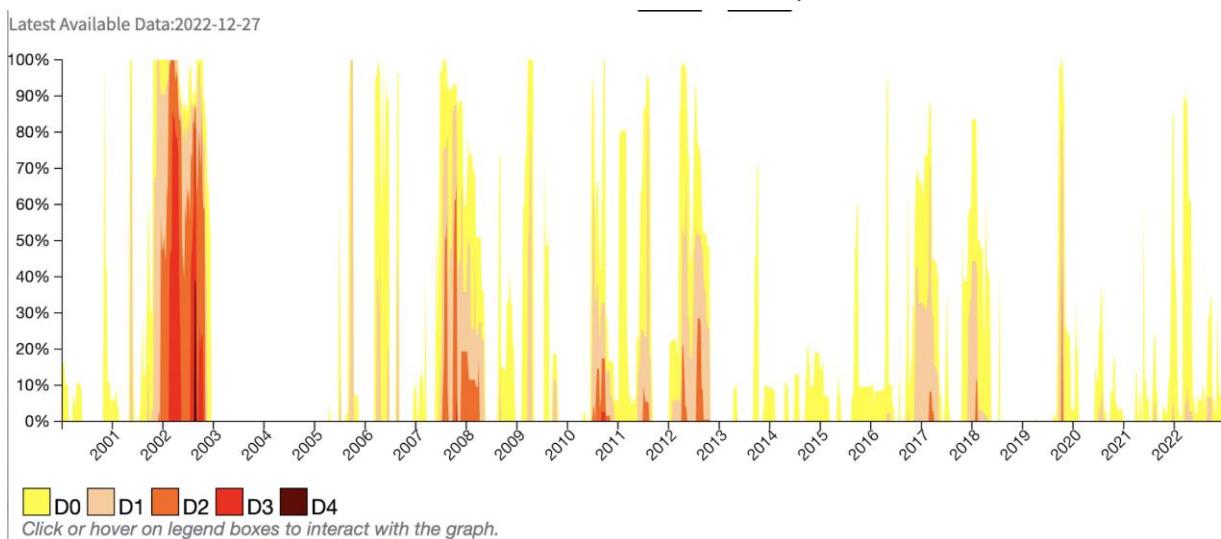
⁷⁴ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO.,

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28%29+Drought&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1997&endDate_mm=12&endDate_dd=31&endDate_yyyy=2022&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND# (last visited Apr. 3, 2023).

⁷⁵ *Data & Maps -- Historical Data and Conditions*, NAT'L INTEGRATED DROUGHT INFO. Sys., <https://www.drought.gov/historical-information?state=maryland&countyFips=24027&dataset=0&selectedDateUSDM=20191015&selectedDateSpi=19581201> (last visited Apr. 3, 2023).

⁷⁶ *What is the USDM*, U.S. DROUGHT MONITOR, <https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx> (last visited Apr. 3, 2023).

FIGURE 48: HISTORICAL DROUGHT IN MARYLAND, 2000-2022⁷⁷



Hazard Future Likelihood – Medium

Given the increased variability and intensity of precipitation due to climate change, there is some uncertainty about the future probability of drought in Howard County. Some mitigating factors include the development of drought-resistant crops and Howard County utilizing water from a variety of external jurisdictions. The future annual probability of a drought is given a 1-30% chance of annual occurrence, or one event every 3-99 years. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Drought in Howard County	
Historical Average (time period)	23 events (1997-2022)
Historical Annual Probability	30+% chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	Yes
Future Annual Probability	1-30% chance of annual occurrence
Future Likelihood Score	2.4 (Infrequent-Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Hurricane/Tropical Cyclone (Risk Score 1.8)

Hazard Description

Hurricanes, tropical storms, tropical depressions, and typhoons are classifications of Tropical Cyclones. For the purposes of this document, the hazard will be referred to as “Hurricane/Tropical Cyclone” as hurricane is the more commonly associated name with this hazard. NOAA defines a tropical cyclone as a “warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with

⁷⁷ Current U.S. Drought Monitor Conditions for Maryland, NAT'L INTEGRATED DROUGHT INFO. Sys., <https://www.drought.gov/drought/states/maryland?places=Howard+County,+MD,+USA> (last visited Apr. 3, 2023).

organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere.”⁷⁸

“Tropical cyclones rotate counterclockwise in the Northern Hemisphere. They are classified as follows:

- Tropical Depression: A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- Tropical Storm: A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots). A storm of this magnitude is given a “name” once it reaches tropical storm intensity.
- Hurricane: A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
 - A hurricane can be described as a well-defined low-pressure system with circulation around the “eye” or center of the storm.⁷⁹
- Major Hurricane: A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Tropical cyclones forming between five- and 30-degrees North latitude typically move toward the west. Sometimes the winds in the middle and upper levels of the atmosphere change and steer the cyclone toward the north and northwest. When tropical cyclones reach latitudes near 30 degrees North, they often move northeast.”⁸⁰ The table below provides a concise explanation of each tropical cyclone category.⁸¹

Tropical Cyclone - Wind Speeds Categories

(Source: NOAA)

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

⁷⁸ *Glossary of National Hurricane Center Terms*, NAT'L HURRICANE CTR. & CENT. PACIFIC HURRICANE CTR., <http://www.nhc.noaa.gov/aboutgloss.shtml#TROPCYC> (last visited Apr. 3, 2023).

⁷⁹ *Hurricane FAQs*, NOAA, <https://www.aoml.noaa.gov/hrd/tcfaq/A11.html> (last visited Apr. 3, 2023).

⁸⁰ *Glossary of National Hurricane Center Terms*, NAT'L HURRICANE CTR. & CENT. PACIFIC HURRICANE CTR., <http://www.nhc.noaa.gov/aboutgloss.shtml#TROPCYC> (last visited Apr. 3, 2023).

⁸¹ See NAT'L HURRICANE CTR. & CENT. PACIFIC HURRICANE CTR., <http://www.nhc.noaa.gov/> (last visited Apr. 3, 2023).

Category	Wind Speed	Definition
Major Hurricane	111+ mph	Category 3, 4, and 5 hurricanes are considered major hurricanes. See the Saffir-Simpson Scale definitions below for more information about these hurricanes.

The following table presents the Risk Score for Hurricane/Tropical Cyclone in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Hurricane/Tropical Cyclone Risk Profile				
LIKELIHOOD	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	3 Likely		50%
CONSEQUENCE	Impact	1.1 Limited-Significant	3.1 Critical-Catastrophic	40%
	Warning Time	1 Very Long	1 Very Long	5%
	Duration	2 Moderate	3 Long	5%
TOTAL RISK SCORE		2.1	3.07	

Hazard Location

Tropical cyclone risk in the United States extends along the entire East Coast (from Florida to Maine), the Gulf Coast, and Hawaii. Historical storm tracks show that the southern Atlantic Coast and the Gulf Coast are at the greatest risk. As one moves further inland and/or north along the Atlantic Coast where colder ocean waters persist, the threat of powerful hurricanes diminishes. However, the threat of tropical storms and remnants of hurricanes is still prevalent. The greatest threat for the occurrence of a tropical cyclone in Howard County is during the Atlantic Hurricane season, which runs from June 1st to November 30th each year. The hurricane/tropical cyclone hazard has the potential to affect the entire County.

While there is potential for hurricane force winds to occur in Howard County, its inland location removes it from the Atlantic coastline and places it north of the warm Carolina waters. Instead, its location makes the County more vulnerable to tropical storms and tropical depressions.

Hazard Extent

The severity of hurricanes and tropical cyclones is measured primarily by wind velocity, surface pressure, and storm surge. Hurricane severity is measured by the Saffir-Simpson Scale, which classifies hurricanes on a number scale of one to five, based on factors, such as wind speed, storm surge height, and

potential damage. The higher the number, the more severe the storm. The table below depicts the potential effects of wind damage during a hurricane event.

Saffir-Simpson Hurricane Wind Scale⁸²

(Source: NHC and NOAA)

Category	Sustained Winds	Damage Level	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	Minimal	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	Moderate	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks
3 (Major)	111-129 mph 96-112 kt 178-208 km/h	Extensive	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (Major)	130-156 mph 113-136 kt 209-251 km/h	Extreme	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (Major)	157 mph or higher 137 kt or higher 252 km/h or higher	Catastrophic	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Since 1950, there has not been a hurricane that has passed directly over Howard County, due to most storms downgrading to either tropical cyclone or tropical depressions by the time they reach the region.

⁸² Saffir-Simpson Hurricane Wind Scale, NAT'L HURRICANE CTR. & CENT. PACIFIC HURRICANE CTR., <https://www.nhc.noaa.gov/aboutsshws.php> (last visited Apr. 3, 2023).

However, hurricanes or tropical cyclones/depressions do pass close enough to bring heavy rain and increased high winds to the County. In the “[Hazard Occurrences](#)” section below for this hazard, a map depicts all storm tracks that occurred within 100 miles of Howard County from 1950-2021.

Hazard Impacts

Tropical cyclones are among the most financially devastating naturally occurring hazards in the United States. Hurricanes, the strongest type of the tropical cyclones in the United States, generate hazards that can cause extensive damage such as high winds, heavy rainfall, tornadoes, and storm surge. Below, you can see evidence of the damage left behind by different storms in Howard County.

FIGURE 49: FLOODING IN THE VALLEY MEDE SUBDIVISION



*Source: Howard County Office of Emergency Management

FIGURE 50: TROPICAL STORM LEE: FLOODING ALONG MAIN STREET ELLICOTT CITY



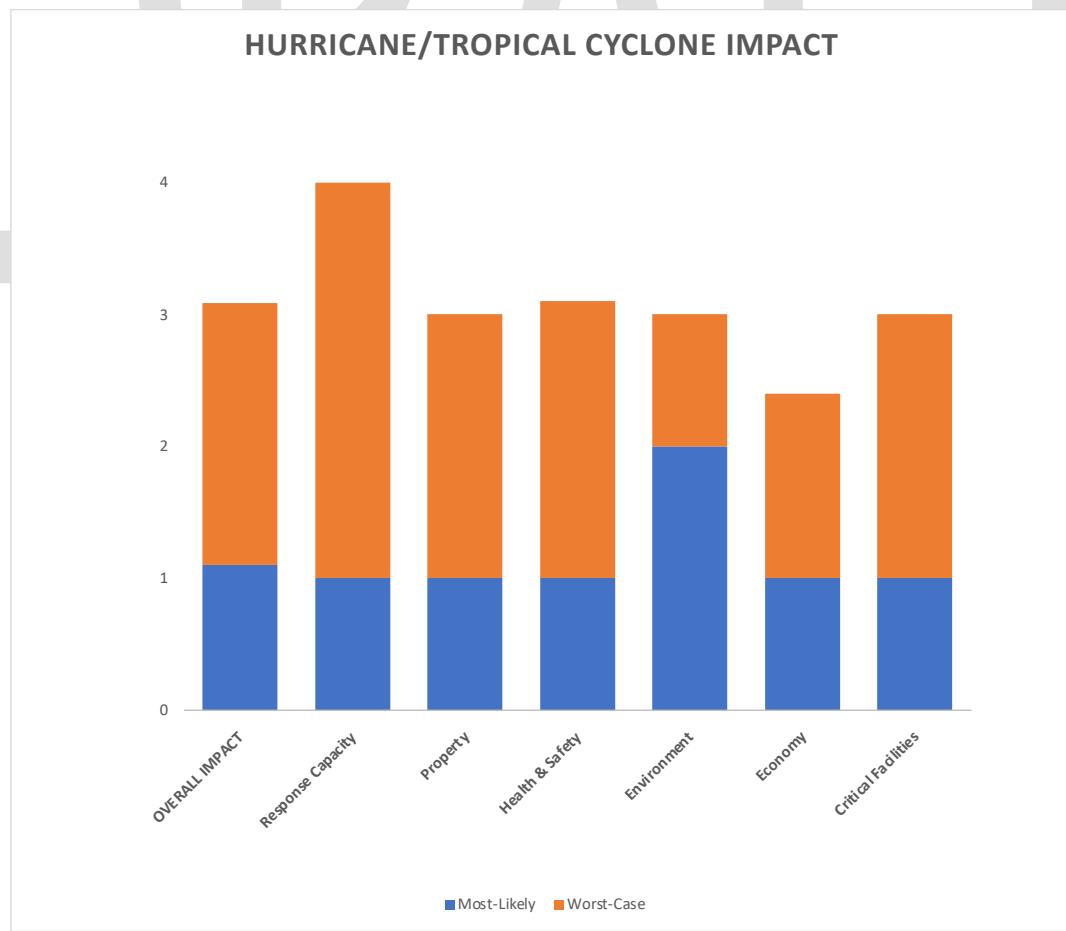
*Source: Elkridge Patch

FIGURE 51: TROPICAL STORM LEE: FLOODING AT A MUNICIPAL PARKING LOT IN HISTORIC ELLICOTT CITY



*Source: Baltimore Sun

The figure and table below characterize hurricane/tropical cyclone impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Hurricanes / Tropical Cyclone - Consequence Analysis

Likely

CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> ▪ Critical and non-critical infrastructure will be damaged. ▪ Ellicott City, Elkridge, and other low-lying areas affected and downed trees and wires with minimal structural damage expected. ▪ Few downed trees and power lines and some flooding across roadways that usually flooded was expected. ▪ Erosion and minor roadbed damage at undersized culverts are expected. ▪ Some structural damage to occupancies and minor flooding is expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> ▪ Zero deaths expected. Heavy rain and flooding are the most common causes of death. ▪ Zero to five injuries expected. Scrapes and cuts from debris are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> ▪ <u>Utilities</u> – Hours of critical facilities will be shut down. Trees and branches could cause downed power lines. ▪ <u>Information/Communication</u> – Hours-weeks-months of shutdown depending on intensity of damage. ▪ <u>Transportation</u> – Road crews shelter in place at height of wind speed will be out of service.
RESPONSE CAPACITY	Limited	<ul style="list-style-type: none"> ▪ <u>Police</u> – Local resources adequate. No impact to response capability and continuity of operations. ▪ <u>Fire and Rescue</u> – Local resources adequate. Limited impact to response capability. Additional personnel may be required to assist with increased call volume, damage assessment, and swift water team. ▪ <u>Health</u> – Local resources adequate. HD operations will not be affected and maintain contact with the EOC. ▪ <u>Public Works</u> – Local resources adequate. No impact on response capability and continuity of operations.
ENVIRONMENTAL IMPACT	Significant	<ul style="list-style-type: none"> ▪ Short-term spike in water pollution due to flooding.
ECONOMIC IMPACT	Limited	<ul style="list-style-type: none"> ▪ Limited amount loss in dollar value. ▪ Some infrastructure impact on economic consequences. ▪ Limited economic impact.
TOTAL IMPACT	Limited - Significant	<p>▪ Total Impact Score: 1.1 on a scale of 1 (Limited) to 4 (Catastrophic).</p>

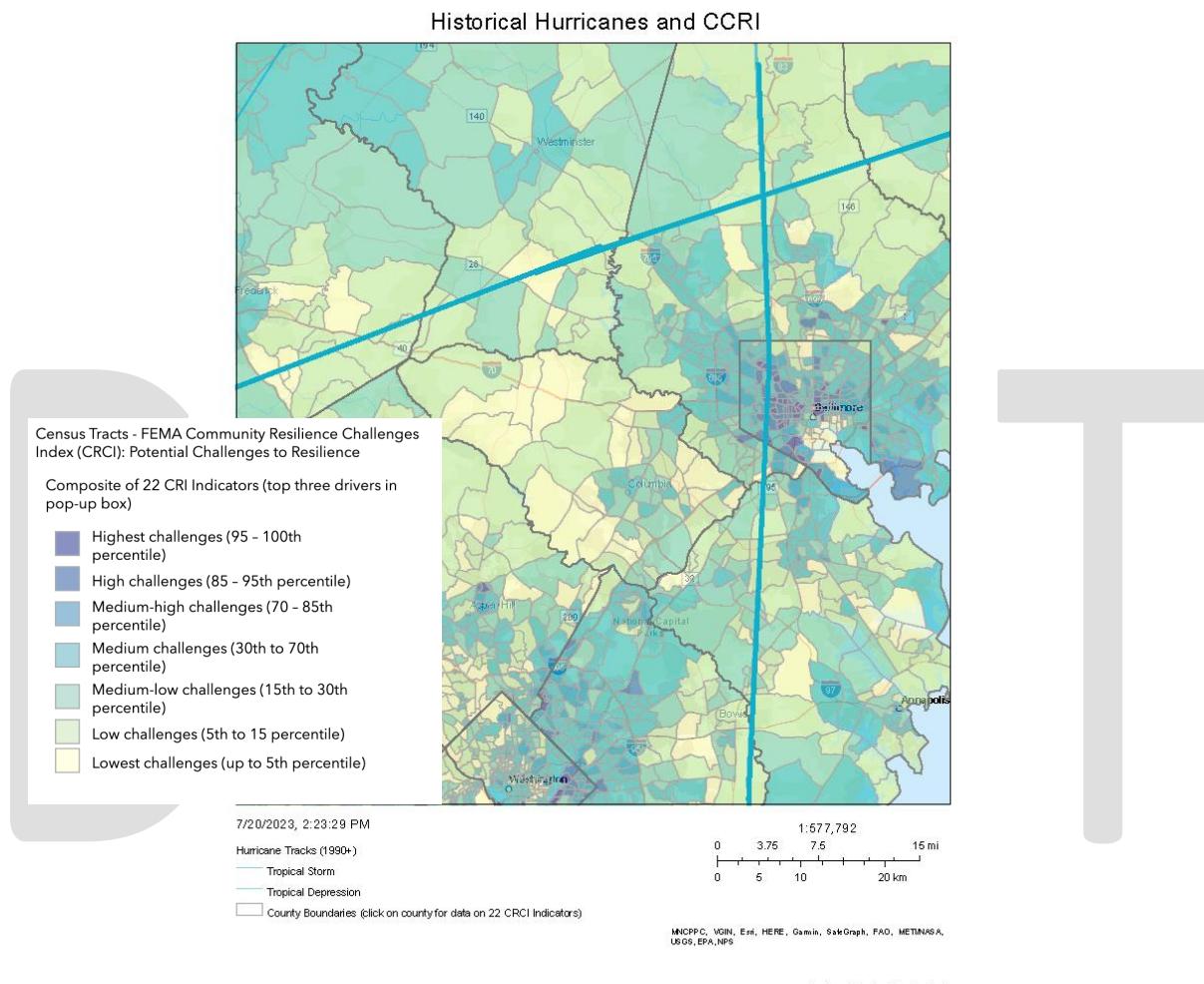
Vulnerability of County Assets

Historically, a hurricane or tropical cyclone has never tracked directly through Howard County; however, tropical cyclones have passed in close proximity after making landfall further south in the United States. As evidenced in Figure 35 and the map below from FEMA's RAPT, storms passing in close proximity would bring significant rainfall to Howard County, as well as the potential for high winds, severe thunderstorms. Given the concentration of population centers in the eastern portion of Howard County, there would be significant concerns were a hurricane to impact the County directly, particularly around Columbia. Assets that are vulnerable are the following:

People

- FEMA's CRI indicates slightly higher challenges to resilience in population centers in the eastern portion of the County. The map below depicts CRI with historical hurricane tracks.

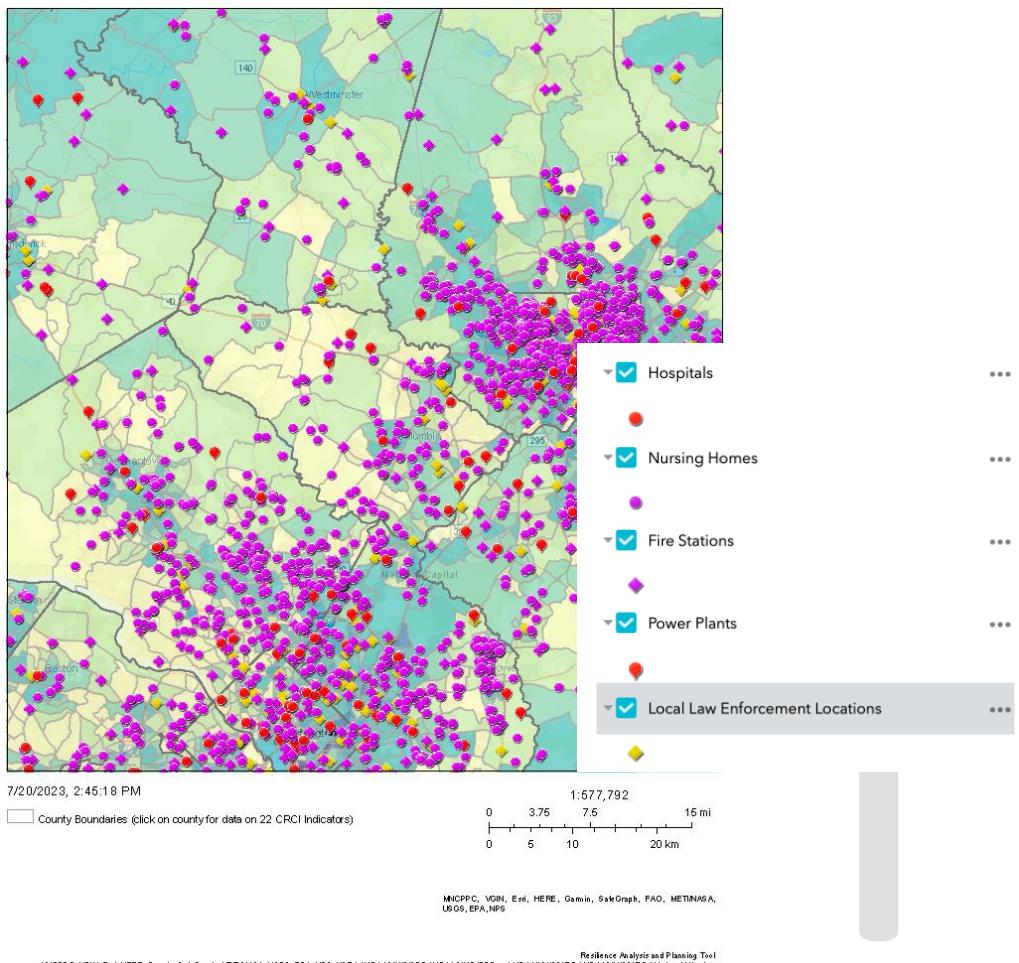
FIGURE 52: HISTORICAL HURRICANES & CCRI



Structures

- All residential and commercial buildings are vulnerable to strong wind
- Most nursing homes, hospitals, fire stations, power plants, law enforcement, universities, public and private schools, and utilities fall in the eastern portion of the County near population centers. The map below shows the clustering of these buildings as well as how these buildings are also largely located where populations with challenges to resilience reside.

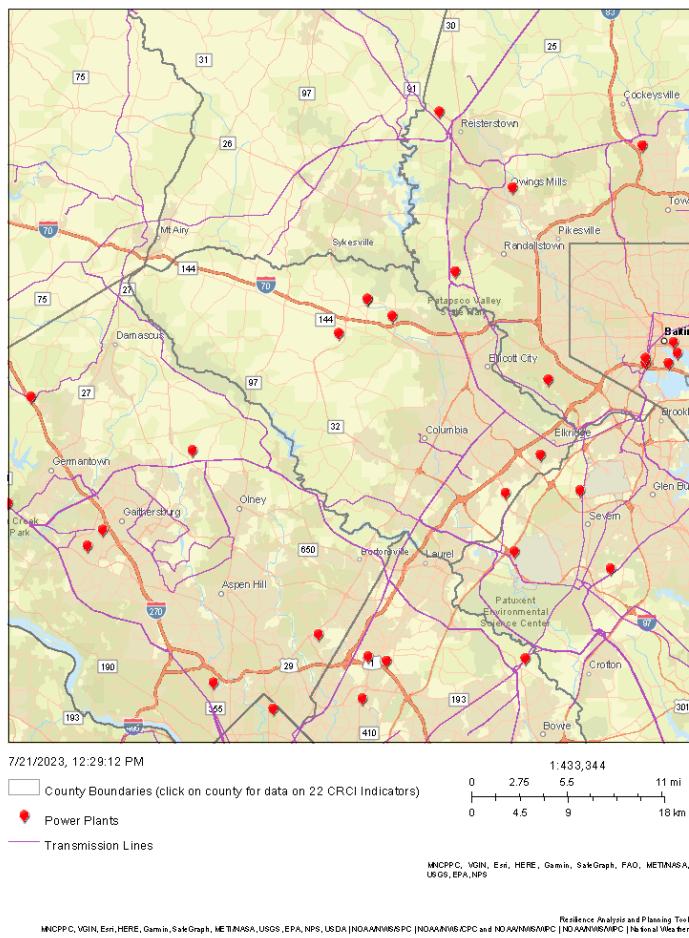
FIGURE 53: STRUCTURAL ASSETS & CCRI



- Historical Ellicott City Economy (due to its vulnerability to flooding, storms that bring heavy rains impact this area and the business's ability to operate).
- Electric/Gas Utilities (strong winds could knock out utilities for large areas of the County).
 - For example, Hurricane Irene, with windspeeds up to 50 mph in the area, caused widespread power outages throughout the County. According to the Baltimore Sun (2011), the storm left around 850,000 businesses and households without power⁸³.
 - The map below depicts power plants and electrical transmission lines that could be affected by high wind speeds.

⁸³ Irene's Greatest Aggravation: Power Outages, 2011, Baltimore Sun, <https://www.baltimoresun.com/maryland/bs-md-irene-power-20110828-story.html>, (last accessed July 26, 2023).

FIGURE 54: ELECTRICAL INFRASTRUCTURE



Systems

- Communications Systems (strong windspeeds could affect cell towers and ham radio antennae).
- Emergency Services (strong windspeeds could hinder large emergency vehicles, such as ambulances and fire engines).

Natural, Historic, and Cultural Resources

- Tree Canopy (strong wind speeds could knock down old or unhealthy trees).

Activities that Have Value to the Community

- Cultural activities that are held outdoors, such as festivals or concerts would be cancelled or postponed.

Effects of Population Change and Development in Hazard-Prone Areas

As Howard County, Maryland, anticipates changes in future population density, it's important to assess how these demographic shifts could influence the County's vulnerability to Hurricanes/Tropical Cyclones. While Howard County may not be directly affected by Hurricanes/Tropical Cyclones due to its distance from the coast, it still faces risks from the storms' residual effects of localized flooding, damaging winds, etc. Therefore, the "Hazard-Prone Areas" are those low-lying areas in the County as well as Historical Ellicott City and the Lawyer's Hill Historical District. Population density in these areas

can significantly impact the vulnerabilities and consequences of these weather events. Greater population density can strain existing drainage systems and stormwater infrastructure. As more land is developed, the capacity of drainage systems to handle runoff may be exceeded during intense rainfall events, potentially causing flooding in susceptible areas. As population density rises, there is an increased concentration of buildings, including residential and commercial structures, in limited geographic areas. Strong damaging winds can cause damage to structures and infrastructure, impacting densely populated areas more significantly. Higher population density often leads to increased urbanization and the expansion of impervious surfaces, such as roads, buildings, and parking lots. This can result in reduced natural absorption of rainwater, leading to increased surface runoff during heavy rainfall and a higher risk of localized flooding.

Future development in areas prone to flooding caused by hurricanes and tropical cyclones can lead to increased exposure of people and assets to the impacts of these storms. As more development occurs, a larger population and more infrastructure could be at risk from strong winds, heavy rainfall, flooding, and other associated hazards. While not directly coastal, parts of Howard County could still experience significant rainfall and flooding from the remnants of hurricanes and tropical cyclones.

Future development in flood-prone areas may also exacerbate the risk of inundation, particularly if stormwater management and drainage systems are not adequately designed to handle increased runoff. Densely populated areas with increased development are likely to have more critical infrastructure, such as buildings, roads, and utility systems. Hurricanes and tropical cyclones can cause widespread damage to these assets, disrupting services and potentially impeding emergency response and recovery efforts.

Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). These sections help identify where existing high population densities are located and where future developmental activities are anticipated.

Hurricanes / Tropical Cyclone - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none">▪ Critical and non-critical infrastructure will be damaged.▪ Ellicott City, Elkridge, and other low-lying areas affected and downed trees and wires with minimal structural damage expected.▪ Few downed trees and power lines and some flooding across roadways that usually flooded was expected.▪ Erosion and minor roadbed damage at undersized culverts are expected.▪ Some structural damage to occupancies and minor flooding is expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none">▪ Zero deaths expected. Heavy rain and flooding are the most common causes of death.▪ Zero to five injuries expected. Scrapes and cuts from debris are the most common causes of injuries.

CRITICAL FACILITIES	<i>Limited</i>	<ul style="list-style-type: none"> ▪ <u>Utilities</u> – Hours of critical facilities will be shut down. Trees and branches could cause downed power lines. ▪ <u>Information/Communication</u> – Hours-weeks-months of shutdown depending on intensity of damage. ▪ <u>Transportation</u> – Road crews shelter in place at height of wind speed will be out of service. 				
RESPONSE CAPACITY	<i>Limited</i>	<ul style="list-style-type: none"> ▪ <u>Police</u> – Local resources adequate. No impact to response capability and continuity of operations. ▪ <u>Fire and Rescue</u> – Local resources adequate. Limited impact to response capability. Additional personnel may be required to assist with increased call volume, damage assessment, and swift water team. ▪ <u>Health</u> – Local resources adequate. HD operations will not be affected and maintain contact with the EOC. ▪ <u>Public Works</u> – Local resources adequate. No impact on response capability and continuity of operations. 				
ENVIRONMENTAL IMPACT	<i>Significant</i>	<ul style="list-style-type: none"> ▪ Short-term spike in water pollution due to flooding. 				
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Limited amount loss in dollar value. ▪ Some infrastructure impact on economic consequences. ▪ Limited economic impact. 				
TOTAL IMPACT	<i>Limited - Significant</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1.1 on a scale of 1 (Limited) to 4 (Catastrophic). 				
<i>Limited</i>		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; background-color: #FFFF99;"></td> <td style="width: 25%; background-color: #99FF99;"></td> <td style="width: 25%; background-color: #99FFCC;"></td> <td style="width: 25%; background-color: #FF9999;"></td> </tr> </table>				

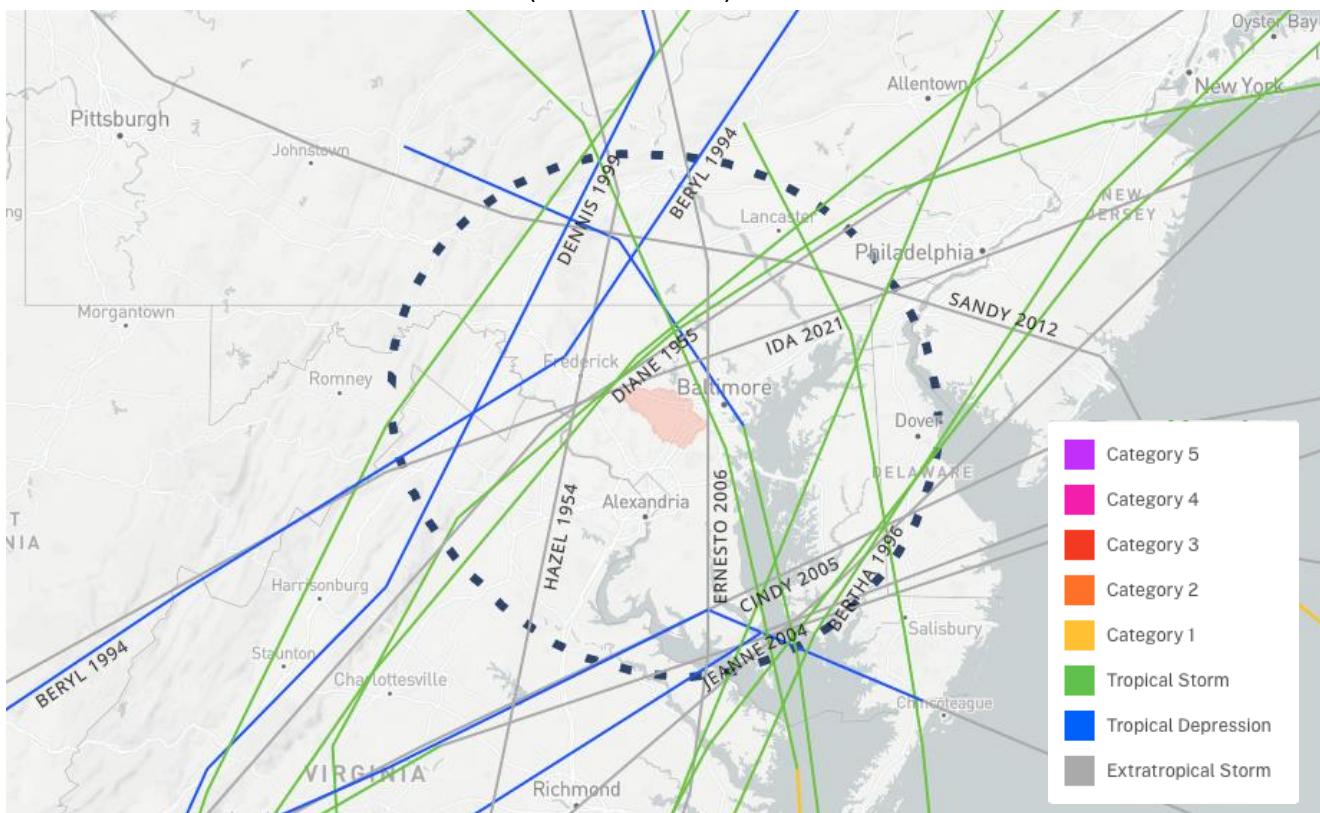
Hazard Occurrences

According to the NCDC database, there has not been a Hurricane in Howard County, Maryland since 2000 (categorized by passage of the eye directly over the County). Despite the eyes of storms not directly passing over Howard County, the County has felt the effects of nearby hurricanes across the years. The database does list one tropical storm event that has impacted Howard County from 1950 to 2022.⁸⁴ Other storms were downgraded to either tropical storms or tropical depressions by the time they reached the Mid-Atlantic region, which is typical for this region. Although not all of these storms brought significant damage, most brought heavy rain and increased high winds across Howard County. The map below depicts all storm tracks that occurred within 100 miles of Howard County from 1950-2021.

⁸⁴ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO., https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Hurricane+%28Typhoon%29&eventType=%28Z%29+Tropical+Depression&eventType=%28Z%29+Tropical+Storm&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2000&endDate_mm=12&endDate_dd=31&endDate_yyyy=2022&county=HOWARD%3A27&hailfilter=0.00&tornfilter=0&windfilter=0.000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND (last visited Apr. 3, 2023).

FIGURE 55: HOWARD COUNTY: STORM TRACKS, 1950-2021

(Source: NOAA⁸⁵)



Notable Hurricane/Tropical Cyclone Incidents in Howard County

**The damage figures have been adjusted for inflation and are detailed in 2022-dollar values

September 1952 Tropical Storm Able	On the night of August 30 th , 1952, Hurricane Able made landfall over Beaufort, South Carolina. As the storm moved northward across South Carolina, North Carolina, and Virginia, Able was downgraded to a tropical storm. On September 1 st , the center of Tropical Storm Able had moved over the western portion of Howard County. Able brought winds of 35 to 40 mph and gusts up to 50 mph. The peak wind gust at the Washington National Airport was 60 mph. The rain associated with the storm caused isolated flooding, while the wind brought down trees and branches and caused power outages to the region. ⁸⁶
October 1954 Hurricane Hazel	On October 15 th , 1954, Hurricane Hazel made landfall 250 miles south of Wilmington, North Carolina as a Category 3 hurricane. Hazel maintained its hurricane force winds as it rapidly progressed north. From Southern Virginia to Central Pennsylvania, Hazel produced Category 1 hurricane force winds. The eye of the storm passed to the west of Washington, D.C. and then near Hagerstown, Maryland. There were reports of peak gusts in an excess of 100 mph in Howard County.

⁸⁵ Historical Hurricane Tracks, NOAA, <https://coast.noaa.gov/hurricanes/#map=4/32/-80> (last visited Apr. 3, 2023).

⁸⁶ Harry F. Hawkins, Jr., *The Weather and Circulation of August 1952*, 80 MONTHLY WEATHER REV. 134 (Aug. 1, 1952),

https://journals.ametsoc.org/view/journals/mwre/80/8/1520-0493_1952_080_0134_twacoa_2_0_co_2.xml.

August 1955 Tropical Storm Connie	On August 12 th , Connie made landfall over the Outer Banks of North Carolina as a Category 1 hurricane. Hurricane Connie then moved northward across North Carolina. By the time Connie reached Maryland's Eastern Shore on August 13 th , it had weakened to a tropical storm. Tropical Storm Connie then moved northwest across the Chesapeake and towards north of Baltimore City, bringing with it 50 mph winds and a substantial amount of rain. Howard County's proximity to Baltimore City indicates that the region experienced a substantial amount of rainfall.
August 1955 Tropical Storm Diane	Only five days after Connie made landfall, on August 17 th , Category 1 Hurricane Diane made landfall near Wilmington, North Carolina. Hurricane Diane was quickly downgraded to a tropical storm as it moved inland. The tropical storm then moved northwest across North Carolina and Virginia before shifting to the northeast over North-Central Virginia. On August 18 th , the center of Tropical Storm Diane tracked through the eastern portion of Frederick County, Maryland, producing winds between 50-60 mph. As a result of its proximity, Tropical Storm Diane brought a significant amount of rain and flooding to Howard County.
June 1972 Tropical Storm Agnes	While the eye of Tropical Storm Agnes did not pass within 100 miles of Howard County, Agnes did cause considerable damage to the region on June 21 st , 1972. The Howard County FIS estimates the total property damage from Tropical Storm Agnes to be as high as \$55.4 million. The majority of the damage occurred along the Patapsco River in Ellicott City and Elkridge areas. The total damage along the Patapsco River was estimated to be approximately \$48.4 million. Property damages along the Little Patuxent River totaled about \$3.2 million and damages along the Patuxent and Middle Patuxent totaled roughly \$689,581. An estimated \$1.373 million worth of damages occurred to roads and bridges throughout the County. Meanwhile, the SHEDLUS database estimates the total property damage from Tropical Storm Agnes to be roughly \$14.9 million.
September 1975 Hurricane Eloise	The remnants of Hurricane Eloise on September 22 nd , 1975, coupled with snow from a previous storm, resulted in over 12 inches of rain in four days and caused both the Patuxent and Patapsco Rivers to overflow up to 24 feet above normal. Much of Ellicott City and Elkridge were again flooded, as some businesses had just reopened after recovering from the extensive damage caused by Tropical Storm Agnes. Mud and debris covered the landscape, and homes and businesses were declared unsafe.
September 1999 Tropical Storm Dennis	The remnants of Hurricane Dennis tracked across Western Maryland on September 7 th , 1990, bringing heavy rain and flooding throughout the County. Strong winds also caused power outages throughout the region.
September 1999 Hurricane Floyd	The remnants of Hurricane Floyd produced high winds and heavy rains which closed 200 roads and streets Countywide on September 16 th , 1999. Businesses were threatened by the raging waters of the Patapsco River as its banks overflowed in Ellicott City. Rainfall measurements of two to five inches were reported throughout the day. County officials reported 17 homes damaged, 350 basements flooded, two people rescued, and the Howard Country Fair was shut down for the first time in its 47-year history.
September 2003 Hurricane Isabel	Hurricane Isabel made landfall on September 18 th , 2003m as a Category 2 hurricane. As the storm moved across Southern Virginia, it weakened to tropical storm status. The rain associated with Hurricane Isabel caused isolated flooding, while strong wind brought

	down power lines and left more than 65,000 homes without power. At one point, 80-90 roads were deemed impassable due to fallen trees. ⁸⁷
September 2006 Tropical Storm Ernesto	Tropical Storm Ernesto made landfall on September 1 st , 2006, in North Carolina. The storm maintained its strength as it tracked northward from North Carolina to Virginia, and then into Southern Maryland. Ernesto's center passed just east of Howard County, bringing upwards of five inches of rain and wind gusts over 50 mph. Ernesto's winds caused over 44,000 residents in the region to lose power. ⁸⁸
September 2008 Hurricane Hanna	On September 6 th , 2008, Hurricane Hanna made landfall in Myrtle Beach, South Carolina. Hanna became an extratropical cyclone as it moved up the Eastern Seaboard towards Canada, ⁸⁹ staying "east of the Baltimore-Washington metropolitan area. Maximum sustained winds generally averaged between 20-35 mph through the afternoon of the 6th." ⁹⁰ There were 537 deaths reported, mostly as a result of flooding in Haiti, and seven deaths were reported on the east coast of the United States. ⁹¹
August 2011 Tropical Storm Irene	In late August and early September 2011, Howard County was impacted by a downgraded Hurricane Irene, which became a tropical storm by the time it reached Central Maryland. Hurricane Irene originally made landfall on August 27 th , 2011, as a Category 1 hurricane near Cape Lookout, North Carolina, with maximum sustained winds of 85 mph. The storm followed the Atlantic coastline as a Category 1 hurricane, which then made a second landfall near Little Egg Inlet, New Jersey the following morning. In Howard County, tens of thousands were left without power. Specifically, on August 27 th , 2011, Howard County experienced 30,000 outages as Hurricane Irene advanced ⁹² . Initial estimates indicated damage of about \$2.5 million in Howard County, where the storm severely damaged two homes and caused significant damage to four others in the Ellicott City area. The highest rainfall totals in Howard County were around four to five inches along the eastern part of the County. The path of the storm is shown in the figure below. In Maryland, Hurricane Irene caused tropical storm force winds and torrential rains. More than 700,000 people were left without power across the State. Total damage in Maryland was estimated at approximately \$20.8 million, with the most severe damages occurring in the Eastern and Southern portions of the State. A Presidential Disaster Declaration (FEMA-DR-4034) was declared for 13 of the 24 counties in Southern and Eastern Maryland as a result of this storm.

⁸⁷ Jack Beven & Hugh Cobb, *Tropical Cyclone Report: Hurricane Isabel*, NAT'L HURRICANE CTR. (July 1, 2004) https://www.nhc.noaa.gov/data/tcr/AL132003_Isabel.pdf.

⁸⁸ Stephanie Desmon & Gadi Dechte, *Ernesto's Wind Gusts Punched Away at Maryland*, BALTIMORE SUN (Sept. 3, 2006), http://articles.baltimoresun.com/2006-09-03/news/0609030063_1_arundel-county-rain-anne-arundel.

⁸⁹ *Hurricane Hanna - September 6, 2008*, NOAA NAT'L WEATHER SERV., <https://www.weather.gov/mhx/Sep062008EventReview> (last visited Apr. 3, 2023).

⁹⁰ *Id.*

⁹¹ *Id.*

⁹² Brian M. Rosenthal, Cecilia Kang, & Clarence F. Williams, *More than 1 million without power, phone service as Hurricane Irene advances*, THE WASHINGTON POST (Aug. 27, 2011), https://www.washingtonpost.com/blogs/post_now/post/thousands-without-power-as-hurricane-irene-advances/2011/08/27/glQAI2X1iJ_blog.html.

	<p>The first two figures below show the total rainfall and wind speeds for Hurricane Irene. The rainfall figure shows rainfall totals in Howard County were around two inches in the western part of the County, with the rainfall total increasing to the east. The highest rainfall totals in Howard County were between four to five inches along the eastern part of the County.</p> <p>Hurricane Irene also caused widespread power outages throughout the impacted area. The figure below provides a Baltimore Gas and Electric (BGE) report showing the number of power outages on August 30th by Zone Improvement Plan (ZIP) code.</p>
September 2011 Tropical Storm Lee	<p>Tropical Storm Lee made landfall on September 4th, 2011, along the Gulf Coast near South-Central Louisiana as a slow-moving storm with heavy rains and winds of 45 mph. The storm slowly moved inland, bringing torrential rain and flooding to the Gulf Coast region. The storm continued inland, tracking towards the Mid-Atlantic and Northeast.</p> <p>On September 7th, 2011, the remnants of the storm reached the Maryland area. That afternoon, the combination of a warm front moving across the area and the moisture from the remnants of Tropical Storm Lee produced heavy storms and flooding. With two to three inches of rain falling on already saturated soils, the heavy rains caused flash flooding throughout Maryland. Specific to Howard County, flash flood warnings were issued after heavy rains caused numerous rivers and creeks to rise. According to the NWS, the Little Patuxent River near Savage rose to 13.6 feet on September 7th, its highest level in the previous five years.^{93 94}</p> <p>The storms and flooding also resulted in numerous road closures. More than 40 road closures were reported in Howard County, including portions of Route 1 and Route 29. South Entrance Road in Columbia, which connects Little Patuxent Parkway to Route 29 Southbound, was closed in the early afternoon of September 7th.</p> <p>The most significant flooding from Tropical Storm Lee occurred along Main Street in Historic Ellicott City, an area prone to flooding. The swollen Patapsco River and Tiber Creek River flooded parts of Main Street. Portions of the road on Main Street were covered in rushing water, causing pockets of water that were several feet deep. Several businesses closest to the river and creek flooded, with up to six feet of floodwater in their basements.⁹⁵ As a result of the flooding, the DFRS evacuated the area from the County line to Cocoa Lane (the 8200 through 8500 blocks). The figures below show flooding along Main Street, as well as behind a municipal parking lot adjacent to Main Street.</p> <p>As a result of the flooding, a Presidential Disaster Declaration (FEMA DR-4038) was declared on October 5th, 2011, for Howard County and several other Maryland counties.</p>

⁹³ Lindsey McPherson, *Heavy Rains Batter County; Flood Warning Extended to Thursday Morning*, BALTIMORE SUN (Sept. 7, 2001), <https://www.baltimoresun.com/ph-ho-cf-flooding-0915-20110907-story.html>.

⁹⁴ The highest level ever recorded there previously was 18.38 feet in June 1972 after Hurricane Agnes.

⁹⁵ Travis Crouse, *Ellicott City Flooding Tropical Storm Lee*, MD HISTORIC DISTRICT (Sept. 7, 2011), <http://www.mdhistoricdistrict.com/ellicott-city-flooding-from-tropical-storm-lee/>.

October 2012 Hurricane Sandy	<p>Hurricane Sandy impacted the United States, Caribbean, and Canada. According to the Tropical Cyclone Report, “The cyclone made landfall as a category 1 hurricane (on the Saffir-Simpson Hurricane Wind Scale) in Jamaica, and as a 100-kt category 3 hurricane in eastern Cuba before quickly weakening to a category 1 hurricane while moving through the central and northwestern Bahamas [...] The system strengthened into a hurricane while it moved northeastward, parallel to the coast of the southeastern United States, and reached a secondary peak intensity of 85 kts while it turned northwestward toward the mid-Atlantic states.”⁹⁶ On October 29th, 2012, Hurricane Sandy made landfall to the north of Maryland, along the coast of Southern New Jersey as a post-tropical cyclone with 70 kt maximum sustained winds.⁹⁷</p> <p>Sandy was responsible for a total of 147 deaths. Within the United States, there were 72 deaths “making Sandy the deadliest U.S. cyclone outside of the southern states since Agnes (1972).”⁹⁸ 48 of those deaths occurred in New York, though none occurred in Howard County. 54 deaths occurred in Haiti, 11 in Cuba, three in the Dominican Republic, two in the Bahamas, two offshore within the Atlantic Ocean, one in Canada, one in Jamaica, and one in Puerto Rico.⁹⁹ Additionally, within the United States, at least 650,000 houses were damaged or destroyed and 8.5 million lost power.¹⁰⁰</p> <p>The size and intensity of the storm brought heavy rain and high winds to Howard County. A water reclamation plant in Savage experienced a power outage. This caused “20 – 25 million gallons of untreated but rain-diluted human waste to spill into the Little Patuxent River, a branch of one of the Chesapeake Bay’s most degraded tributaries.”¹⁰¹ Water contamination became a significant threat to the health and environment of those downstream from the plant. Water mains feeding Howard County from the City of Baltimore failed, and the drinking water supply was limited for a period of one to two weeks.</p>
August 2020 Hurricane Isaias	<p>In late July of 2020, the National Hurricane Center began tracking a tropical wave that developed off the coast of Africa. This tropical wave would gradually move west towards the Caribbean, while gradually strengthening. This tropical wave was given the name Isaias when it was designated as a tropical storm at 11 PM on Wednesday July 29th. Isaias then took a northwest turn towards the Bahamas, while remaining just off of the east coast of Florida. There, it reached its peak intensity as a Category 1 hurricane, with maximum sustained winds of 85 mph, and a minimum central pressure of 987 mb. Weakening occurred as Isaias moved through the Bahamas, dropping back down to a strong tropical storm. Isaias then re-strengthened as it began to turn northward and move towards the North Carolina coastline, eventually reaching Category 1 hurricane</p>

⁹⁶ Eric S. Blake, Todd B. Kimberlain, Robert J. Berg, John P. Cangialosi, and John L. Beven II, *Tropical Cyclone Report: Hurricane Sandy*, NOAA NAT'L HURRICANE CTR. (Feb. 12, 2013), https://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf.

⁹⁷ *Id.*

⁹⁸ *Id.*

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ Timothy B. Wheeler, *Storm triggers Big Howard Sewage Spill*, BALTIMORE SUN (Oct. 30, 2012), <https://www.baltimoresun.com/news/environment/bs-gr-howard-sewer-leak-20121030-story.html>.

	status once again, with winds of 85 mph and a minimum central pressure of 988 mb. Isaias made landfall at Ocean Isle Beach, North Carolina at 11:10 PM EDT on Monday August 3 rd . ¹⁰² In Howard County, the 911 Call center received about a dozen calls for trees, branches, and wires down. There were no deaths or injuries reported.
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Hazard Future Likelihood - Medium

The historical probability is based on the eye of a storm passing directly over Howard County. However, this does not account for the numerous hurricanes and tropical storms that have passed in close proximity and have had impacts on Howard County. The future annual probability of this event is 1-30% chance of annual occurrence, or one event every 3-99 years. An expected increase in rainfall levels and extreme storms may result in a slight increase in the likelihood of flooding.¹⁰³ The National Climate Assessment also states that “there has been a substantial increase in most measures of Atlantic hurricane activity since the early 1980s [including] measures of intensity, frequency, and duration as well as the number of strongest (Category 4 and 5) storms.”¹⁰⁴ Other considerations include Howard County’s proximity to the Chesapeake Bay and its location on the East Coast.

The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Hurricane/Tropical Cyclone Hazard in Howard County	
Historical Average (time period)	1 event (2002-2022)
Historical Annual Probability	1-10% chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	Yes
Future Annual Probability	1-30% chance of annual occurrence
Future Likelihood Score	2.4 (Infrequent-Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Wildfires (Risk Score 1.7)

Hazard Description

Wildfires are uncontrolled forest fires, grassland fires, rangeland, or urban-interface fires which consume natural fuels and spread in response to the environment.¹⁰⁵ Wildfires can be either a natural phenomenon or human-caused. The frequency and severity of wildfires depends on both weather and

¹⁰² *Tropical Storm Isaias Impacts: August 4th, 2020*, NOAA NAT’L WEATHER SERV., <https://www.weather.gov/lwx/TropicalStormIsaias> (last visited Apr. 6, 2023).

¹⁰³ *Fourth National Climate Assessment, Volume II: Impacts, Risks, & Adaptation in the United States*, U.S. GLOBAL CHANGE RESEARCH PROGRAM, <https://nca2018.globalchange.gov> (last visited Apr. 3, 2023).

¹⁰⁴ *Id.*

¹⁰⁵ *NWCG Glossary of Wildland Fire Terminology*, Nat’l Wildfire Coordinating Group, <https://www.nwcg.gov/publications/pms205> (last visited Apr. 6, 2023).

human activity. Wildfires can occur any month in Maryland but peak in the spring and fall. During these seasons, deciduous trees are bare, allowing sunlight and wind to reach the ground and dry any available fuels. The relative humidity of the air is also lower and, combined with a breeze, creates the conditions for wildfires to spread rapidly. Wildfires can also occur in late fall. Depending on weather conditions, the month of November also generally has a high rate of wildfires.¹⁰⁶ The following table presents the Risk Score for drought in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Wildfire Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	2.2 Infrequent-Likely		50%
CONSEQUENCE	Impact	1 Limited	1.7 Limited-Significant	40%
	Warning Time	4 Short	4 Short	5%
	Duration	1 Short	2 Moderate	5%
TOTAL RISK SCORE		1.9	2.1	

Hazard Location

Although urban interface fires have the greatest possibility to cause property damage, the potential for wildfires exists throughout the entire County. The greatest risk for significant wildfires to occur would be in large, forested areas such as the Patapsco State Park and the Hugh Thomas Wildlife Management Area to the north. The Patapsco River Valley, where Patapsco State Park is located, is characterized by steep slopes exceeding 20% grade. In addition, dense vegetation and hardwoods provide ample fuel for fire. In the southern portion of the County, the Rocky Gorge Reservoir Park and the Patuxent Wildland Area are also areas at risk for potential wildfires. The Patuxent Wildland Area is a State-designated wildland, which restricts the ability to reduce fuels or create ingress routes. In addition, the characteristics of the Patuxent Wildland Area are similar to the Patapsco State Park, where dense vegetation and hardwoods provide high fuel loads.

Hazard Extent

The frequency and severity of wildfires depends on many factors. The three that control wildfire behavior the most are the availability of fuels, the weather, and the areas topography. In addition, vegetation left over after a dry winter can provide more fuel. The speed and intensity of a fire will usually increase as the slope and wind increases, and the humidity decreases. The severity in Howard

¹⁰⁶ For additional information on wildfires, see *Wildland Fire in Maryland*, MARYLAND DEP'T OF NAT. RES., <https://dnr.maryland.gov/forests/Pages/wfm.aspx> (last visited Apr. 3, 2023).

County has been historically low, and the duration of wildfires has ranged from a matter of hours to several days.

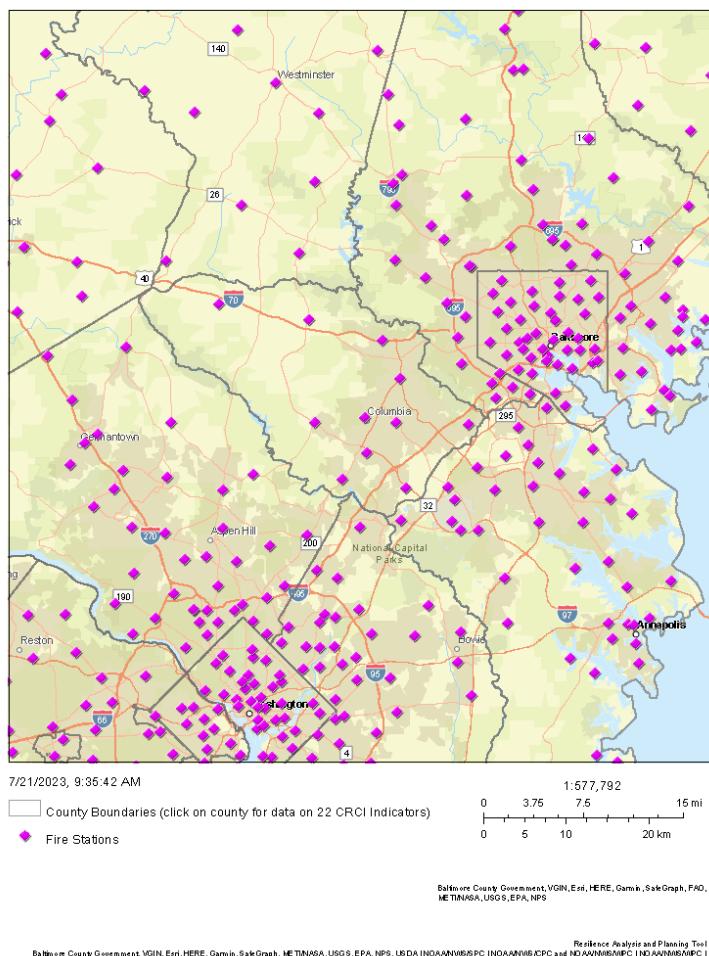
A measure to predict daily wildfire and a forecast for future conditions for the County is the National Fire Danger Rating System (NFDRS)¹⁰⁷. It rates fire potential using five color-coded levels, which are described below.

Fire Danger Level	Description
Low	Fuels do not ignite easily from small embers, but a more intense heat source, such as lightning, may start fires in duff or dry rotten wood. Fires in open, dry grasslands may burn easily a few hours after a rain, but most wood fires will spread slowly, creeping or smoldering. Control of fires is generally easy.
Moderate	Fires can start from most accidental causes, but the number of fire starts is usually pretty low. If a fire does start in an open, dry grassland, it will burn and spread quickly on windy days. Most wood fires will spread slowly to moderately. Average fire intensity will be moderate except in heavy concentrations of fuel, which may burn hot. Fires are still not likely to become serious and are often easy to control.
High	Fires can start easily from most causes and small fuels (such as grasses and needles) will ignite readily. Unattended campfires and brush fires are likely to escape. Fires will spread easily, with some areas of high intensity burning on slopes or concentrated fuels. Fires can become serious and difficult to control unless they are put out while they are still small.
Very High	Fires will start easily from most causes. The fires will spread rapidly and have a quick increase in intensity, right after ignition. Small fires can quickly become large fires and exhibit extreme fire intensity, such as long-distance spotting and fire whirls. These fires can be difficult to control and will often become much larger and longer-lasting fires.
Extreme	Fires of all types start quickly and burn intensely. All fires are potentially serious and can spread very quickly with intense burning. Small fires become big fires much faster than at the "very high" level. Spot fires are probable, with long-distance spotting likely. These fires are very difficult to fight and may become very dangerous and often last for several days.

Notably, Howard County has a wealth of fire response assets, both internally and in neighboring jurisdictions, as evidenced in the map below, that would allow for rapid suppression, even in the more rural parts of Howard County.

¹⁰⁷ National Fire Danger Rating System, US Forest Service,
<https://www.fs.usda.gov/detail/cibola/landmanagement/resourcemanagement/?cid=stelprdb5368839>, (last accessed July 26, 2023).

FIGURE 56: HOWARD COUNTY FIRE STATIONS

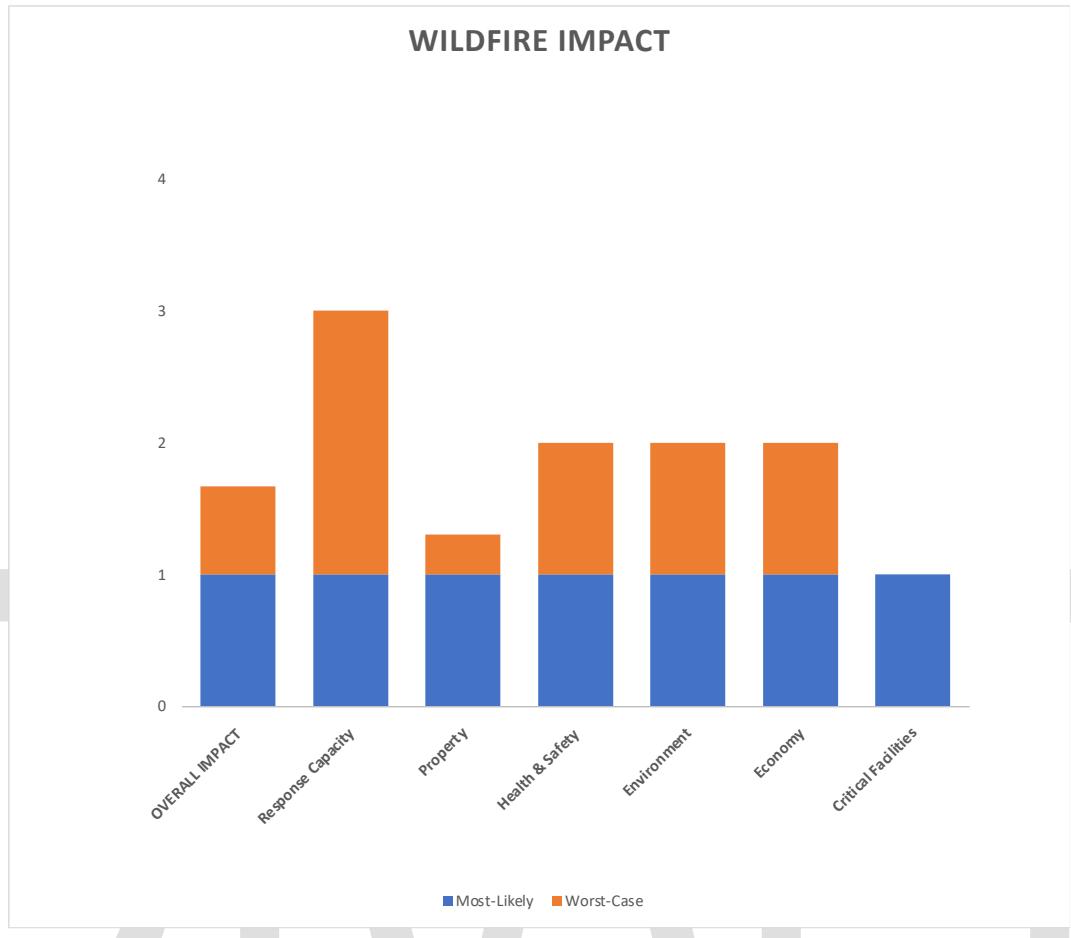


Hazard Impacts

The severity in Howard County has been historically very low, and the duration of wildfires has ranged from a matter of hours to several days. Wildland urban interface fires¹⁰⁸ are becoming increasingly problematic in Maryland. As people continue to live and work near wildland areas, the threat to private property from wildfires increases. This phenomenon is growing in Howard County as suburbanization and population growth continues in the County.

The figure and table below characterize wildfire impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.

¹⁰⁸ *What is the WUI?*, U.S. FIRE ADMIN., <https://www.usfa.fema.gov/wui/what-is-the-wui.html> (last visited Apr. 6, 2023) (defining the wildland urban interface as “the zone of transition between unoccupied land and human development”).



Vulnerability of County Assets

Data on occurrences of wildfires within Howard County is not available, but the areas at greater risk are the more rural, western portions of Howard County, which is largely agricultural and has a low population density. Assets that are vulnerable to wildfires are the following:

People

- People with challenges to resilience according to FEMA's Community Resilience Index. Please refer to [Chapter 2, Section FEMA Community Resilience Index](#) to review this map and indicators for the County.
- People living in the rural, western portions of Howard County (Patapsco State Park, Hugh Thomas Wildlife Management Area).

Structures

- All residential and commercial buildings are vulnerable to wildfires

Systems

- Economy (most area farms are located in the western portion of the County where wildfires are more likely to occur).

Natural, Historic, and Cultural Resources

- Tree Canopy (trees can be damaged or destroyed by wildfires)

- Historic wooden buildings located in or near the State parks.

Activities that Have Value to the Community

- Camping and hiking areas

Effects of Population Change and Development in Hazard-Prone Areas

Increased population density can lead to urban expansion into wildland areas, creating what is known as the urban-wildland interface. This interface is particularly vulnerable to wildfires, as homes and infrastructure are in close proximity to natural vegetation and forested areas. Higher population density can contribute to an increase in human activities that could spark wildfires, such as campfires, discarded cigarette butts, outdoor equipment use, and electrical malfunctions. Densely populated areas have more infrastructure and utilities, including power lines and gas pipelines, which can be vulnerable to wildfire-related damage. Wildfires can disrupt essential services and pose additional risks to residents.

The interaction between population growth, land use, and fire risk is crucial in determining the potential impacts on wildfire vulnerability. The proximity of structures to natural fuels like trees and grasslands can expedite fire spread. Urbanization can create localized microclimates that influence fire behavior. Wind patterns, heat retention in urban areas, and altered fuel characteristics can contribute to more intense and unpredictable fire behavior, making firefighting efforts more challenging. Development can influence the level of community awareness and preparedness for wildfires.

Future population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). These sections help identify where existing high population densities are located and where future developmental activities are anticipated.

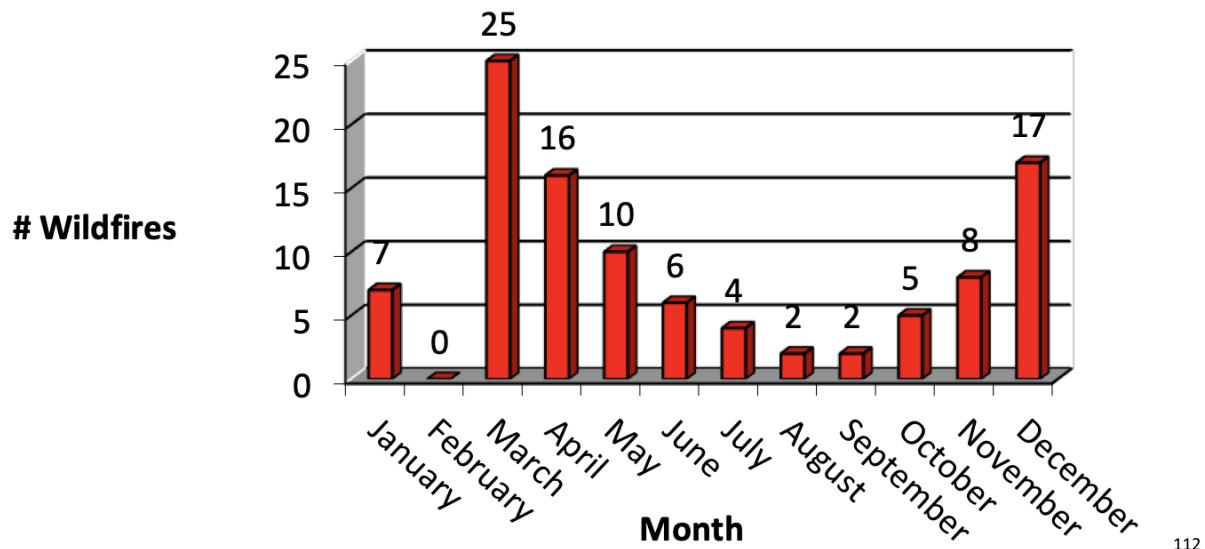
Wildfire - Consequence Analysis		
Likely		
Category	Ranking	Description
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> ▪ 0% of critical and non-critical infrastructure will be damaged. ▪ Scorched earth and destroyed landscaping expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> ▪ Zero deaths are expected. Smoke and toxic gas is the most common causes of death. ▪ Zero to two injuries are expected. Smoke inhalation and toxic gases are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> ▪ <u>Utilities</u> - Shutdown or out of service is unlikely. ▪ <u>Information/Communications</u> - Shutdown or out of service is unlikely. ▪ <u>Transportation</u> – Traffic is shut down for twenty (20) minutes.
RESPONSE CAPACITY	Limited	<ul style="list-style-type: none"> ▪ <u>Police</u>- Local resources adequate. No impact to response capability or continuity of operations. ▪ <u>Fire and Rescue</u> -Local resources adequate. Traffic issues and increased response times may be impacted. ▪ <u>Health</u>- Local resources adequate. HD operations will not be affected and will be communicating with the EOC.

		<ul style="list-style-type: none"> ▪ <u>Public Works</u> - Local resource adequate with minimal to no impact on response capability and continuity of operations. ▪ <u>DPW</u>- Mutual aid needed (Fire and Rescue, possibly SHA). Some response calls will be rerouted. 		
ENVIRONMENTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Minimal impact with a loss to plant and animal life in the immediate area. ▪ Limited environmental impact is expected. 		
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Limited loss in dollar value. ▪ Limited economic consequences. 		
TOTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> ▪ Total Impact Score: 1 on a scale of 1 (Limited) to 4 (Catastrophic). 		
<i>Limited</i>		Significant	Critical	Catastrophic

Hazard Occurrences

Wildfires incident data shows fires in Maryland occur relatively frequently. In an average year, “the Maryland Forest Service responds to an average of 325 wildfires that burn more than 3,200 acres of forest, brush, and grasses. Fire departments respond to over 5,000 wildfire incidents per year.”¹⁰⁹ In 2018, Maryland experienced a total of 77 wildfires.¹¹⁰ In 2021, that number had jumped to 102.¹¹¹

2021 Wildfire Starts



¹¹²

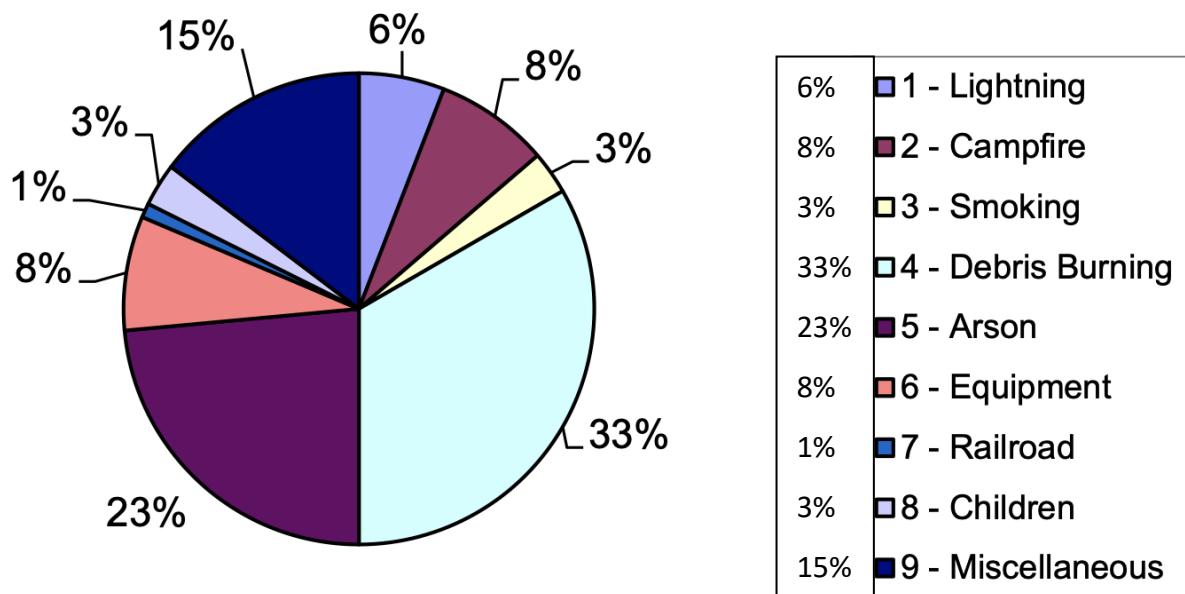
¹⁰⁹ *Wildland Fire in Maryland*, MARYLAND DEP’T OF NAT. RES., <https://dnr.maryland.gov/forests/Pages/wfm.aspx> (last visited Apr. 3, 2023).

¹¹⁰ *Maryland Forest Service Wildland Fire Program 2018 Annual Wildland Fire Report*, MARYLAND DEP’T OF NAT. RES. (2018) <https://dnr.maryland.gov/forests/Documents/fire/2018AnnualWildfireReport.pdf>.

¹¹¹ *Maryland Forest Service Wildland Fire Program 2021 Annual Wildland Fire Report*, MARYLAND DEP’T OF NAT. RES. (2021) <https://dnr.maryland.gov/forests/Documents/fire/2021AnnualWildfireReport.pdf>.

¹¹² *Id.*

2021 Fire Cause



The table below summarizes the total number of fires and acres for the State of Maryland between 2004 and 2021.¹¹³

Fires and Acres Burned in Maryland from 2004 - 2021¹¹⁴

(Source: Maryland Department of Natural Resources)

Year	Total Number of Fires	Total Acres Burned
2004	253	3,149
2005	441	4,344
2006	753	6,074
2007	622	5,102
2008	583	2,339
2009	408	4,853
2010	170	1,503
2011	125	8,310
2012	159	837
2013	122	161
2014	118	1,721
2015	158	1,078
2016	121	242
2017	107	2,175

¹¹³ *Id.*

¹¹⁴ *Id.*

Year	Total Number of Fires	Total Acres Burned
2018	77	359
2019	138	1,493
2020	76	1,421
2021	102	1,363

The NCDC¹¹⁵ indicated there were no wildfire incidents between 1950 and 2022 within Howard County. However, additional research does reflect that wildfires have occurred within Howard County. According to the Spatial Hazard Events and Losses Database for the United States (SHELDUS) database,¹¹⁶ two wildfires caused several thousand dollars' worth of damage in 1963. According to the 2015 HIRA, there were 6,919 wildfire hazard events recorded from 1995-2001. Periodical sources were also consulted to identify past wildfire events for Howard County. Based on this research, some recent wildfire events are described below.

Notable Wildfire Incidents in Howard County

March 1999	On March 30 th , 1999, a 10-acre brushfire raged for four hours in the Patapsco Valley State Park. Firefighters were then called to a 5-acre brushfire within an hour after extinguishing the park fire. Firefighters responded to four other fires within eight miles of one another. The high number of fires was due to drought-like conditions.
March 2004	On March 23 rd , 2004, a brushfire on County land near Oakland Mills High School in Columbia burned 10 acres of land. Fueled by dead corn stalks and trees, the fire raced across an open field before firefighters contained it an hour later. ¹¹⁷
February 2011	On February 19 th , 2011, high winds with gusts up to 45 mph, high temperatures, and low humidity contributed to the start of eight brushfires, which eventually burned down 20 acres. One of the largest fires occurred near the 3800 block of Manor Lane in Ellicott City. A wildfire was also located on Interstate 95 in the Laurel area between MD-198 and the Capital Beltway closing both northbound and southbound lanes until the fire was brought under control.

Additionally, current wildfire data from DFRS reflects the following data relating to the number of wildfires within Howard County:

2016	2017	2018	2019
116	135	112	57

¹¹⁵ *Storm Events Database*, NOAA NAT'L CTRS. FOR ENV'T INFO.,

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28%29+Wildfire&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=9999&endDate_mm=12&endDate_dd=31&endDate_yyyy=9999&county=HOWARD%3A27&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=24%2CMARYLAND (last visited Apr. 6, 2023).

¹¹⁶ *Spatial Hazard Events and Losses Database for the United States*, AZ. STATE UNIV. CTR. FOR EMERGENCY MGMT. AND HOMELAND SECURITY, <https://cemhs.asu.edu/sheldus> (last visited Apr. 6, 2023).

¹¹⁷ Gus Sentementes, *Brush Fire Scorches About 10 Acres*, BALTIMORE SUN (Mar. 24, 2004), http://articles.baltimoresun.com/2004-03-24/news/0403240194_1_firefighters-oakland-mills-corn-stalks.

Due to conflicting data, a definitive total number of wildfires occurring within Howard County from 1995-2022 cannot be determined. However, based on all the data provided above, there is an estimated number of over 7,300 wildfire hazard events that have occurred in Howard County in the reviewed time period of 1997-2022.

Hazard Future Likelihood - Medium

The future annual probability of this hazard is 1-30% chance of annual occurrence, or one event every 9-99 years. As noted above, wildfire incidents are directly related to weather patterns and antecedent conditions, and thus its probability of occurrences are dynamic. Other considerations include the prevalence of native pine trees within the County and lesser maintenance of fallen trees.

The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Wildfire in Howard County	
Historical Average (time period)	Estimated over 7,300 events (1997-2022)
Historical Annual Probability	30%+ chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	1-30% chance of annual occurrence
Future Likelihood Score	2.2 (Infrequent/Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

While climate change is increasingly a driver of fire behavior and wildfire occurrence, especially in cases of the intense fire behavior seen in the Western United States, Canada, and Australia, the local context of Howard County is quite different. Subject matter experts identified high population density, ease of access to water, and a robust response system as factors that currently mitigate any increase in likelihood due to the myriad effects of climate change.¹¹⁸ Additionally, challenges in data collection do not distinguish between emergency-level wildfires and smaller occurrences. As such, there is not an expected increase in future likelihood, but Howard County continues to observe these instances and refine data collection to ensure continued accurate analysis.

Earthquake (Risk Score 1.7)

Hazard Description

An Earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Stress is created in the earth's crust from thermal variations, tectonic changes, and other forms of pressure. Weaknesses in the earth crust yield when the stresses exceed the friction along these crustal weaknesses, and an earthquake happens. At the earth's surface, earthquakes may manifest themselves

¹¹⁸ Howard County HIRA Subject Matter Expert Workshops, Consequence Analysis. Fall 2022

by a shaking or displacement of the ground. This may lead to loss of life and destruction of property. The size of an earthquake is expressed quantitatively as magnitude¹¹⁹, while local strength of shaking is expressed as intensity. The following table presents the Risk Score for earthquakes in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Earthquake Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
Likelihood	Likelihood		2 Infrequent	50%
Consequence	Impact	1 Limited	3.5 Critical-Catastrophic	40%
	Warning Time	4 Short	4 Short	5%
	Duration	1 Short	4 Very Long	5%
TOTAL RISK SCORE		1.6	2.6	

Hazard Location

The entire County is susceptible to the effects of earthquakes. The map shown below was produced by the 2018 U.S. Geological Survey National Seismic Hazard Mapping Project. “The 2018 Update of the U.S. National Seismic Hazard Model defines the potential for earthquake ground shaking for various probability levels across the conterminous United States and is applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy.”¹²⁰

¹¹⁹ The inherent size of an earthquake is commonly expressed using a magnitude.

¹²⁰ Earthquake Hazards Program, *2018 United States (Lower 48) Seismic Hazard Long-term Model*, USGS (Oct. 24, 2019), <https://www.usgs.gov/programs/earthquake-hazards/science/2018-united-states-lower-48-seismic-hazard-long-term-model> (last visited Apr. 3, 2023).

FIGURE 57: UNITED STATES EARTHQUAKE HAZARD MAP

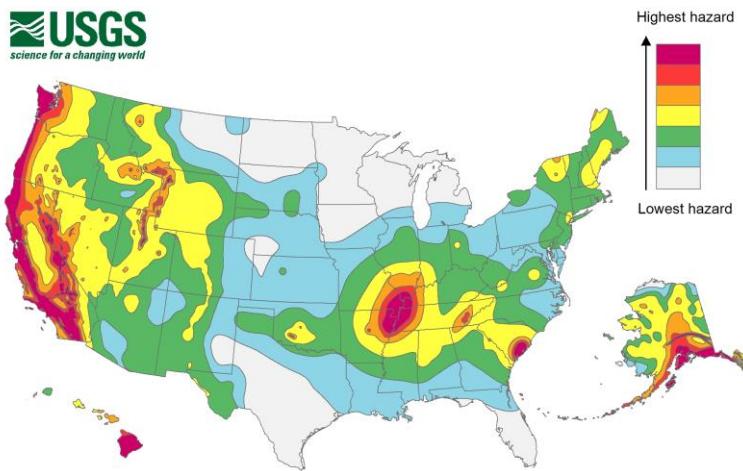
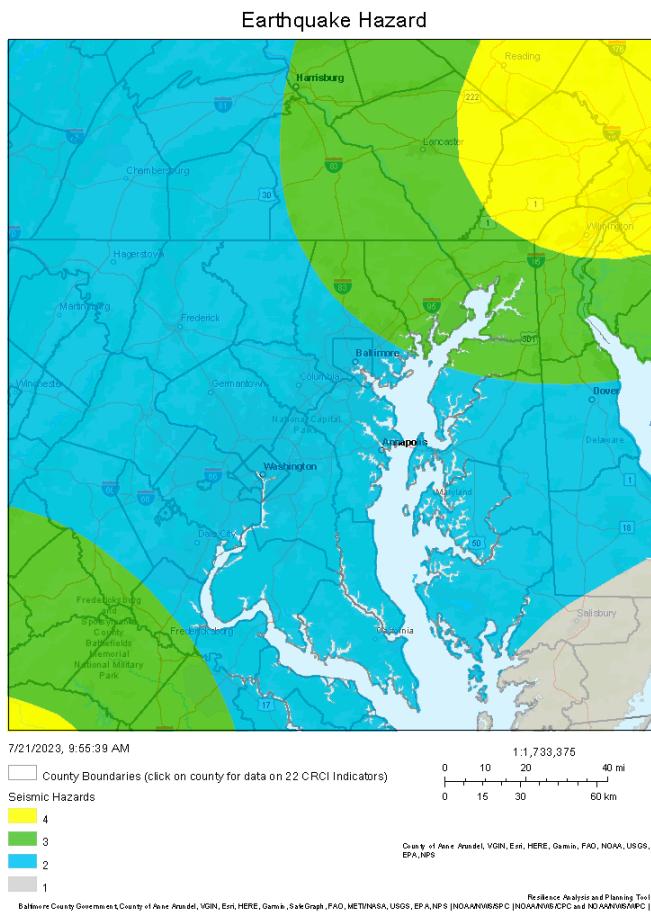


FIGURE 58: HOWARD COUNTY EARTHQUAKE HAZARD



Hazard Extent

Earthquakes are measured by their Mercalli magnitude and their intensity. The Modified Mercalli Intensity Scale describes the severity of earthquake effects. It is a ranking based on observed effects that people will experience and find relatable. The lower numbers of the intensity scale generally deal with the way the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above¹²¹. The table below describes these measurements. Definitions sourced from U.S. Geological Survey (USGS).

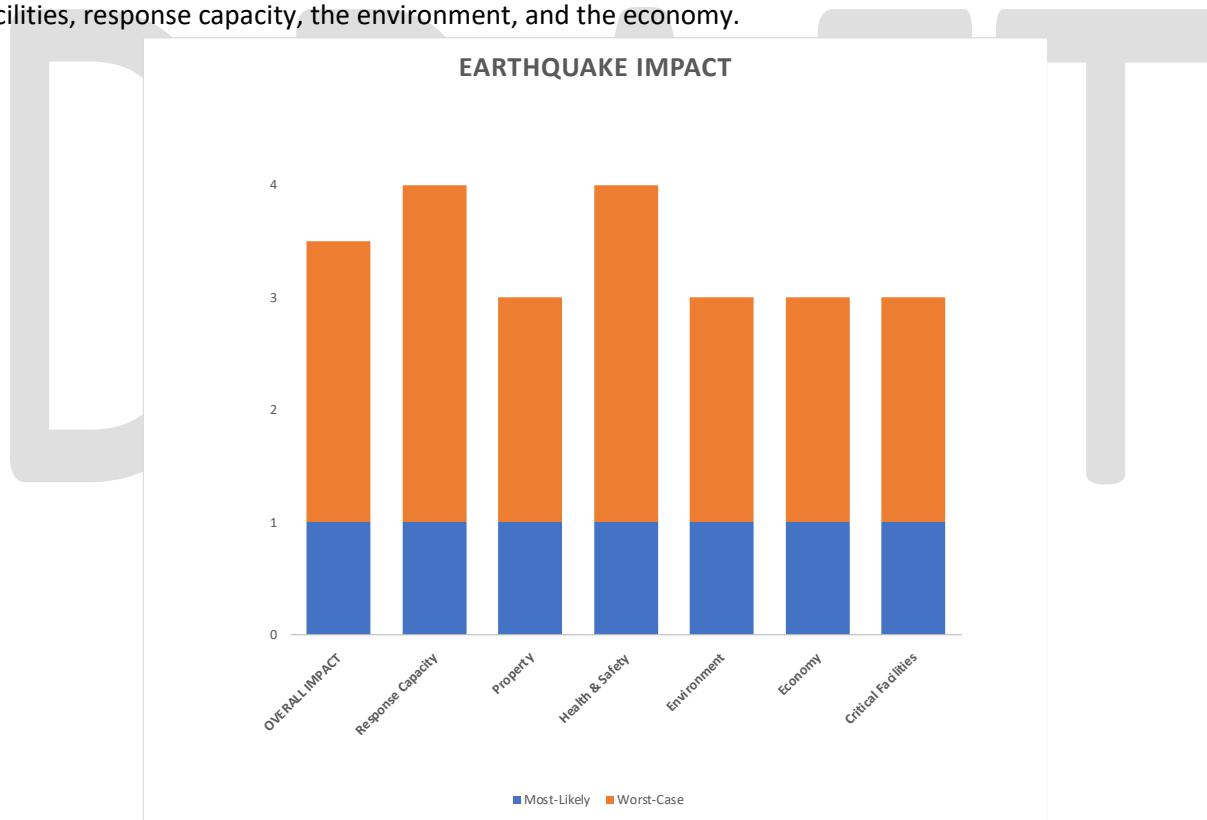
Intensity	Richter Magnitude	Shaking	Description/Damage	Average Estimated Annual Frequency
I	<2.0-2.9	Not Felt	Not felt except by a very few under especially favorable conditions.	Continual/several million per year
II		Weak	Felt only by a few persons at rest, especially on upper floors of buildings.	Over one million per year
III	3.0-3.9	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.	Over 100,000 per year
IV		Light	Felt indoors by many, outdoors by a few during the day. At night, some will be awakened. Dishes, windows, and doors disturbed; walls may make cracking sound. Sensation like a heavy truck striking a building. Standing motor cars rocked noticeably.	
V	4.0-4.9	Moderate	Felt by nearly everyone; many awakened. Some dishes/windows broken. Unstable objects overturned. Pendulum clocks may stop.	10,000 to 15,000 per year
VI		Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage is slight.	
VII	5.0-6.9	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken	1,000 to 1,500 per year
VIII		Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial	

¹²¹ Draft City of Annapolis Hazard Mitigation Plan, 2023, Office of Emergency Management, https://www.annapolishazards.org/_files/ugd/636565_9caaa9bd07c746dbb8a27472dc7d5aca.pdf, (last accessed July 28, 2023).

			buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	
IX		Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	100-150 per year
X	7.0-9.0 and greater	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	One per year

Hazard Impacts

The figure and table below characterize earthquake impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Earthquake - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> Critical and non-critical infrastructure are not damaged. No structural damage expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> Health- Zero deaths are expected. Being crushed by structural damage is the most common cause of death.

		<ul style="list-style-type: none"> <i>Health</i>- Zero to five injuries are expected. Broken or fractured bones and internal bleeding are the most common causes of injuries.
CRITICAL FACILITIES	<i>Limited</i>	<ul style="list-style-type: none"> <i>Utilities</i> – Water lines would be the only essential functions that will be out of service. Other outages unlikely. <i>Information/Communications</i> – No shutdown. No major impact on information or communications infrastructure. <i>Transportation</i> – Impacts if any to transportation will be minor and short-term.
RESPONSE CAPACITY	<i>Limited</i>	<ul style="list-style-type: none"> <i>Police</i> – Local resources adequate. <i>Fire and Rescue</i> – Local resources adequate. Should not impact operations. May require damage assessment teams. <i>Health</i> – Local resources adequate. HD operations will not be affected after building has been cleared to be safe by emergency/ facility personnel. <i>Public Works</i> – Local resources adequate with no impact response capability and continuity of operations.
ENVIRONMENTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Minimal environmental impact on air, water, and land is expected. Limited environmental impact is expected.
ECONOMIC IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Limited economic impact.
TOTAL IMPACT	<i>Limited</i>	<ul style="list-style-type: none"> Total Impact Score: 1 on a scale of 1 (Limited) to 4 (Catastrophic).
<i>Limited</i>		Significant Critical Catastrophic

Vulnerability of County Assets

Earthquakes can impact multiple County assets depending on its intensity. Assets that are vulnerable are the following:

People

- There are no known deaths due to earthquakes in Howard County.
- People in nursing homes or with disabilities (The map below depicts these populations and locations of nursing homes in the County).
- People with higher challenges to resilience (Please refer to [Chapter 2, section FEMA Community Resilience Index](#) to review this map).

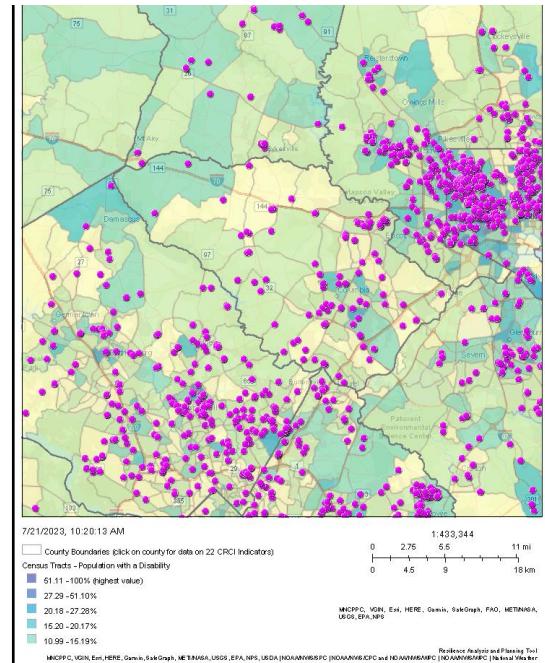
Structures

- All commercial and residential buildings are vulnerable to earthquakes.
- Historic buildings (made of unreinforced masonry) and concentrations of these buildings are in Historic Ellicott City and Lawyer's Hill Historic District.
- Water treatment plant damage (Little Patuxent Water Reclamation Plant).

Systems

- Communications Infrastructure (Cell Towers/Radio Operations).
- Water Infrastructure (water pipes).

FIGURE 59: NURSING HOMES & PERCENTAGE WITH A DISABILITY



- Transportation (roads could be blocked by fallen debris or if roads are damaged).
- Emergency Services (closed roads and damaged equipment could hinder services).
- Economy (rebuilding costs and businesses closed).

Natural, Historic, and Cultural Resources

- Environment (contamination due to broken pipes/gas lines).

Activities that Have Value to the Community

- Damage to houses of worship, community centers, places where people gather.

Effects of Population Change and Development in Hazard-Prone Areas

As Howard County anticipates potential changes in population density, it's crucial to understand how these trends may influence the County's vulnerability to earthquakes. Although not located near a tectonic plate boundary, understanding earthquake vulnerability is important due to the potential for distant earthquakes to impact the area. Increased population density often leads to more extensive development, with a higher concentration of buildings, roads, and critical infrastructure. In the event of an earthquake, densely populated areas may experience a greater impact on buildings and infrastructure, resulting in higher risks of structural damage, collapse, and potential casualties. While Howard County is not located on a major fault line, increased development may extend into nearby regions with greater seismic activity potential. In the event of a surface rupture or ground shaking, densely developed areas could experience more significant ground displacement, contributing to structural damage.

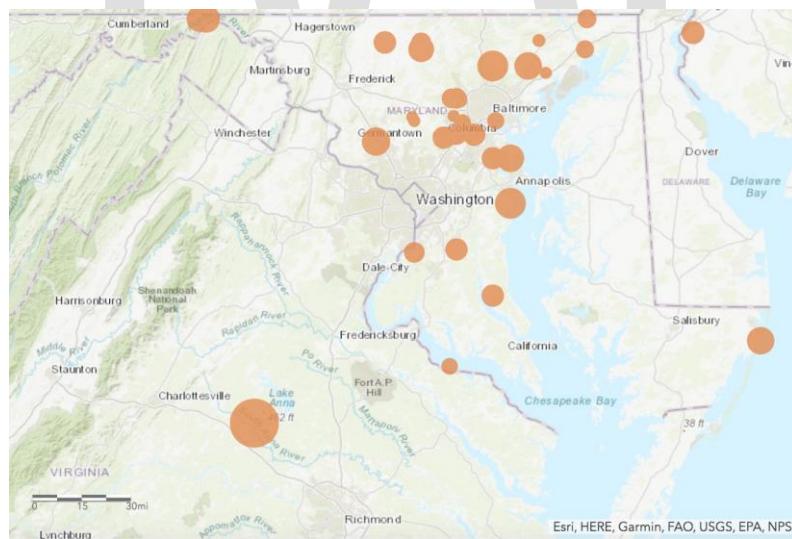
There are no earthquake-prone areas in Howard County, therefore, we conclude that future development in general could possibly increase our vulnerability to earthquakes. The design and construction of new structures will play a significant role in determining their vulnerability to earthquake-induced ground shaking. Poorly constructed or inadequately designed buildings could suffer damage or collapse during an earthquake, particularly in areas more susceptible to ground shaking. Areas with certain types of soil, especially loose or water-saturated soils, can experience a phenomenon known as liquefaction during an earthquake. Future development in zones prone to soil liquefaction could be at risk of significant ground settlement, which can lead to structural damage, tilting, or even sinking of buildings and infrastructure. High-density urban development can amplify the impacts of an earthquake. Tall buildings and closely spaced structures may experience more intense shaking due to the phenomenon known as "urban canyon" effects. Additionally, increased population density can lead to more congestion during evacuation, hampering emergency response efforts. Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). This will help you identify where existing high population densities are located and where future developmental activities are anticipated.

Hazard Occurrences

Data from the Maryland Geological Survey (MGS) indicates there have been 70 earthquakes with epicenters in Maryland between 1758-2017.¹²² The USGS shows the earliest recorded earthquake with its epicenter in Maryland occurred in Annapolis on April 24th, 1758. The shock lasted 30 seconds and could be felt as far away as Pennsylvania. In recent years, moderate-sized earthquakes which occurred in nearby states have been felt in Maryland with only minimal effects. On November 19th, 1969, a 4.3 magnitude earthquake near Elgood, West Virginia was felt in Central Maryland, including Howard County. On February 28th, 1973, residents throughout the Mid-Atlantic region were jolted awake by shock waves from a minor earthquake near the Delaware/New Jersey/Pennsylvania border. Numerous points in northeastern Maryland reported this earthquake.¹²³

Maryland's USGS earthquake history was reviewed to identify past earthquake occurrences that have impacted Howard County. According to the USGS, there were 18 notable earthquake incidents in Howard County, Maryland since 1991.¹²⁴ The strongest magnitude event was a magnitude 2.7 event that occurred near Columbia, MD in 1993. More recently Howard County has experienced a magnitude 2.1 event in August of 2021 and a magnitude 2.0 event in October of 2022. The likelihood of significant earthquake damage in Howard County is low since the probability of the area being stricken by an earthquake is relatively low as compared to other parts of the country. Even though earthquakes do occur occasionally, the County is in an area of very low seismic activity.

FIGURE 60: APPROXIMATE EPICENTER OF MARYLAND EARTHQUAKES SINCE 1758¹²⁵



¹²² James P. Reger, *Earthquakes and Maryland*, Md GEOLOGICAL SURVEY, http://www.mgs.md.gov/geology/geohazards/earthquakes_and_maryland.html (last visited Apr. 3, 2023) (These numbers reflect the most up to date data according to the Maryland Geological Survey. Events that may have occurred since 2017 are not listed).

¹²³ *Id.*

¹²⁴ USGS Earthquake Catalog, USGS, shorturl.at/noPSO (last visited Apr. 3, 2023).

¹²⁵ James P. Reger, *Earthquakes and Maryland*, Md GEOLOGICAL SURVEY, http://www.mgs.md.gov/geology/geohazards/earthquakes_and_maryland.html (last visited Apr. 3, 2023).

Notable Earthquake Incidents in Howard County

November 1969	On November 19 th , 1969, a 4.3 magnitude earthquake near Elgood, West Virginia was felt in central Maryland, including Howard County. ¹²⁶
March – December 1993	From March through December 1993, data indicated that a series of two-dozen small tremors occurred near Columbia, Maryland, ranging in magnitude from >1 to 2.7 on the Richter Scale. ¹²⁷
August 2011	<p>On August 23rd, 2011, Maryland experienced the effects of a nearby earthquake when a 5.8 magnitude quake centered in Virginia impacted much of the East Coast. Tremors were felt as far south as North Carolina, as far north as Buffalo and Boston, and as far west as Detroit. The epicenter of the earthquake was about 3.5 miles beneath Mineral, Virginia, which is 35 miles northwest of Richmond. The USGS indicated the earthquake was one of the strongest ever to occur in Virginia and the strongest felt in Maryland.</p> <p>After the ground shook for several seconds, buildings were evacuated, and some businesses and agencies shut down for the afternoon. Rail travel was interrupted, and many commuters faced an early, congested rush hour.¹²⁸ Damage inspections after the earthquake found structural damage was limited, although in some areas there were significant localized damages. In Howard County, many residents were startled by the earthquake but there was no significant damage or injuries reported.</p> <p>The figure below is a USGS “shake map” that shows the intensity of shaking from the Mineral, Virginia earthquake. Note that the area west of Baltimore, where Howard County is located, experienced weak to low shaking intensity and no expected damages.</p>
October 2017	October 30 th , 2017, an earthquake with a magnitude of 1.52 occurred in Glenelg.
November 2017	November 11 th , 2017, an earthquake with a magnitude of 1.5 occurred in Roxbury.
August 2021	August 4 th , 2021, an earthquake with a magnitude of 2.1 occurred in Clarksville.
October 2022	October 10 th , 2022, an earthquake with a magnitude of 2.0 occurred in Sykesville.

¹²⁶ Maryland, THE GREAT SOUTHEAST SHAKEOUT, <https://www.shakeout.org/southeast/maryland/> (last visited Apr. 7, 2023).

¹²⁷ James P. Reger, *Earthquakes and Maryland*, MD GEOLOGICAL SURVEY,

http://www.mgs.md.gov/geology/geohazards/earthquakes_and_maryland.html (last visited Apr. 3, 2023).

¹²⁸ Scott Calvert & Childs Walker, *Earthquake in Virginia Rattles Baltimore and the East Coast*, BALTIMORE SUN (August 23, 2011, 12:00am), <https://www.baltimoresun.com/maryland/bs-xpm-2011-08-23-bs-md-earthquake-20110823-story.html>.

Hazard Future Likelihood – Low

While there is a very likely chance (30%+) of *any* earthquake occurring annually based on historical data, most earthquakes would be low enough in intensity that most community members would not feel them. The historical number of earthquakes is therefore higher than the future likelihood of the hazard occurring. The future annual probability of an earthquake is 1-10% chance of annual occurrence, or one event every 10-99 years. One consideration that could impact the future likelihood of the hazard occurring is if there is an increase in fracking¹²⁹ within the County. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of an Earthquake in Howard County	
Historical Average (time period)	18 events (1992-2022)
Historical Annual Probability	30% + chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	Yes
Future Annual Probability	1-10% chance of annual occurrence
Future Likelihood Score	2 (Infrequent)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Space Weather (Risk Score 1.3)

Hazard Description

Solar storms are a type of space weather. Space weather generally comprises four components: solar flares, coronal mass ejections (CMEs), high speed solar wind, and solar energetic particles.¹³⁰ The type of space weather that is most relevant to Howard County is the threat of geomagnetic storms which fall under coronal mass ejections. A geomagnetic storm is “a major disturbance of Earth’s magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth.”¹³¹ These storms result from variations in the solar wind that produces major changes in the currents, plasmas, and fields in Earth’s magnetosphere.¹³² The largest storms that result from these conditions are associated with solar CMEs “where a billion tons or so of plasma from the sun, with its embedded magnetic field, arrives at Earth. CMEs typically take several days to arrive at Earth, but have been observed, for some of the most intense storms, to arrive in as short as 18 hours.”¹³³ These storms could cause disturbances in the electric power grid, which could negatively impact homes and businesses in Howard County.

¹²⁹ Water Res. Mission Area, *Hydraulic Fracturing*, USGS, https://www.usgs.gov/mission-areas/water-resources/science/hydraulic-fracturing?qt-science_center_objects=0#qt-science_center_objects (last visited Apr. 3, 2023) (defining fracking as “a process that typically involves injecting water, sand, and chemicals under high pressure into a bedrock formation via a well. This process is intended to create new fractures in the rock as well as increase the size, extent, and connectivity of existing fractures in order to extract trapped oil and gas.”).

¹³⁰ *Space Weather FAQ*, NOAA SPACE WEATHER PREDICTION CTR., <https://www.swpc.noaa.gov/content/space-weather-faq-frequently-asked-questions> (last visited Apr. 7, 2023).

¹³¹ *Geomagnetic Storms*, NOAA SPACE WEATHER PREDICTION CTR., <https://www.swpc.noaa.gov/phenomena/geomagnetic-storms> (last visited Apr. 7, 2023).

¹³² *Id.*

¹³³ *Id.*

The following table presents the Risk Score for space weather in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Space Weather Risk Profile					
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight	
	Likelihood	1.0 Unlikely			50%
Consequence	Impact	1.6 Limited-Significant	3.2 Critical-Catastrophic	40%	
	Warning Time	1 Very Long	1 Very Long	5%	
	Duration	3 Long	4 Very Long	5%	
TOTAL RISK SCORE		1.3	2.0		

Hazard Location

Geomagnetic storms are the highest space weather concern for Howard County, and all parts of the County are at the same risk.

Hazard Extent

Geomagnetic storms are measured by “ground-based instruments that observe how much the horizontal component of Earth’s magnetic field varies. Based on this measurement, the storms are categorized from G1 (minor) to G5 (extreme). In the most extreme cases, transformers in power grids may be damaged, spacecraft operation and satellite tracking can be hindered, high frequency radio propagation and satellite navigation systems can be blocked, and auroras may appear much further south than normal¹³⁴. The table below is the scale that NOAA uses to measure classify geomagnetic storms¹³⁵.

¹³⁴ *Storms from the Sun*, NASA, https://www.nasa.gov/mission_pages/sunearth/news/storms-on-sun.html#:~:text=To%20measure%20the%20strength%20of,goes%20from%201%20to%209., (last accessed July 31, 2023).

¹³⁵ *NOAA Space Weather Scales*, NOAA, https://www.swpc.noaa.gov/sites/default/files/images/NOAA_scales.pdf, (last accessed July 31, 2023).

Category		Effect	Physical measure	Average Frequency (1 cycle = 11 years)
Scale	Descriptor	Duration of event will influence severity of effects		
Geomagnetic Storms				
G 5	Extreme	<u>Power systems</u> : widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. <u>Spacecraft operations</u> : may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. <u>Other systems</u> : pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).**	Kp=9	4 per cycle (4 days per cycle)
G 4	Severe	<u>Power systems</u> : possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. <u>Spacecraft operations</u> : may experience surface charging and tracking problems, corrections may be needed for orientation problems. <u>Other systems</u> : induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).**	Kp=8	100 per cycle (60 days per cycle)
G 3	Strong	<u>Power systems</u> : voltage corrections may be required, false alarms triggered on some protection devices. <u>Spacecraft operations</u> : surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. <u>Other systems</u> : intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).**	Kp=7	200 per cycle (130 days per cycle)
G 2	Moderate	<u>Power systems</u> : high-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. <u>Spacecraft operations</u> : corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. <u>Other systems</u> : HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).**	Kp=6	600 per cycle (360 days per cycle)
G 1	Minor	<u>Power systems</u> : weak power grid fluctuations can occur. <u>Spacecraft operations</u> : minor impact on satellite operations possible. <u>Other systems</u> : migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).**	Kp=5	1700 per cycle (900 days per cycle)

* Based on this measure, but other physical measures are also considered.
 ** For specific locations around the globe, use geomagnetic latitude to determine likely sightings ([see www.swpc.noaa.gov/Aurora](http://www.swpc.noaa.gov/Aurora))

Hazard Impacts

In a severe or extreme geomagnetic storm, electric power grid systems could suffer from widespread voltage control problems and possible transformer damage. In a worst-case scenario, such storms could result in complete power grid collapse or blackouts. When magnetic fields move about in the vicinity of a conductor, such as a wire, an electric current is induced into the conductor. This happens on a grand scale during geomagnetic storms. By receiving geomagnetic storm alerts and warnings, power companies can minimize damage and power outages.¹³⁶

Besides the risk to the electric power grid, space weather could have other potential impacts on the ability to conduct timely and uninterrupted emergency response related communication for or among the people of Howard County. Examples include: solar radiation storms that could cause disruption of satellite communication which could disrupt a wide variety of communication methods or Global Navigation Satellite System (GNSS) (i.e. Global Positioning System (GPS)) location precision; or Radio Blackouts of High-Frequency (HF) communication due to an energetic solar flare during the daylight hours could result in inability to communicate via HF radio emergency bands, commercial terrestrial radio, or Amateur Radio networks aiding in emergency response.¹³⁷

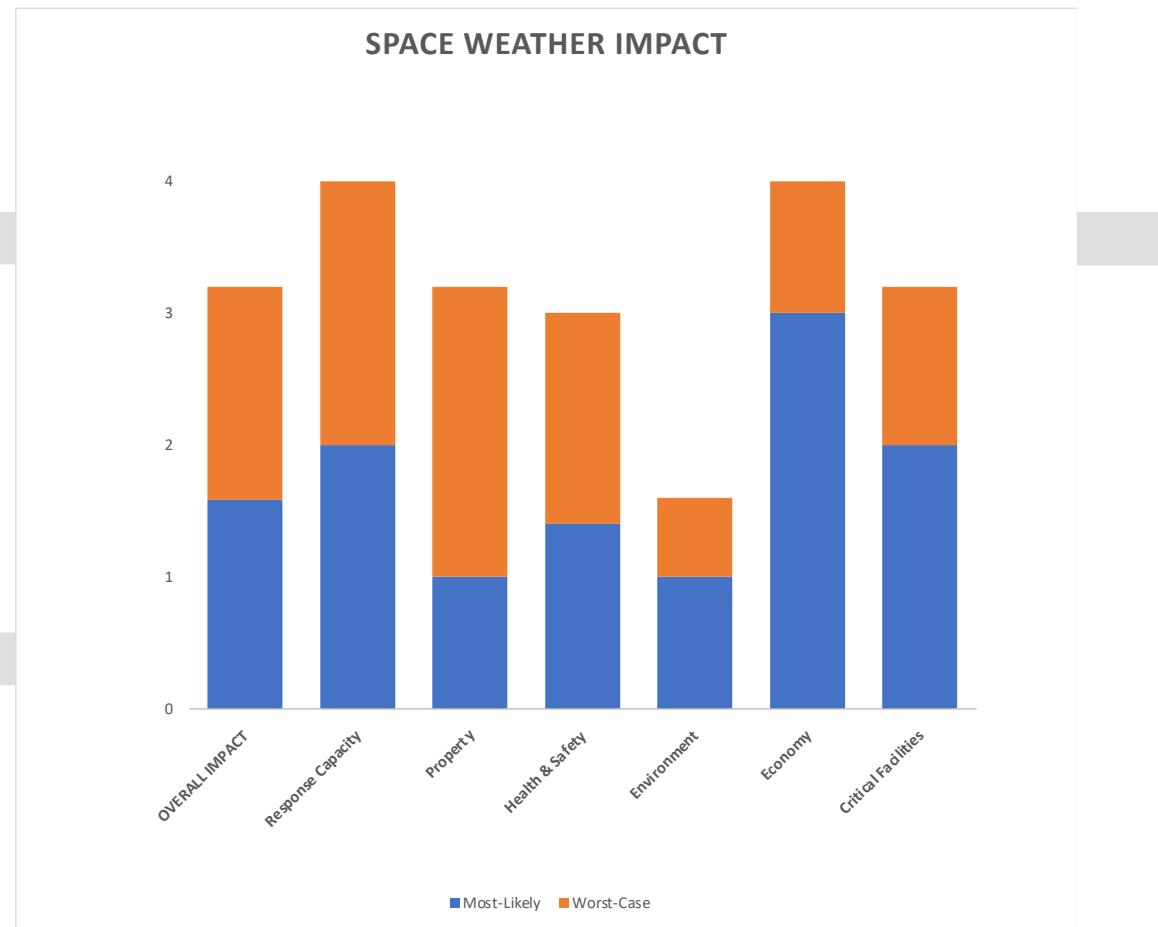
¹³⁶ *A Profile of Space Weather*, NOAA SPACE WEATHER PREDICTION CTR.,

http://www.swpc.noaa.gov/sites/default/files/images/u33/primer_2010_new.pdf (last visited Apr. 7, 2023).

¹³⁷ All the data from this section of the HIRA was provided by the NOAA.

Geomagnetic storms are the highest space weather concern for Howard County. These storms are categorized by the NOAA Space Weather Scales rating from G-1 (minor) to G-5 (extreme).¹³⁸ The risk of hazard intensifies when coupled with extreme weather that has already stressed the power grid, inclining heat waves, blizzards, winter storms, tropical systems, and tornadoes.

The figure and table below characterize space weather impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



Vulnerability of County Assets

Across Howard County, the primary impact of a space weather event will be born out on the electrical infrastructure grid, which will then have a host of cascading effects, depending on the magnitude of the event. Assets in the County that are vulnerable are the following:

People

- Underserved communities, such as those communities with higher challenges to resilience (please refer to Chapter 2, Section FEMA Community Resilience Index to view the map), would be disproportionately impacted by a geomagnetic storm event that takes out the electrical grid

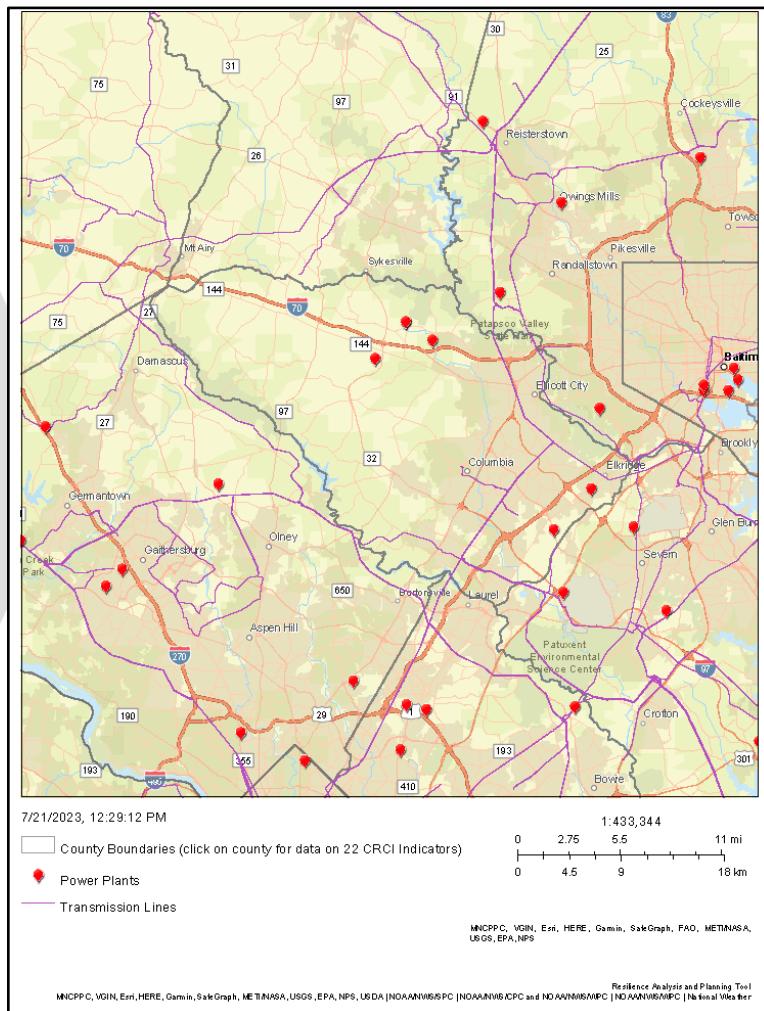
¹³⁸ NOAA Space Weather Scales, NOAA SPACE WEATHER PREDICTION CTR., <https://www.swpc.noaa.gov/noaa-scales-explanation> (last visited Apr. 3, 2023).

due to its cascading effects. These communities will be less likely to have access to alternate power sources like generators.

Structures

- The Energy community lifeline (electricity blackouts or complete loss; unable to pump fuel for vehicles).
- The map below shows power plants and main transmission lines that would be vulnerable to a geomagnetic storm.

FIGURE 61: HOWARD COUNTY ELECTRICAL INFRASTRUCTURE



Systems

- Economy (due to loss of power, businesses do not have access to ecommerce or cannot open businesses).
- Communications (radios and internet are taken out).
- Supervisory Control And Data Acquisition (SCADA) systems (fuel pipelines and other critical infrastructure would be vulnerable).
- Food (loss of storage capabilities).

- Emergency Services (no electricity, fuel, radios, or internet would hinder communications, medical services, and affect equipment).

Natural, Historic, and Cultural Resources

- Environment (migratory animals).
- Historic and cultural artifacts that need environment control for preservation.
- Animal care facilities, such as zoos, veterinary hospitals, and rescues.

Activities that Have Value to the Community

- Many large entertainment venues and events, like concerts at Merriweather Post Pavilion, would be canceled due to loss of electricity.

Effects of Population Change and Development in Hazard-Prone Areas

Increased population density often corresponds with higher technology reliance. In densely populated areas, there could be a greater dependence on electronic devices, communication networks, and critical infrastructure that are susceptible to disruption from space weather events. Densely populated regions may have a more extensive and interconnected communication network, which could be vulnerable to disturbances caused by space weather phenomena like geomagnetic storms. These disruptions can affect both local and long-distance communication systems. The widespread use of GPS navigation systems in densely populated areas increases the potential impact of space weather on navigation accuracy and reliability. Disruptions in GPS signals due to ionospheric disturbances can affect transportation systems and location-based services. Regardless of population density, critical infrastructure sectors such as power grids, transportation, and emergency services can be affected by space weather. Ensuring the resilience of these systems is essential to minimizing vulnerability. Space weather events have the potential to affect global communication and navigation systems, which can impact regions with varying population densities, especially in the context of a technologically interconnected world.

As Howard County, Maryland, envisions future development and urbanization, it's crucial to assess how these changes may impact the county's vulnerability to space weather events. As development expands, so does the complexity and interconnectivity of the power grid. A more intricate power distribution system can be more susceptible to geomagnetically induced currents (GICs) during space weather events, potentially leading to transformer damage and power outages. Densely developed areas are likely to have extensive communication networks, making them more susceptible to disruptions caused by space weather. High-frequency radio signals used for communication, navigation, and emergency services can be affected by ionospheric disturbances during geomagnetic storms. Development can lead to greater interconnectivity between various infrastructure systems. While this can improve efficiency, it can also amplify the cascading effects of space weather-induced disruptions, potentially affecting multiple sectors simultaneously.

Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). This will help you identify where existing high population densities are located and where future developmental activities are anticipated.

Space Weather - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> Critical and non-critical infrastructure will be damaged. Possibility of critical and high voltage switch gear being destroyed, and back-up generators may be worn out. Possible issues to communication and potential concerns with traffic signals are expected.
HEALTH AND SAFETY	Limited-Significant	<ul style="list-style-type: none"> Unknown deaths are expected. Lightning and electrocution are the most common causes of death. Complications due to extreme heat are the most common causes of death. Community members requiring power use for life sustaining interventions would be impacted. For those individuals, underlying medical conditions are the most common causes of death. Unknown injuries likely.
CRITICAL FACILITIES	Significant	<ul style="list-style-type: none"> <u>Utilities</u> – minor disruption due to brownouts. <u>Information/Communication</u> – minor disruption due to brownouts. <u>Transportation</u> – minor disruption due to brownouts.
RESPONSE CAPACITY	Significant	<ul style="list-style-type: none"> <u>Police</u> – Local resources adequate. Low impact to response capability or continuity of operations. May cause law enforcement to lose radio, computer communication for a limited period of time. Land lines will be required for communication. <u>Fire and Rescue</u> – Local resources adequate. Communication issues will be the most impacted. <u>Health</u> – Mutual aid needed. Administrative duties will be on hold until communication can be restored. Clinical services can continue to provide services and maintain mutual charts of their patients. <u>Public Works</u> – Local resources adequate. Any responses that have potential failure nodes due to electronic communications are impacted.
ENVIRONMENTAL IMPACT	Limited	<ul style="list-style-type: none"> Minimal impact on air, water, and land is expected. Limited environmental impact is expected.
ECONOMIC IMPACT	Critical	<ul style="list-style-type: none"> Business disruption, closure, and extended period of electrical, and telecommunications and IT infrastructure damage assessment and repair in economic consequences. Critical economic impact.
TOTAL IMPACT	Limited-Significant	<ul style="list-style-type: none"> Total Impact Score: 1.6 on a scale of 1 (Limited) to 4 (Catastrophic).
	Limited	Significant
		Critical
		Catastrophic

Hazard Occurrences

There have been no notable occurrences of space weather having an impact in Howard County within the reviewed period.

Hazard Future Likelihood - Low

The future annual probability of the hazard occurring is zero-10% chance of annual occurrence, or one event every 10-100 years. A space weather hazard has occurred historically in other jurisdictions, specifically, geomagnetic storms have caused power grid blackouts in the past. This coupled with population density and the high use of electronics within the County may impact the future likelihood of the hazard occurring. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of Space Weather in Howard County	
Historical Average (time period)	No notable occurrences (1972-2022)
Historical Annual Probability	0% chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	0-10% chance of annual occurrence
Future Likelihood Score	1.25 (Unlikely- Infrequent)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Pest Infestation/Zoonotic Infection (1.2)

Hazard Description

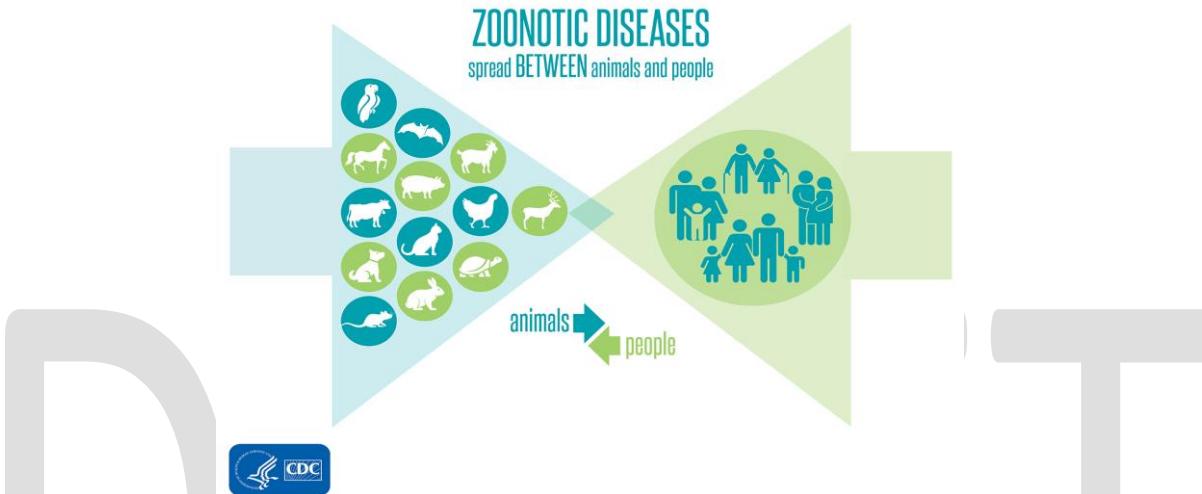
Pest Infestation is the occurrence of one or more pest species in an area or location where their numbers and impact are currently or potentially at intolerable levels. Zoonotic Diseases (also known as zoonoses) “are caused by infections that spread between animals and people”¹³⁹. Additionally, “scientists estimate that more than six out of every ten known infectious diseases in people are spread from animals, and three out of every four new or emerging infectious diseases in people are spread from animals. Every year, tens of thousands of Americans will get sick from harmful germs spread between animals and people”²⁴⁷.

Pest infestations include vectors such as insects, birds, and rodents. Two species of bedbugs feed on humans: the common bedbug (*Cimex lectularius*), which occurs in most parts of the world, and the tropical bedbug (*Cimex hemipterus*), which occurs mainly in tropical countries. They are a severe nuisance when they occur in large densities, being commonest in places with poor housing conditions. They are not important in the transmission of diseases, although they possibly play a role as vectors of Hepatitis B virus. For infants living in heavily infested houses, where they may receive 100 or more bites a night, it is possible that the blood loss could cause mild anemia. Zoonotic diseases spread between

¹³⁹ Zoonotic Diseases, CTRS. FOR DISEASE CONTROL & PREVENTION, <https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html> (last visited Apr. 3, 2023).

animals and people. Some examples of zoonotic diseases / infections include, but are not limited to, animal influenza, avian influenza, and Lyme disease.¹⁴⁰

FIGURE 62: ZOONOTIC DISEASE SPREAD¹⁴¹



Zika is a viral disease transmitted to humans by infected mosquitoes. It causes fever and severe joint pain. Other symptoms include muscle pain, headache, nausea, fatigue, and rash. After the bite of an infected mosquito, onset of illness occurs usually between four to eight days but can range from two to 12 days. The Zika virus was first identified in 1947 in Uganda. This virus produced a rare and mild disease until suddenly re-emerged in Brazil in 2015 and spread explosively through South America, Central America, and the Caribbean. The first importation in the United States may have occurred between March and mid-April of 2016, however, it was not detected until July 2016.¹⁴² The Zika virus is associated with a birth defect known as microcephaly. In addition, the Zika virus can cause a neurologic condition, known as Guillain-Barre Syndrome, in adults which results in muscle weakness or paralysis, in extreme cases.

These viruses are transmitted from human-to-human by the bites of infected female mosquitoes. Most commonly, the mosquitoes involved are *Aedes aegypti* and *Aedes albopictus*, two species which can also transmit other mosquito-borne viruses, including West Nile Virus and dengue. These mosquitoes can be found biting throughout daylight hours, though there may be peaks of activity in the early morning and late afternoon. Both species are found biting outdoors, but *Aedes aegypti* will also readily feed indoors.

¹⁴⁰ *Id.*

¹⁴¹ *Id.*

¹⁴² Giovanni Marini, Giorgio Guzzetta, Roberto Rosa, & Stefano Merler, *First outbreak of Zika virus in the continental United States: a modelling analysis*, 22 EURO SURVEILL. 37, <https://doi.org/10.2807/1560-7917.ES.2017.22.37.30612>.

The following table presents the Risk Score for pest infestation/zoonotic diseases in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.

Pest Infestation/Zoonotic Infection Risk Profile				
Likelihood	Risk Assessment Category	Likely Hazard Scenario	Worst-Case Hazard Scenario	Weight
	Likelihood	1.0 Unlikely		
Consequence	Impact	1.2 Limited-Significant	1.3 Limited-Significant	40%
	Warning Time	1 Very Long	1 Very Long	5%
	Duration	4 Very Long	4 Very Long	5%
TOTAL RISK SCORE		1.2	1.3	

Hazard Location

Low, but persistent levels of West Nile Virus and more recently (to a lesser extent), Zika Virus, are examples of mosquito related pest infestations that have been documented throughout Maryland, including Howard County. There is frequent travel within the County and many bed bug cases occur in hotels. The County is also near many metropolitan areas/airports/and interstates which increases the likelihood of diseases being spread across the County. Lyme disease, a tickborne related disease, is also well documented in Howard County.

Hazard Extent

Measuring the severity of pest infestations and/or zoonotic infection will depend largely on the nature of the infestation or infection. For **zoonotic infections**, such as Zika, diagnostic testing or antibody testing is used to determine the level of infection in the population. One limiting factor of antibody testing is that it cannot distinguish between a recent infection and a prior infection, so it is difficult to estimate local infection levels based on antibody testing alone¹⁴³. Surveys of the disease vector, in the case of Zika, mosquitoes, also provide insights about the potential for spread of the infection. Once a zoonoses is detected, it can be classified, like other diseases, as an epidemic, a pandemic, an outbreak, or eventually endemic. The definitions for each classification are below:

- Epidemic— “a disease that affects a large number of people within a community, population, or region”¹⁴⁴.

¹⁴³ Centers for Disease Control and Prevention. *Testing for Zika*.

<https://www.cdc.gov/zika/symptoms/diagnosis.html>. (Last accessed August 1, 2023).

¹⁴⁴ What’s the Difference Between a Pandemic, an Epidemic, Endemic, and an Outbreak? 2020, Intermountain Health, <https://intermountainhealthcare.org/blogs/topics/live-well/2020/04/whats-the-difference-between-a-pandemic-an-epidemic-endemic-and-an-outbreak/>, (last accessed August 1, 2023).

- Pandemic— “an epidemic that’s spread over multiple countries or continents”¹⁴⁵.
- Endemic—a disease that “belongs to a particular people or country”¹⁴⁶.
- Outbreak— “a greater than anticipated increase in the number of endemic cases. It can also be a single case in a new area. If it’s not quickly controlled, an outbreak can become an epidemic”¹⁴⁷.

In addition, the World Health Organization (WHO) also created the six Pandemic Phases to help countries around the world prepare and respond to diseases. These phases might not always proceed in numerical order. The phases along with their descriptions and actions that the WHO recommends for affected and not-yet-affected countries can be seen in the table below¹⁴⁸:

	ESTIMATED PROBABILITY OF PANDEMIC	DESCRIPTION	MAIN ACTIONS IN AFFECTED COUNTRIES	MAIN ACTIONS IN NOT-YET-AFFECTED COUNTRIES
PHASE 1	Uncertain	No animal influenza virus circulating among animals has been reported to cause infection in humans.	Producing, implementing, exercising, and harmonizing national pandemic influenza preparedness and response plans with national emergency preparedness and response plans.	
PHASE 2		An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.		
PHASE 3		An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.		
PHASE 4	Medium to high	Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level outbreaks has been verified.	Rapid containment.	Readiness for pandemic response.
PHASE 5	High to certain	The same identified virus has caused sustained community-level outbreaks in at least two countries in one WHO region.	Pandemic response: each country to implement actions as called for in their national plans.	Readiness for imminent response.
PHASE 6	Pandemic in progress	In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region.		
POST-PEAK PERIOD		Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.	Evaluation of response; recovery; preparation for possible second wave.	-
POSSIBLE NEW WAVE		Level of pandemic influenza activity in most countries with adequate surveillance is rising again.	Response	
POST-PANDEMIC PERIOD		Levels of influenza have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.	Evaluation of response; revision of plans; recovery.	

¹⁴⁵ *Ibid.*

¹⁴⁶ *Ibid.*

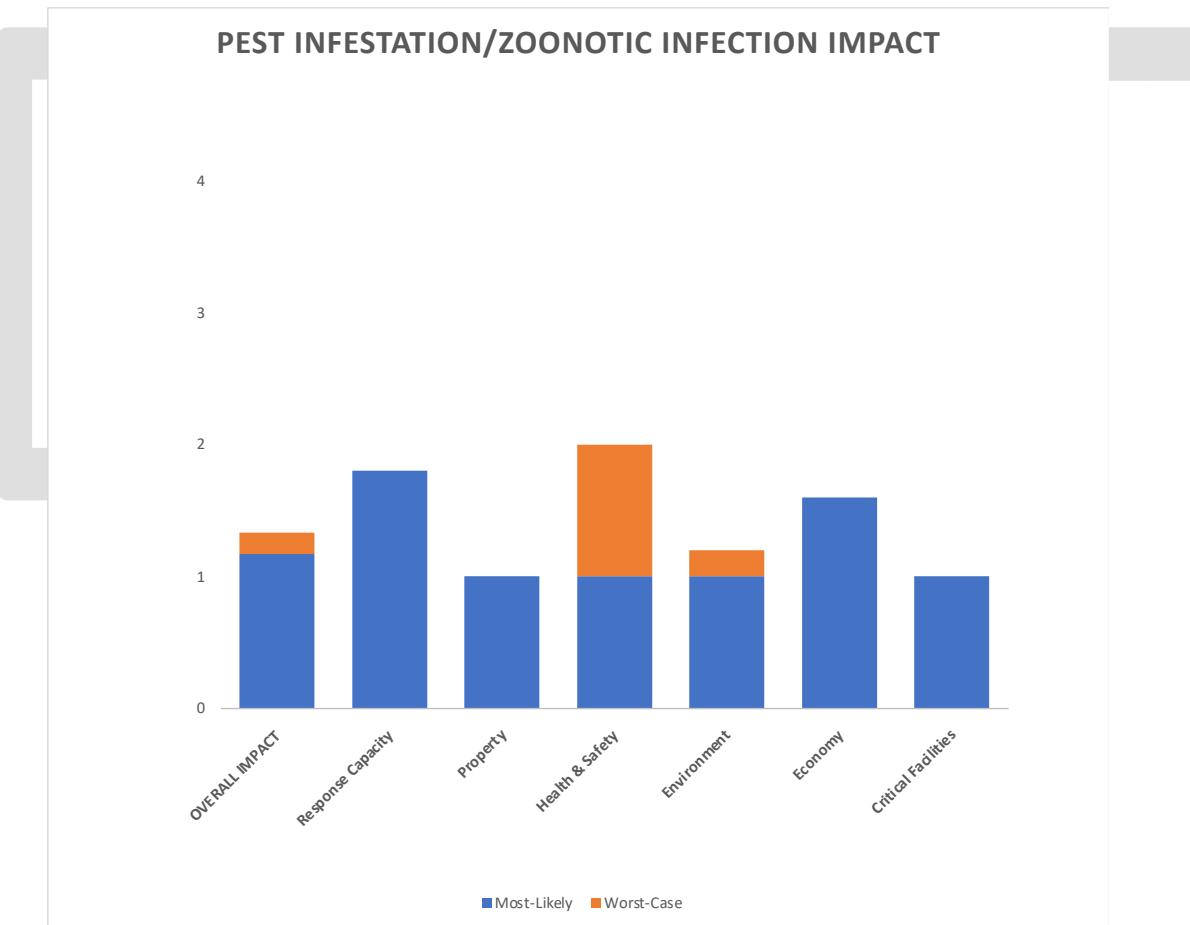
¹⁴⁷ *Ibid.*

¹⁴⁸ The WHO Pandemic Phases, National Library of Medicine, <https://www.ncbi.nlm.nih.gov/books/NBK143061/>, (last accessed August 1, 2023).

For **pest infestations**, such as bed bugs or lice, the magnitude will largely be determined by households affected, as this is the greatest indicator of spread occurring between community members. Pest infestations that are agricultural in nature may rely on a Disease Severity Index that determines the percentage of a crop/herd affected¹⁴⁹.

Hazard Impacts

Like West Nile Virus, Zika has the potential to affect community members and visitors to Howard County who have spent time in areas with an infected mosquito population. Pregnant women may be the most vulnerable as cases of microcephaly have been linked with fetuses exposed in utero to the Zika virus. The figure and table below characterize pest infestation/zoonotic infection impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy.



¹⁴⁹ US Department of Agriculture. Chiang, K., Liu, H., Bock, C.H. 2017. A discussion on disease severity index values: warning on inherent errors and suggestions to maximize accuracy. Annals of Applied Biology. 171:139-154.
<https://www.ars.usda.gov/research/publications/publication/?seqNo115=338027>

Vulnerability of County Assets

While specific impacts on Howard County would depend on the nature of the hazard, there are likely to be health and human safety impacts for whatever pest infestation or zoonotic infection. The following assets would be vulnerable in Howard County:

People

- People who live in western Howard County (more rural areas provide ample habitat for some pests).
- People who live in densely populated areas, which is eastern Howard County (high population density can lead to easier vector transmission).
- People unable to clean and maintain their homes to prevent pest infestation or transmission of zoonoses (this could include older adults or people with access and functional needs).
- People in consistent contact with livestock or those who work on farms.
- More vulnerable populations in eastern Howard County, as indicated in the [Community Resilience Index map in Chapter 2](#) may experience disparate effects based on being less likely to implement mitigation measures that could prevent transmission.

Structures

- Wooden structures, both residential and commercial, are vulnerable to insects like termites

Systems

- Economy (zoonoses, such as avian flu, threaten large swathes of livestock and can negatively impact production; also, pest infestations can cause the shutdown of businesses).
- Food safety (people could eat contaminated animal products).

Natural, Historic, and Cultural Resources

- Historic homes made of wood are vulnerable to termites.

Activities that Have Value to the Community

- Entertainment or cultural events could be canceled if a building is closed due to unsanitary conditions caused by pests.

Effects of Population Change and Development in Hazard-Prone Areas

Continued development will increase population density, thereby expanding opportunities for vector transmission. As Howard County is in close proximity to a major international airport, two major metropolitan areas, an international shipping port, and a major interstate, it experiences a constant flow of people through Howard County from across the world, expanding the possibility for unknowing transmission of a zoonotic infection or introduction of a pest.

As Howard County, Maryland, anticipates potential changes in population density and undergoes future development, it's crucial to understand how these trends could influence the County's vulnerability to pest infestation and zoonotic infections. Higher population density often leads to increased urbanization, which can alter natural habitats and provide new environments for pests and disease vectors to thrive. This can include increased waste production and poorly managed urban areas that attract pests like rodents and insects. Crowded living conditions can increase the potential for zoonotic

disease transmission from animals to humans. Increased contact between humans and animals, including pets and wildlife, can facilitate the spread of diseases like rabies, Lyme disease, and West Nile virus. Both high and low population density areas could be affected by changing climate patterns, influencing the distribution of pests and diseases. Warmer temperatures can extend the range of disease vectors and increase the rate of pest reproduction. Regardless of population density, modern travel and globalization can introduce pests and diseases to new areas. Air travel, trade, and tourism can contribute to the spread of pests and zoonotic infections.

Population growth, density, and upcoming development are most noticeable in the central and southeastern parts of Howard County. To locate the specific areas of current and projected population density, as well as anticipated future development, please refer to Chapter 2 of the Plan. This chapter covers the [Growth and Development](#), with a subsection dedicated to [Future Development](#). This will help you identify where existing high population densities are located and where future developmental activities are anticipated.

Pest Infestation / Zoonotic Infection - Consequence Analysis		
Likely		
CATEGORY	RANKING	DESCRIPTION
PROPERTY DAMAGE	Limited	<ul style="list-style-type: none"> No structural damage but significant loss in furniture and carpeting is expected.
HEALTH AND SAFETY	Limited	<ul style="list-style-type: none"> Zero deaths are expected. Most deaths would be unlikely but when they do occur, it is due to an occurrence in conjunction with other comorbidities. Zero to five injuries are expected. Allergy, anxiety, and sleepiness are the most common causes of injuries.
CRITICAL FACILITIES	Limited	<ul style="list-style-type: none"> <u>Utilities</u> – No critical facilities will be shut down and no outage is expected. <u>Information/Communications</u> – Shutdown unlikely. No major impact on information or communications infrastructure. <u>Transportation</u> – Shutdown unlikely. Impacts to transportation will be minor and short-term.
RESPONSE CAPACITY	Limited-Significant	<ul style="list-style-type: none"> <u>Police</u> – Local resources adequate. No impact to response capability or continuity of operations. <u>Fire and Rescue</u> – Local resources adequate. No impact to response capability and continuity of operations. <u>Health</u> – Local resources adequate. HD operations will not be affected severely. The HDOC will be monitoring and recording infestations throughout the county with the assistance of environmental health. Informing the public and steps needed to ensure to maintain a healthy living environment will occur. <u>Public Works</u> – Local resources adequate. No impact on response capability and COOP.
ENVIRONMENTAL IMPACT	Limited	<ul style="list-style-type: none"> Limited environmental impact is expected. Minimal impact on air, water, and land resources.
ECONOMIC IMPACT	Limited-Significant	<ul style="list-style-type: none"> Negative impact on retail and County reputation in economic consequences.

TOTAL IMPACT	<i>Limited-Significant</i>	▪ Total Impact Score: 1.2 on a scale of 1 (Limited) to 4 (Catastrophic).		
Limited		Significant	Critical	Catastrophic

Hazard Occurrences

There have been no notable incidents in Howard County during the review period of 1972-2022.

Hazard Future Likelihood - Low

While there may be continued instances of zoonotic infections or pest reports, there is no evidence that these would rise to the level of an infestation or a widespread infectious event. The future annual probability for this hazard is a 1% chance of annual occurrence, or one event every 99 years. The following table anticipates the future occurrence rate of the hazard based on historical likelihood and future trends.

Future Likelihood of a Pest Infestation/Zoonotic Infection in Howard County	
Historical Average (time period)	Zero events (1972-2022)
Historical Annual Probability	0% chance of annual occurrence
Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)	No
Future Annual Probability	0-1% chance of annual occurrence
Future Likelihood Score	1.0 (Infrequent- Likely)
<i>Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.</i>	

Emerging Hazard Trends

Howard County recognizes that hazards and the risks they present are likely to change from year to year, and that the emerging issue of global climate change will likely affect how hazards will impact the County in the future. Although there is no way to accurately anticipate these future developments, the County continually monitors trends in terms of probability and potential impacts as a way to develop and calibrate mitigation activities.

Climate Change

In the Baltimore Metropolitan region, annual temperature, annual precipitation, and sea levels are all rising slowly and steadily, and have been doing so for many decades.¹⁵⁰ Future projections anticipate continued increases in temperature, precipitation, and sea levels, increasing the likelihood and consequences of a variety of hazards, such as extreme heat, flooding, thunderstorms, windstorms, hurricanes, and severe winter weather.¹⁵¹ These changes will put additional strain on underserved

¹⁵⁰ Planning, Designing, Operating, and Maintaining Local Infrastructure in a Changing Climate, BALTIMORE METRO. COUNCIL, https://www.baltometro.org/sites/default/files/bmc_documents/general/transportation/climate-change/Climate%20Change%20Resource%20Guide.pdf (last visited Apr. 3, 2023).

¹⁵¹ *Id.* at 9-17.

populations who do not have the same resources to withstand and recover from natural hazards as the general population, as well as those who may be more vulnerable to the impacts of natural hazards because of health conditions or age.

Additionally, climate change will strain local infrastructure and lifelines with heavy precipitation, flooding, sea level rise, extreme heat, and other extreme weather conditions. For example, transportation, stormwater, water, wastewater, facilities, and solid waste infrastructure will be subjected to heightened challenges that will threaten their continuity of operations and increase maintenance costs.¹⁵²

Food Insecurity

Natural hazards threaten food security by posing risks at every step of the food supply chain: production, transportation, storage, and distribution. For example, droughts can reduce crop yields, lowering the amount of food in the supply chain; tornadoes can destroy major roads relied upon by food transporters; and storms may knock out power, causing refrigerated food to spoil.

Climate change has exacerbated these supply chain vulnerabilities, revealing the need for local emergency managers to increase their situational awareness of the issue and identify the communities at greatest risk of food insecurity. This requires mapping local food distribution points, warehouses, roads prone to flooding and high traffic, public schools, and areas of higher food insecurity, as well as building relationships with pantries, the Maryland Food System Council, and private food businesses. It also requires building up the resilience of the infrastructure that underlies the food supply chain, such as transportation and power.

¹⁵² *Id.* at 20-35.

Chapter 5: Capability Assessment

CFR Requirements for Plan Integration

44 CFR § 201.6(c)(4): The plan must include [a] plan maintenance process that includes:

- (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
- (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
- (iii) Discussion on how the community will continue public participation in the plan maintenance process.

44 CFR § 201.6(b)(3): [T]he planning process must include [the] review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Introduction

Through the dedication and hard work of multiple County departments and agencies, Howard County continues to maintain a high level of preparedness through the application of hazard mitigation principles. For example, the County maintains strong flood-control practices, including rigorous permitting procedures which aim to ensure flooding is kept to a minimum in the region. The County is constantly looking for opportunities to implement, update, and cross-pollinate hazard mitigation principles into various plans, ordinances, regulations, and programs across the County. This approach ensures that all documents are well-coordinated, complementary, and that effective hazard mitigation principles are applied in all applicable aspects of County management.

The sections below include a review of select planning documents and ordinances used by the County in the areas of building standards, stormwater management, comprehensive planning, emergency operations, and capital improvements programming. Areas where hazard mitigation principles are addressed or should be addressed are indicated. Options to incorporate hazard mitigation considerations into these documents have been included to facilitate the seamless application of mitigation principles to the plans and documents. The rest of the section includes a brief overview of County organization followed by a Capabilities Assessment table describing specific capabilities across County government related to hazard mitigation.

Plan Integration

This document review is comprised of an inventory of the County's existing planning and regulatory tools and a review and incorporation of existing plans and other technical information as appropriate.

The purpose of a plan/ordinance review is trifold:

- To identify existing County standards and mandates;

- To provide an inventory and review of sample plans and ordinances and identify sections in these documents that address hazard mitigation-related issues; and,
- To provide a platform to integrate plans and other documents to reconcile any inconsistencies among different documents.

The sections below include a review of relevant Howard County plans and ordinances, including:

- PlanHoward 2030¹⁵³
- Office of Emergency Management Strategic Plan 2020-2025¹⁵⁴
- County Ordinances related to Subdivision and Land Development, Floodplains, and Stormwater Management

Planning Integration Practices

Internal Process for Integrating this Plan into Other Planning Mechanisms

Howard County departments and offices consistently work together when developing plans to integrate each other's plan data, information, goals, and actions. It is standard practice to reach out and engage with relevant partners in other departments and offices when writing a new plan or updating an old one. In addition, OEM employees are members of several different working groups (both within and external to the County) that meet once a month or more where news of new plans, expertise that is needed, or missing information is shared with the group. One of these groups is called the Emergency Management Operations Group (EMOG). These meetings occur monthly and are hosted by OEM and representatives from County departments that could be asked to work in the Emergency Operations Center during an incident attend these meetings. This provides OEM with the chance to make sure that not only is hazard mitigation planning incorporated into all other plans in the County, but that we include other plan strategies in this Plan as well.

External Process for Integrating this Plan into Other Planning Mechanisms

Howard County departments and offices often work with external agencies and neighboring jurisdictions during the planning process to integrate each other's plan data, information, goals, and actions. All OEM employees sit on at least one Baltimore Urban Area Security Initiative (UASI) committee where regional partners come together once a month to discuss jurisdictional plans that are being developed, regional plans, resources, and available trainings. This ensures that data, best practices, and expertise can be shared. Some of these groups under the UASI include the Public Information and Outreach Committee, the Recovery/Emergency Management/Training and Exercise Committee, the Regional Catastrophic Preparedness Grant Program Taskforce, the Special Operations Committee, the Disaster Debris Committee, the Regional Evacuation Working Group, and the Grants and Fiscal Representatives Committee.

¹⁵³ PlanHoward 2030, HOWARD CNTY. DPET. OF PLANNING AND ZONING (amended Feb. 9, 2021),

<https://www.howardcountymd.gov/sites/default/files/2021-03/PlanHoward2030Amended.pdf>.

¹⁵⁴ Strategic Plan 2020-2025, HOWARD CNTY. OFFICE OF EMERGENCY MGMT. (June 2020), <https://live-hoco-d9.pantheonsite.io/sites/default/files/2021-05/Signed%20Final%202020-2025%20OEM%20Strategic%20Plan.pdf>.

Howard County General Plan (PlanHoward2030)

The following policies and implementing actions in the County General Plan, developed by the Howard County Department of Planning and Zoning (DPZ) in 2012 and amended in 2021, were developed to be in harmony with relevant County plan actions. Howard County OEM participated as part of the DFRS in contributing to this plan. We have listed the clauses below that relate to hazard mitigation.

PLANHOWARD 2030 REVIEW			
PLAN TOPIC	PAGE NUMBER	ITEM TYPE	CURRENT CLAUSE
Environmental Protection	19	Water Resources Element (WRE)	The Water Resources Element (WRE), an amendment to General Plan 2000, was adopted in April 2010. The WRE is intended to ensure the County has a safe and adequate supply of drinking water, and adequate land and water capacity for the treatment of wastewater and stormwater, to support future growth. The WRE contains policies and actions to help the County manage water resources more sustainably to ensure that, as the County continues to grow, water resources will be conserved, protected, and restored to health. The WRE is included in PlanHoward 2030 by reference and may be updated in the future to reflect evolving water and sewer demand and pollution reduction requirements.
	19	Policy 3.1	Ensure the adequacy of wastewater treatment capacity.
	19	Policy 3.2	Reduce pollution loads to surface and groundwater.
	19	Implementing Action	Stormwater Utility. Institute a dedicated fund to ensure increased and sustained funding for stormwater and watershed management programs.
	20	Policy 3.3	Use watershed management plans to guide the protection and restoration of water resources.
	20	Implementing Action	Watershed Management Plans. Prepare comprehensive watershed management plans for all watersheds, to set priorities and guide efforts to protect, restore, and improve the County's water resources. Complete and update all watershed management plans on a regular cycle.
	20	Implementing Action	Forest Cover and Riparian Forest Buffers. Establish and achieve measurable goals for forest cover and riparian forest buffers in all County watersheds.
	20	Implementing Action	Wetlands. Develop a wetlands program to inventory, map, protect, and enhance wetland resources.
	20	Policy 3.4	Coordinate regional protection of water resources.
	20	Implementing Action	Patuxent and Patapsco Rivers. Coordinate and cooperate with other local, regional, and State agencies and organizations on joint watershed planning and management for the Patuxent and the Patapsco Rivers.
	20	Implementing Action	Patapsco Heritage Area Management Plan. Work with the Patapsco Heritage Greenway, Inc. and Baltimore County to

PLANHOWARD 2030 REVIEW			
PLAN TOPIC	PAGE NUMBER	ITEM TYPE	CURRENT CLAUSE
			assist in implementing the management plan, certified by the Maryland Heritage Area Authority, for those portions that apply to Howard County. The adopted plan is included in PlanHoward2030 by reference.
	22	Implementing Action	Best Management Practices. Expand current outreach and education efforts to promote and assist private property owners with the implementation of BMP.
	24	Implementing Action	Streams, Wetlands, and Floodplains. Evaluate the effectiveness of current regulations in protecting streams, wetlands, and floodplains.
	25	Policy 3.8	Improve stormwater management practices throughout the County to help restore and protect water resources.
	25	Implementing Action	Redevelopment. Ensure redevelopment is designed and implemented to reduce stormwater runoff rate, volume, and pollution to the maximum extent practicable.
	Recommendation: There are no additional recommendations at this time.		
Resource Conservation	Recommendation: Include an additional implementing action to protect historic resources from the impacts of natural hazards through preservation-based hazard mitigation solutions.		
Economic Development	Recommendation: Develop a new policy and implementing actions that encourages economic resilience and encourages business owners to have a business continuity plan for flood and other hazard events.		
Public Facilities and Services	105	Policy 8.4	Policy 9.4 – Ensure the adequacy of water and sewer services.
	105	Implementing Action	Wastewater Treatment Plant Capacity. Monitor flows to the Little Patuxent Water Reclamation Plant to ensure sufficient capacity for projected growth in the Planned Service Area.
	108	Policy 8.7	POLICY 8.7 – Identify and fund the most cost-effective strategies for Watershed Implementation Plan execution.
	108	Implementing Action	Best Management Practices. Monitor and evaluate the cost-effectiveness of diverse BMP to maximize nutrient reduction from the funds expended.
	119	Policy 8.16	POLICY 8.16 – Minimize loss of life, loss of property, and injury due to fire or medical emergencies.
	119	Implementing Action	Fire Stations. Construct and staff the new and replacement fire stations in the current Capital Improvement Program (Waterloo, Elkridge, and Banneker). Renovate and rehabilitate existing fire stations as appropriate to ensure the continued provision of efficient service.
	120	Implementing Action	Underground Cisterns. Continue to construct underground cisterns to support fire suppression in the Rural West.
	120	Implementing Action	Fire and Rescue Vehicles. Provide funding to replace fire and rescue vehicles when needed.

PLANHOWARD 2030 REVIEW			
PLAN TOPIC	PAGE NUMBER	ITEM TYPE	CURRENT CLAUSE
	120	Implementing Action	Adequate Resources. Ensure the Police Department has adequate staff and equipment based on levels of crime and demand for services.
Recommendation: There are no additional recommendations at this time.			
Community Design	138	Implementing Action	Infrastructure Gaps. Expand existing infrastructure for older communities that were constructed under prior regulations, so these communities could benefit from additional improvements such as storm drains and sidewalks.
	138	Implementing Action	Environmental Enhancement. Expand environmental remediation to address storm water management, stream bank erosion, and buffer conservation.
	Recommendations: There are no additional recommendations at this time.		
General Plan Amendment	Ellicott City Watershed Master Plan (2020) is a comprehensive, long-range document created by a community-driven vision for historic Ellicott City and the Tiber Branch Watershed and was adopted as a general plan amendment and included in PlanHoward2030 by reference.		

Howard County Code of Ordinances – Subdivision and Land Development, Floodplain, and Stormwater Management (2022)

The following sections of the Howard County Subdivision and Land Development, Floodplain, and Stormwater Management Ordinances relate to mitigation and are echoed in this document.

HOWARD COUNTY CODE OF ORDINANCES REVIEW – SUBDIVISION AND LAND DEVELOPMENT, FLOODPLAIN, AND STORMWATER MANAGEMENT ORDINANCES	
TITLE 16 – SUBTITLE 1 – SUBDIVISION AND LAND DEVELOPMENT	
PLAN TOPIC & CITATION(S)	CURRENT CLAUSE
§ 16.104 Waivers § 16.104(d)(2-6)	(d) <i>No Waivers of Floodplain, Wetland, Stream, or Steep Slope Regulations in the Tiber Branch Watershed.</i> The Department may not grant waivers of any requirement of section 16.115 or section 16.116 of this title for any property located in the Tiber Branch Watershed unless the waiver: (2) Is necessary for the reconstruction of existing structures or infrastructure damaged by flood, fire, or other disaster; (3) Is necessary for the construction of a stormwater management or flood control facility as part of a redevelopment project; (4) Is necessary for the retrofit of existing facilities or installation of new facilities intended solely to improve stormwater management or flood control for existing development[.] (5) Is requested as part of a development proposal and the Director of the Department of Public Works, or his designee serving as Floodplain Administrator, finds that upon completion of construction of the development, which may include off-site improvements within the Tiber Branch Watershed, there will be improvement to flood control in the

	<p>Tiber Branch Watershed at least ten percent more than what would otherwise be required by law; or</p> <p>(6) Is necessary for the construction of an addition, garage, driveway or other accessory use improvement of an existing residential structure on property located within the Tiber Branch Watershed that increases the square footage of the impervious surfaces on the property by no more than 25 percent over the square footage of impervious surfaces that existed on the property prior to the effective date of this bill [Dec. 9, 2016].</p>
§ 16.115 Floodplain Preservation § 16.115(a)(1-3) § 16.115(b)(1-2) § 16.115(c)(1-2)	<p>(a) <i>Development Restricted in 100-Year Floodplain (Base Flood Elevation)</i>. Development within the boundaries of the 100-year floodplain (base flood elevation) shall be pursuant to title 16, subtitle 7 of this Code. Most land within base flood elevation is considered a protection area (i.e., a stream valley or valuable ecological area or scenic resource) which is shown:</p> <ul style="list-style-type: none"> (1) In the General Plan of Howard County for conservation status; or (2) In the master plan of parks for acquisition as a conservation area; or (3) In the capital improvement program for acquisition as a conservation area. <p>(b) <i>Floodplain Protection</i>. In subdivisions and site development plans containing a 100-year floodplain (base flood elevation), the floodplain land shall be protected in accordance with one of the following alternatives. Prior to the recordation of the final plat and final acceptance of the construction drawings, a deed description of the floodplain will be provided when requested.</p> <ul style="list-style-type: none"> (1) Deed the floodplain land to the County. Developers are encouraged to dedicate and deed the land in the 100-year floodplain (base flood elevation) to Howard County as permanent open space. (2) Grant a floodplain easement to Howard County. If the floodplain is not dedicated to the County, the developer shall grant the County right of entry through a perpetual easement, and shall: <ul style="list-style-type: none"> (i) Dedicate and deed the land area within the 100-year floodplain (base flood elevation) in fee simple to a legally constituted property owners association. The property owners association may use the area in any manner consistent with the maintenance and preservation of the area as a floodplain; or (ii) Include the 100-year floodplain (base flood elevation) within the boundary of the lots in accordance with section 16.120 of this subtitle. The property owner whose lot includes floodplain area may use the area in any manner consistent with the maintenance and preservation of the area as a floodplain. <p>(c) <i>Prohibitions on Use of Floodplain Land</i>:</p> <ul style="list-style-type: none"> (1) A person shall not store materials of any kind in a floodplain either temporarily or permanently. Accordingly, building materials and other debris shall not be stored or discarded in floodplains. (2) No clearing, excavating, filling, altering drainage, or impervious paving, may occur on land located in a floodplain unless required or authorized by the Department of Planning and Zoning upon the advice of the Department of Inspections, Licenses and Permits, the Department of Public Works, the Department of Recreation and Parks, the Soil Conservation District, or the Maryland Department of the Environment. Any proposed construction of a structure located within a floodplain shall be subject to the requirements of the Howard County Building Code.

<p>§ 16.116 Protection of Wetlands, Streams, and Steep Slopes</p> <p>§ 16.116(a)(1-4) § 16.116(b)(1-2)</p>	<p>(a) <i>Streams and Wetlands:</i></p> <p>(1) Grading, removal of vegetative cover and trees, paving, and new structures shall not be permitted within 25 feet of a wetland in any zoning district.</p> <p>(2) Grading, removal of vegetative cover and trees, paving, and new structures shall not be permitted within:</p> <ul style="list-style-type: none"> (i) Fifty feet of an intermittent stream bank; (ii) Seventy-five 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 in the NT, PGCC, and MXD districts; (iii) One hundred feet of a perennial stream bank for Use III and IV streams; and (iv) Fifty feet of a perennial stream bank in nonresidential zoning districts. <p>(3) In residential subdivisions, wetlands, streams, and their buffers shall be located in required open space or a non-buildable preservation parcel rather than on residential lots except as permitted by section 16.120 of this subtitle.</p> <p>(4) Wetlands and the required buffers for wetland and streams shall be delineated on final plats and site development plans with a clear notation of use restrictions. Wetland limits shall be identified with surveyed bearings and distances. Wetlands need not be delineated for agricultural preservation subdivisions or rural cluster subdivisions if a qualified professional certifies that wetlands and buffers will not be impacted by the proposed lots or potential development.</p> <p>(b) <i>Steep Slopes.</i> Steep slopes are slopes that average 25 percent or greater over ten vertical feet.</p> <p>(1) Grading, removal of vegetative cover and trees, new structures, and paving shall not be permitted on land with existing steep slopes, except when:</p> <ul style="list-style-type: none"> (i) The on-site and off-site contiguous area of steep slopes is less than 20,000 square feet; and (ii) There is sufficient area, a minimum ten feet, outside of stream and wetland buffers for required sediment and erosion control measures. <p>(2) In residential subdivisions steep slopes existing at the time of subdivision shall be located in required open space or a preservation parcel, except as permitted by section 16.120 of this subtitle.</p>
<p>§ 16.131 Sewage Disposal and Water Supply</p> <p>§ 16.131(b)</p>	<p>(b) <i>Sewage Disposal and Water Supply Required Pursuant to Regulations.</i> Subdivision and site development plans shall provide for sewage disposal and for an appropriate supply of potable water in accord with the provisions of the Howard County master plan for water and sewerage, the regulations of the Maryland Department of Environment and the regulations of the Howard County Health Department. Community water systems and community sewer systems may be constructed and operated only in the metropolitan district. No waiver may be granted to these requirements. Provision shall be made for an adequate supply of water for fire protection.</p>
<p>§ 16.133 Storm Drainage</p> <p>§ 16.133(a-f)</p>	<p>(a) <i>Requirement to Construct Storm Drainage.</i> Where deemed necessary by the Director of Planning and Zoning, after consultation with the Director of Public Works:</p> <p>(1) The developer shall construct storm drains to handle on-site runoff; and</p>

	<p>(2) The developer shall provide on-site drainage easements; however, these may not encroach on required perimeter landscaping unless approved by the Department of Planning and Zoning; and</p> <p>(3) The developer shall provide off-site drainage easements; and</p> <p>(4) The developer shall provide for the handling of off-site runoff to an acceptable outlet in the same watershed pursuant to subsection (c) below.</p> <p>(b) <i>Watersheds.</i> For the purposes of this subtitle, there are 4 major outlets: the Patapsco Watershed, the Middle Patuxent Watershed, the Main Patuxent Watershed, and the Little Patuxent Watershed.</p> <p>(c) Options for Handling Off-site Runoff. Developers shall do one of the following for all subdivisions:</p> <ul style="list-style-type: none"> (1) Provide for the construction of all necessary drainage structures through and between the developer's subdivision and an acceptable outlet in the same watershed; or (2) If all or part of the necessary drainage structures between the developer's subdivision and an acceptable outlet in the same watershed has been provided by another developer, the developer of the proposed subdivision shall pay the County an off-site drainage fee prior to recordation of the plat; or (3) Pay the County an off-site drainage fee prior to recordation of the plat. <p>(d) Restriction on Construction in 100-Year Floodplain. Construction on land within the 100-year floodplain shall be subject to the restrictions of section 16.115, "Floodplain Preservation."</p> <p>(e) Use of the Off-site Drainage Fees. The County may expend off-site drainage fees paid by the developers of subdivisions in a given watershed only for the construction of drainage facilities in that watershed.</p> <p>(f) Deleted.</p>
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TITLE 16 – SUBTITLE 7 – FLOODPLAIN

PLAN TOPIC & CITATION(S)	CURRENT CLAUSE
§ 16.705 Requirements and Restrictions Applicable to the Floodplain	<p>(a) Within the floodplain, no development shall be permitted except as provided in this subtitle, the Howard County Building Code adopted at title 3, subtitle 1 of the Howard County Code and the Subdivision Regulations adopted at title 16, subtitle 1 of the Howard County Code.</p>
§ 16.705(a) § 16.705(b) § 16.705(c)(1-6) § 16.705(d) § 16.705(e)(1-3)	<p>(b) Within the approximate floodplain for new subdivisions, site development plans, or single lots, the 100-year flood elevations (base flood elevations) shall be certified by a qualified design professional as determined by the Director of the Department of Public Works based on hydrologic and hydraulic analyses which include a floodway analysis. For a single lot, if no data are available, methods described in Federal Emergency Management Agency Publication No. 265, "Managing Floodplain Development in Approximate Zone A Areas", or a method approved by the Department of Planning and Zoning shall be used to determine the BASE flood elevation.</p>
	<p>(c) <i>Buildings and Structures.</i> In addition to the requirements set forth in the Howard County Building Code, new buildings and structures (including the placement and replacement of manufactured homes) and substantial improvement of existing structures (including</p>

	<p>manufactured homes) that are located, in whole or in part, in any special flood hazard area shall:</p> <ul style="list-style-type: none"> (1) Be designed (or modified) and constructed to safely support flood loads. The construction shall provide a complete load path capable of transferring all loads from their point of origin through the load-resisting elements to the foundation. Structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses, including hydrodynamic and hydrostatic loads and the effects of buoyancy, from flooding equal to the flood protection elevation or the elevation required by these regulations or the Howard County Building Code, whichever is higher. (2) Be constructed by methods and practices that minimize flood damage. (3) Use flood damage-resistant materials below the elevation of the lowest floor required in section 3114 of the Howard County Building Code. (4) Have electrical systems, equipment and components, and mechanical, heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment located at or above the elevation of the lowest floor required in section 3114 of the Howard County Building Code. Electrical wiring systems are permitted to be located below elevation of the lowest floor provided they conform to the provisions of the electrical part of the Howard County Building Code for wet locations. If replaced as part of a substantial improvement, electrical systems, equipment and components, and heating, ventilation, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall meet the requirements of this section. (5) Have the electric panelboard elevated at least three feet above the BFE. (6) Comply with the requirements of the most restrictive designation if located on a site that has more than one flood zone designation (a zone, designated floodway).
	<p>(d) <i>Recreational Vehicles.</i> Recreational vehicles shall not be parked or stored in special flood hazard areas.</p>
	<p>(e) <i>Protection of Water Supply and Sanitary Sewage Systems.</i></p> <ul style="list-style-type: none"> (1) New and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems. (2) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into systems and discharges from systems into floodwaters. (3) In addition to the requirements of section 3.808 of this Code, on-site waste disposal systems shall be located to avoid impairment to or contamination from them during conditions of flooding.
§ 16.706 Permits § 16.706(a) § 16.706(b) § 16.706(c)	<p>(a) <i>Permits Required.</i> A person shall not begin any development or construction which is wholly within, partially within, or in contact with any flood hazard area established in section 16.703 of this subtitle, including but not limited to: Filling; grading; construction of new structures; the substantial improvement of buildings or structures, including repair of substantial damage; placement or replacement of manufactured homes, including substantial improvement or repair of substantial damage of manufactured homes; erecting or installing a temporary structure, or alteration of a watercourse, until a permit is</p>

<p>§ 16.706(d) § 16.706(e)(1-2) § 16.706(f)(1-2) § 16.706(g)</p>	<p>obtained from the County in accordance with the requirements of this subtitle and the Howard County Building Code.</p> <p>(b) In addition to the permits required in paragraph (a), Applicants for permits in nontidal waters of the state are advised to contact MDE. Unless waived by MDE, pursuant to Code of Maryland Regulations 26.17.04, construction on nontidal waters and floodplains, MDE regulates the "100-year frequency floodplain of free-flowing waters," also referred to as nontidal waters of the state. To determine the 100-year frequency floodplain, hydrologic calculations are based on the ultimate development of the watershed, assuming existing zoning. The resulting flood hazard areas delineated using the results of such calculations may be different than the special flood hazard areas established in section 16.703 of this subtitle.</p> <p>(c) <i>A Permit is Valid Provided the Actual Start of Work is Within 180 Days of the Date of Permit Issuance.</i> Requests for extensions shall be submitted in writing and justifiable cause demonstrated. The Floodplain Administrator may grant, in writing, one or more extensions of time, for additional periods not exceeding more than 90 days each and provided there has been no amendment or revision to the basis for establishing special flood hazard areas and BFEs set forth in section 16.703 of this subtitle.</p> <p>(d) <i>Application Required.</i> In accordance with the Howard County Building Code, an application for a permit shall be made by the owner of the property or the owner's authorized agent prior to the start of any work. The application shall be on a form provided by the Department of Inspections, Licenses and Permits.</p> <p>(e) <i>Additional Application Requirements—Certain Development.</i> In addition to the permit application requirements set forth in section 3.101 of this Code, a permit application for development proposals and subdivision proposals having the lesser of five lots or at least five acres in special flood hazard areas where base flood elevations are not shown on the FIRM shall include:</p> <ul style="list-style-type: none"> (1) A determination of the base flood elevations; and (2) If hydrologic and hydraulic engineering analyses are submitted, such analyses shall be performed in accordance with the requirements and specifications of MDE and FEMA. <p>(f) <i>New Technical Data.</i></p> <ul style="list-style-type: none"> (1) The Applicant may seek a letter of map change by submitting new technical data to FEMA, such as base maps, topography, and engineering analyses to support revision of floodplain and floodway boundaries and/or base flood elevations. Such submissions shall be prepared in a format acceptable to FEMA and any fees shall be the sole responsibility of the Applicant. A copy of the submittal shall be attached to the application for a permit. (2) An Applicant who submits new technical data to support any change in floodplain and designated floodway boundaries or base flood elevations shall submit a letter of map change from FEMA as soon as practicable, but not later than six months after the date such information becomes available. Such submissions shall be prepared in a format acceptable to FEMA and any fees shall be the sole responsibility of the Applicant.
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	(g) <i>Application of Requirements.</i> The general requirements of this subtitle and the Howard County Building Code apply to all development proposed within all special flood hazard areas identified in section 16.703 of this subtitle.
§ 16.710 Subdivision Proposals and Development Proposals § 16.710(a-c)	In accordance with section 16.115 of this Code, in all flood zones, subdivision proposals and development proposals shall: <ul style="list-style-type: none"> (a) Be consistent with the need to minimize flood damage and are subject to all applicable standards in this subtitle and the Howard County Building Code. (b) Have utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage. (c) Have adequate drainage paths provided to reduce exposure to flood hazards and to guide floodwaters around and away from proposed structures.
§ 16.711 Variances § 16.711(a)(1-4) § 16.711(b)(1-6) § 16.711(c)(1-2)	<p>(a) <i>Generally.</i></p> <p>(1) <i>Authority to consider.</i> The Floodplain Administrator, through the Director of the Department of Inspections, Licenses and Permits, shall have the power to consider and authorize or deny variances from the strict application of the requirements of these regulations for construction adjacent to a floodplain in accordance with section 3112.4 of the Howard County Building Code. A variance shall be approved only if it is determined to not be contrary to the public interest and where, owing to special conditions of the lot or parcel, a literal enforcement of the provisions of these regulations, an unnecessary hardship would result.</p> <p>(2) <i>Conditions.</i> Upon consideration of the purposes of these regulations, the individual circumstances, and the considerations and limitations of this section, the Floodplain Administrator, through the Director of the Department of Inspections, Licenses and Permits, may attach such conditions to variances as it deems necessary to further the purposes of these regulations.</p> <p>(3) <i>Notification to Applicant.</i> The Floodplain Administrator, through the Director of the Department of Inspections, Licenses and Permits, shall notify, in writing, any Applicant to whom a variance is granted to construct or substantially improve a building or structure with its lowest floor below the elevation required by these regulations that the variance is to the floodplain management requirements of these regulations only, and that the cost of federal flood insurance will be commensurate with the increased risk, with rates up to \$25.00 per \$100.00 of insurance coverage and that the construction of structures below the base flood elevation increases risks to life and property.</p> <p>(4) <i>Records.</i> A record of all variance actions, including justification for issuance shall be maintained pursuant to section 16.709 of this subtitle.</p> <p>(b) <i>Considerations for Granting Variances.</i> The Floodplain Administrator, through the Director of the Department of Inspections, Licenses and Permits shall make an affirmative decision on a variance request for construction adjacent to a floodplain only upon:</p> <ul style="list-style-type: none"> (1) A showing of good and sufficient cause. (2) A determination that failure to grant the variance would result in exceptional hardship due to the physical characteristics of the property. Increased cost or inconvenience of meeting the requirements of these regulations does not constitute an exceptional hardship to the Applicant. (3) A determination that the granting of a variance for development within any designated floodway, or flood hazard area with base flood elevations but no designated

	<p>floodway, will not result in increased flood heights beyond that which is allowed in these regulations.</p> <p>(4) A determination that the granting of a variance will not result in additional threats to public safety; extraordinary public expense, nuisances, fraud or victimization of the public, or conflict with existing local laws.</p> <p>(5) A determination that the building, structure or other development is protected by methods to minimize flood damages.</p> <p>(6) A determination that the variance is the minimum necessary to afford relief, considering the flood hazard.</p>
	<p>(c) <i>Variance Prohibited.</i></p> <p>(1) A variance shall not be issued within any designated regulatory floodway if any increase in flood levels during the base flood discharge would result.</p> <p>(2) A variance may not be issued for any property located in the Tiber Branch Watershed unless the variance:</p> <ul style="list-style-type: none"> (i) Was requested on or before November 7, 2016; (ii) Is necessary for the reconstruction of existing structures or infrastructure damaged by flood, fire, or other disaster; (iii) Is necessary for the construction of a stormwater management or flood control facility as part of a redevelopment project; (iv) Is necessary for the retrofit of existing facilities or installation of new facilities intended solely to improve stormwater management or flood control for existing development; (v) Is requested as part of a development proposal and the Director of the Department of Public Works, or his designee serving as Floodplain Administrator, finds that upon completion of construction of the development, which may include off-site improvements within the Tiber Branch Watershed, there will be improvement to flood control in the Tiber Branch Watershed at least ten percent more than what would otherwise be required by law; or (vi) Is necessary for the construction of an addition, garage, driveway or other accessory use improvement of an existing residential structure on property located within the Tiber Branch Watershed that increases the square footage of the impervious surfaces on the property by no more than 25 percent over the square footage of impervious surfaces that existed on the property prior to the effective date of this bill [Dec. 9, 2016].

TITLE 18 – SUBTITLE 9 – STORMWATER MANAGEMENT

PLAN TOPIC & CITATION(S)	CURRENT CLAUSE
§ 18.903 – Design Criteria; Minimum Control Requirements; Alternatives § 18.903(a-b)	<p>(a) The minimum control requirements established in this section and the design manual are as follows:</p> <p>(1) The County shall require that the planning techniques, nonstructural practices, and design methods specified in the design manual be used to implement ESD to the MEP. The use of ESD planning techniques and treatment practices must be exhausted before any structural BMP is implemented. Stormwater management for development projects subject to this subtitle shall be designed using ESD sizing criteria, recharge volume, water quality volume, and channel protection storage volume criteria according to the design</p>

	<p>manual. The MEP standard is met when channel stability is maintained, predevelopment groundwater recharge is replicated, nonpoint source pollution is minimized, and structural stormwater management practices are used only if determined to be absolutely necessary.</p> <p>(2) Control of the two-year and ten-year frequency storm event is required according to the design manual and all subsequent revisions if the County determines that additional stormwater management is necessary because historical flooding problems exist and downstream floodplain development and conveyance system design cannot be controlled.</p> <p>(3) One-hundred-year peak management control is required according to the design manual. For purposes of calculating the 100-year 24-hour storm event, 8.51 inches of rainfall depth shall be the minimum depth used.</p> <p>(4) The County may require more than the minimum control requirements if:</p> <ul style="list-style-type: none"> (i) Hydrologic or topographic conditions warrant; or (ii) Flooding, stream channel erosion, or water quality problems exist downstream from a proposed project. <p>(b) Stormwater management where applicable, shall be consistent with adopted and approved watershed management plans or flood management plans as approved by the Maryland Department of the Environment in accordance with the Flood Hazard Management Act of 1976.</p>
§ 18.904 Stormwater Management Measures § 18.904(a,g,h)	<p>(a) <i>Required</i>. The ESD planning techniques and treatment practices and structural stormwater management measures established in this subtitle and the design manual shall be used, either alone or in combination, in a stormwater management design. A developer shall demonstrate that ESD has been implemented to the MEP before the use of a structural BMP is considered in developing the stormwater management design.</p> <p>(g) <i>Alternatives</i>. Alternative ESD planning techniques and treatment practices and structural stormwater measures may be used for new development runoff control if they meet the performance criteria established in the design manual and all subsequent revisions. Practices used for redevelopment projects shall be approved by the County. All alternative ESD practices shall be approved by the Administration.</p> <p>(h) <i>Modifications</i>. For the purposes of modifying the minimum control requirements or design criteria, the owner or developer shall submit to the County an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications of the proposed development upon a dam, highway, structure, or natural point of restricted streamflow. The point of investigation is to be established with the concurrence of the County, downstream of the first downstream tributary whose drainage area equals or exceeds the contributing area to the project or stormwater management facility.</p>
§ 18.905 Stormwater Management Design Process § 18.905(b)(6)	If a stormwater management plan involves direction of some or all runoff off of the site, the developer shall obtain from adjacent property owners any easements or other necessary property interests concerning flowage of water.

§ 18.908 Waivers; Watershed Management Plans § 18.908(a)(3)	<p>(a) Waiver Requests. A request for a waiver under this section shall:</p> <p>(3) Be prohibited for any property located in the Tiber Branch Watershed unless the waiver:</p> <ul style="list-style-type: none"> (i) Was requested on or before November 7, 2016; (ii) Is necessary for the reconstruction of existing structures or infrastructure damaged by flood, fire, or other disaster; (iii) Is necessary for the construction of a stormwater management or flood control facility as part of a redevelopment project; (iv) Is necessary for the retrofit of existing facilities or installation of new facilities intended solely to improve stormwater management or flood control for existing development; (v) Is requested as part of a development proposal and the Director of the Department of Public Works, or his designee serving as Floodplain Administrator, finds that upon completion of construction of the development, which may include off-site improvements within the Tiber Branch Watershed, there will be improvement to flood control in the Tiber Branch Watershed at least ten percent more than what would otherwise be required by law; or (vi) Is necessary for the construction of an addition, garage, driveway or other accessory use improvement of an existing residential structure on property located within the Tiber Branch Watershed that increases the square footage of the impervious surfaces on the property by no more than 25 percent over the square footage of impervious surfaces that existed on the property prior to the effective date of this bill [Dec. 9, 2016].
§ 18.910 Redevelopment § 18.910(b-c)	<p>(b) All redevelopment projects shall reduce existing impervious area within the limit of disturbance by at least 50 percent. Where site conditions prevent the reduction of impervious area, then ESD practices shall be implemented to provide qualitative control for at least 50 percent of the site's impervious area. When a combination of impervious area reduction and stormwater management practice implementation is used, the combined reduction shall equal or exceed 50 percent of the existing impervious area within the limit of disturbance.</p> <p>(c) Alternative stormwater management measures may be used to meet the requirements in subsection (b) of this section if the owner or developer satisfactorily demonstrates to the County that impervious area reduction has been maximized and ESD has been implemented to the MEP. Alternative stormwater management measures include, but are not limited to:</p> <ul style="list-style-type: none"> (1) An on-site structural BMP; (2) An off-site structural BMP to provide water quality treatment for an area equal to or greater than 50 percent of the existing impervious area; or (3) A combination of impervious area reduction, ESD implementation, and an on-site or off-site structural BMP for an area equal to or greater than 50 percent of the existing site impervious area within the limit of disturbance.
TITLE 3 – SUBTITLE 1 – BUILDING CODE	
PLAN TOPIC & CITATION(S)	CURRENT CLAUSE

§ 3114 Floodplain § 3114.1 § 3114.2 § 3114.3 § 3114.4 § 3114.5 § 3114.6 § 3114.7 § 3114.8 § 3114.9	<p>3114.1 General. For the purpose of this Section, the floodplain is delineated in title 16, subtitle 7 of the Howard County Code.</p> <p>3114.2 Within designated floodplain.</p> <p>The construction, reconstruction, modification, alteration, repair, or improvement of buildings, manufactured homes, or other structures located within a designated floodplain shall be done in accordance with the requirements set forth in this section.</p> <p>3114.2.1 New construction. New residential or nonresidential construction shall not occur within a designated floodplain.</p> <p>Exception 1: An existing nonconforming structure located within a designated floodplain which is destroyed by fire or flood, or that sustains substantial damage may be restored to the same size and dimension and in the same location on the same lot as the destroyed structure, provided construction begins within 12 months of the date of destruction. Construction shall comply with the elevating and floodproofing requirements of subsection 3114.4 for new construction adjacent to a floodplain. A person shall not intentionally demolish or reconstruct any nonconforming structure. This exception does not apply to manufactured homes. A manufactured home cannot be restored under any condition within a designated floodplain.</p> <p>Exception 2: Transportation networks, utility installations, piers, open pier structures, and open decks approved by the Department of Public works. Streets, sidewalks, pathways, and utility systems in accordance with the Howard County Design Manual and all other applicable codes, ordinances, resolutions, and regulations.</p> <p>3114.2.2 Additions and enlargements. Existing nonconforming structures located within a designated floodplain shall not be expanded or enlarged.</p> <p>3114.2.3 Modifications, alterations, and repairs. Modifications, alterations, repairs, or improvements that cost less than 50% of the fair market value of the structure may be made to existing nonconforming structures located within a designated floodplain without floodproofing or elevating if the owner demonstrates through a Maryland State registered professional engineer that floodproofing or elevating is impractical.</p> <p>3114.3 Substantial improvements within a designated floodplain. Substantial improvements within a designated floodplain shall meet the standards set forth in this subsection and Title 16, Subtitle 7 of the Howard County Code.</p> <p>3114.3.1 Residential. The lowest floor, including a basement, of substantial improvements to existing nonconforming residential structures located within a designated floodplain shall be elevated to at least 2 feet above the 100-year flood elevation.</p> <p>3114.3.2 Nonresidential. The lowest floor, including a basement, of substantial improvements to existing nonconforming nonresidential structures shall be elevated to at least 2 feet above the 100-year flood elevation or shall be designed so that any area of the building which is lower than 2 feet above the 100-year flood elevation, as determined or approved by the Department of Public Works, is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of withstanding applicable hydrostatic, hydrodynamic, impact, soil, and, when applicable, hurricane and tidal wave loading conditions. The water tightness and structural capabilities shall be those described in floodproofing regulations published by the Office of the Chief of Engineers, U.S. Army, Washington, D.C., December 1995, or subsequent revisions, and section 16.705(c) of the Howard County Code.</p>
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3114.4 Construction adjacent to a designated floodplain. Where buildings are located adjacent to a designated floodplain the following subsections and title 16, subtitle 7 of the Howard County Code shall apply:

3114.4.1 Residential. In new construction of residential buildings or additions or substantial improvements to residential buildings, all floors, including those of basement and storage areas, shall be elevated at least 2 feet above the 100-year flood level.

3114.4.2 Nonresidential. In new construction of nonresidential buildings or additions or substantial improvements to nonresidential buildings, either:

(i) All floors (including those of basement and storage areas) and all electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities associated with the buildings shall be elevated at least two feet above the 100-year flood level, as determined or approved by the Department of Public Works; or

(ii) The construction or improvement shall be designed so that any areas of the building that are lower than two feet above the 100-year flood elevation, as determined or approved by the Department of Public Works, are watertight with walls substantially impermeable to the passage of water and with structural components having the capability of withstanding applicable hydrostatic, hydrodynamic, impact, soil, and, when applicable, hurricane and tidal wave loading conditions. The water tightness and structural capabilities shall be those described in floodproofing regulations, published by the office of the Chief of Engineers, U.S. Army, Washington, D.C., December 1995, or subsequent revisions, and section 16.705(c) of the Howard County Code.

3114.4.3. Modifications, alterations or repairs. Modifications, alterations, repairs, or improvements that costs less than 50% of the fair market value of the structure may be made to existing nonconforming structures located adjacent to a designated floodplain without floodproofing or elevating.

3114.4.4. Variances. Variances to the requirements set forth in this subsection may be granted by the Building Official in accordance with section 16.711 of the Howard County Code.

3114.5 Substantial improvements adjacent to a designated floodplain. Substantial improvements adjacent to a designated floodplain shall meet the standards set forth in this subsection and title 16, subtitle 7 of the Howard County Code.

3114.5.1 Residential. The lowest floor, including a basement, of substantial improvements to existing nonconforming residential structures located adjacent to a designated floodplain shall be elevated to at least 2 feet above the 100-year flood elevation.

3114.5.2 Nonresidential. The lowest floor, including a basement, of substantial improvements to existing nonconforming nonresidential structures and all electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities associated with the buildings shall be located adjacent to a designated floodplain shall be elevated to at least two feet above the 100-year flood elevation or shall be designed so that any area of the building which is lower than two feet above the 100-year flood elevation, as determined or approved by the Department of Public Works, is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of withstanding applicable hydrostatic, hydrodynamic impact, soil, and, when applicable, hurricane and tidal wave loading conditions. The water tightness and structural capabilities shall be those described in floodproofing regulations published by the Office of the Chief of

Engineers, U.S. Army, Washington, D.C., December 1995, or subsequent revisions, and section 16.705(c) of the Howard County Code.

3114.6 Verification. For the purpose of verifying compliance with Section 3114.4 for construction adjacent to a designated floodplain, the following shall apply:

- (i) When floodproofing by means other than elevating, a document stating that the proposed construction has been adequately designed to withstand the loading conditions stated in subsection 3114.4.2(ii) shall be certified by a professional engineer or architect currently registered in Maryland. This document shall be required prior to issuance of a building permit.
- (ii) When floodproofing by elevating is used, the owner shall agree, in writing, to provide a FEMA elevation certificate form 086-0-33, completed by a professional engineer or professional land surveyor currently registered in Maryland, certifying that the as-built lowest floor of the structure is elevated at least 2 feet above the 100-year floodplain elevation. The agreement shall be made prior to the issuance of the building permit and the completed certification shall be submitted prior to foundation approval by the Building Official.
- (iii) Fair market value of a structure shall be established by a recent (within 6 months) formal appraisal from a qualified appraiser. Fair market value shall not include land value.
- (iv) Cost to repair or improve a structure shall be established by a recent (within 6 months) written estimate from a licensed contractor and shall include the complete cost of repairs or improvements to the point of use or occupancy.

3114.7 Definitions. Notwithstanding Chapter 2 of the International Building Code, the following definitions shall apply to Section 3114.0, Floodplain, of this Code:

Accessory structure. A detached structure on the same parcel or property as the principal structure that has a use that is incidental to the principal structure including, but not limited to, a shed or detached garage.

Adjacent to a floodplain. Sharing a common border with a floodplain.
Basement. An enclosed area that is below grade on all sides.

Floodplain. Shall be as delineated in title 16, subtitle 7 of the Howard County Code.

Floodproofing. Any combination of additions, changes, or adjustments to a structure which reduce or eliminate flood damage to real estate or improved real property, water or sanitary facilities, or structures and their contents , such that the buildings or structures are watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

Historic structure. A building listed on the national register of historic places, a state inventory of historic places, or an inventory of historic structures adopted by resolution of the County Council. A historic structure also includes a structure that is certified or preliminarily determined by the United States Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district.

Lowest floor. The lowest floor or the lowest enclosed area, including a basement. Lowest floor does not include an unfinished or flood resistant enclosure used solely for parking vehicles, building access, or storage in an area other than a basement area. The enclosure

shall not be built so as to render the structure in violation of the applicable non-elevation design requirements of subsections 3114.4 and 3114.6 of this Code.

Manufactured home. A manufactured home shall have the meaning set forth in title 16, subtitle 7 of the Howard County Code.

New construction. Structures, including additions and improvements, and the placement of manufactured homes, for which the start of construction commenced on or after 3/15/1977, the initial effective date of the Howard County Flood Insurance Rate Map, including any subsequent improvements, alterations, modifications, and additions to such structures.

The repair or replacement of a manufactured home because of substantial damage is considered to be new construction and is prohibited in accordance with Section 3114.2.1 of this Code.

Structure. For purposes of this Subsection 3114 to this Code, shall have the meaning set forth in title 16, subtitle 7 of the Howard County Code.

Substantial damage. Damage of any origin sustained by a structure where the cost of returning the structure to its condition prior to damage would equal or exceed 50% of the structure's fair market value before the damage occurred.

Substantial improvement. The repair, reconstruction, or improvement of a building or structure, the cost of which is equal to or greater than 50% of the fair market value of the building or structure prior to damage, improvement, or repair. For the purpose of this definition, "substantial improvement" occurs when the first alteration of a wall, ceiling, floor, or other structural part of the building begins, whether or not that alteration affects the external dimensions of the building or structure. The term does not include any project for improving a building or structure to comply with existing State or local health, sanitary, or housing code requirements which are necessary to assure safe living conditions. This term does not include an alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

Variance. The grant of relief from a term of this subtitle.

3114.8 Variances and waivers. Except as provided in Section 3114.4 of this Code, a variance or waiver of this section is not allowed. The building official shall consider a variance in accordance with the provisions of section 16.711 of the Howard County Code.

3114.9 Other agencies. A permit issued by the Building Official under this subtitle is not valid until all necessary permits for the development are obtained. Receipt of federal or State permits do not exempt a development from the provisions of this subtitle.

Howard County Office of Emergency Management Strategic Plan 2020-2025

The following goals and objectives of the Howard County OEM Strategic Plan, developed by the Howard County OEM, relate directly to mitigation and are echoed in this document.¹⁵⁵

HOWARD COUNTY EMERGENCY STRATEGIC PLAN 2020-2025		
PLAN TOPIC	ITEM TYPE	CURRENT CLAUSE
Strategic Goal 1	Goal	Strengthen Howard County's capabilities to restore and stabilize government operations, economy, and community life, and ensure that compatible continuity programs are developed and maintained for all Howard County departments.
	Objectives	<ul style="list-style-type: none"> • Ensure departments are maintaining Continuity of Operations (COOP) Plans. • Coordinate COOP training and maintain County-wide COOP uniformity. • Annually assess the COOP and COG programs.
Strategic Goal 3	Goal	Prevent, protect, and mitigate against human-caused and natural hazards.
	Objectives	<ul style="list-style-type: none"> • Synchronize the timelines of all mitigation planning activities. • Seek additional mitigation grant funding and ensure match availability, as applicable. • Maintain the mitigation steering committee to implement mitigation planning objectives and strategies. • Integrate prevention, protection, and mitigation plans with appropriate departmental plans.
Strategic Goal 4	Goal	Tailor emergency management funding, projects, and planning initiatives according to the HIRA, Threat and Hazard Identification and Risk Assessment (THIRA), and any relevant risk and vulnerability assessments.
	Objectives	<ul style="list-style-type: none"> • Use risk and vulnerability assessments to determine funding priorities, and to direct County investments. • Use risk and vulnerability assessments to increase preparedness, reduce risk, and increase the capacity to respond and recover. • Ensure OEM staff members are well-versed in current HIRA and THIRA to best utilize plan findings.

¹⁵⁵ Strategic Plan 2020-2025, HOWARD CNTY. OFFICE OF EMERGENCY MGMT. (June 2020), <https://live-hoco-d9.pantheonsite.io/sites/default/files/2021-05/Signed%20Final%202020-2025%20OEM%20Strategic%20Plan.pdf>.

Strategic Goal 5	Goal	Further develop the community outreach program by seeking out best practices and identifying additional opportunities to strengthen and foster relationships among individuals and community groups.
	Objectives	<ul style="list-style-type: none"> • Lead the emergency management-related content and dissemination efforts of County public information officers with County and regional partners to ensure messages resonate with targeted and general audiences. • Coordinate and expand community outreach efforts and actively establish and maintain partnerships with community leaders. • Ensure that pre-disaster preparedness, mitigation information, and post-disaster assistance programs and services are available to all people in the community. • Develop a plan to provide leadership and support through guidance documents and dissemination of best practices, to encourage businesses and nonprofits to prepare mitigation and recovery plans. • Develop a process to identify trending community issues both for preparedness information before a disaster and to focus post-disaster information on the real questions and needs of the community. • Identify and target community preparedness education efforts for communities without adequate resources.
Strategic Goal 7	Goal	Maintain and continually improve the strategic planning process, which holistically integrates planning, training, exercises, and evaluation, and that ensures plans are vertically and horizontally synchronized with appropriate departments, stakeholder agencies, and jurisdictions.
	Objectives	<ul style="list-style-type: none"> • Ensure emergency management program maintenance is followed accordingly, and plans are reviewed and updated as necessary. • Ensure that progress is made on correcting gaps identified during the after-action process. • Maintain records of plan maintenance and of corrective actions on plans exercised or tested during real or planned events. • Continue to standardize emergency procedures, protocols, and policies throughout the County in order to promote a unified response when necessary.
Strategic Goal 8	Goal	Maintain a formal training and exercise program that is driven by hazard vulnerabilities, corrective actions from After Action Reports (AARs), and gaps in capabilities and plans.

	Objectives	<ul style="list-style-type: none"> • Ensure training and exercises are implemented as appropriate to evaluate and improve capabilities, preparedness, plans, strategies, and operational readiness in a fault-free environment. • Ensure revised plans or newly created plans are trained on and followed with appropriate exercise building blocks. • Incorporate and organize training opportunities for officials and emergency management and response personnel, as well as the public, in an effort to improve inter and intradepartmental collaboration. • Ensure departments are following through with recommended items in Improvement Plans and AARs. • Continue to host a variety of exercise types to adequately train County staff (tabletop, functional, full scale, and etc.)
Strategic Goal 9	Goal	Continually improve Emergency Operations Center (EOC) and Departmental Operation Centers (DOCs) functions and capabilities. Design, build, and operationalize a permanent EOC that meets the current and future capacity needs identified in multiple AARs.
	Objectives	<ul style="list-style-type: none"> • Improve the resource management system, complete with an inventory of equipment, with information for appropriate agencies on location and availability as well as accessibility directions. • Pursue building a permanent "state of the art" EOC to nationally accepted standards in a strategic location within the County. • Maintain a Joint Information System with current information on hazards and activities to prevent injuries and property loss in Howard County.
Strategic Goal 10	Goal	Enhance and expand partnerships and collaboration with Non-Governmental Organizations (NGOs), faith-based organizations, the private sector, and public sector agencies. Ensure the effective management, appropriate oversight, integrity, and security of supply chains within the County via these partnerships.

<p style="text-align: center;">DRAFT</p>	<p>Objectives</p> <ul style="list-style-type: none"> • Improve private-sector knowledge of County government plans and procedures, and vice-versa. • Link businesses, together with government resources, to create a resource network for emergency events to enable the marshaling of resources to confront novel or complex disasters. • Provide businesses with encouragement and tools to improve their resilience. • Increase private-sector involvement, information, tools, and education in countywide preparedness and recovery. • Communication and collaboration with public sector agencies external to Howard County Government. • Ensure engagement with private critical infrastructure partners. • Ensure engagement with supply chain leaders and partners within the County.
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Plans in Development

Howard County continuously works to integrate hazard mitigation planning into additional County planning mechanisms, such as through its forthcoming General Plan update, *HoCo by Design*, the *Climate Action and Resiliency Plan*, and the 2024-2029 FMP.

HoCo By Design

Howard County's forthcoming General Plan update, *HoCo by Design*, is scheduled for final approval and release in 2023, after the time of writing this NHMP. The DPZ is responsible for this plan. Howard County OEM served as part of the Technical Advisory Group for the development of this plan. As of July 2023, *HoCo by Design* has been released in draft form and is being reviewed by County Council,¹⁵⁶ and it seeks to provide a long-term vision for "how and where the County should develop and grow as it adjusts to evolving economic, environmental, and social conditions over the next 20 years."¹⁵⁷ *HoCo by Design* will incorporate *PlanHoward 2030* and its amendments, such as the *Ellicott City Watershed Master Plan*,¹⁵⁸ which the County adopted in December 2020 to address hazard mitigation lessons learned from the historic Ellicott City floods of 2016 and 2018. Additionally, *HoCo By Design* will focus on equity as a guiding principle, and cites the "protect[ion of] populations in vulnerable areas from natural hazards" as a best practice.¹⁵⁹

¹⁵⁶ *HoCo by Design Public Draft Release*, HOWARD CNTY., <https://www.hocobydesign.com/public-draft> (last visited Apr. 7, 2023).

¹⁵⁷ *HoCo by Design Chapter 1*, HOWARD CNTY. (Dec. 1, 2022),

<https://www.hocobydesign.com/18058/widgets/57052/documents/37629>

¹⁵⁸ *Ellicott City Watershed Master Plan*, HOWARD CNTY. DEPT. OF PLANNING & ZONING (Dec. 7, 2020),

<https://www.howardcountymd.gov/sites/default/files/media/2020-12/Ellicott%20City%20Watershed%20Master%20Plan%20Final%20Adopted.pdf>

¹⁵⁹ *Id.* at 15.

Howard County Climate Forward: Climate Action and Resiliency Plan

In June 2023, the Howard County Office of Community Sustainability (OCS) published its first climate action plan since 2015, *HoCo Climate Forward*.¹⁶⁰ On page 6 of this plan, it is described how the Office of Community Sustainability reviewed this Natural Hazard Mitigation Plan to “ensure Climate Forward is coordinated with and responsive to these emergency management plans”. *HoCo Climate Forward* provides overviews of the following topics specific to Howard County:

- Climate risks and impacts
- Climate vulnerabilities, particularly for underserved populations
- Community-wide Greenhouse Gas (GHG) emissions inventory
- New climate goals
- Climate solutions

Development of this plan included a variety of research modalities, including, among other things:

- Review of relevant and local and regional climate action plans and climate vulnerability assessments
- Expert input from subcontractor ICF to prepare draft mitigation and resiliency strategies based on climate science and what would be the most impactful
- Focus groups with internal stakeholders to refine mitigation and resiliency strategies
- Community survey, specifically reaching out to underserved populations, to gather feedback on climate emergency preparedness¹⁶¹

2024-2029 Flood Mitigation Plan

The Howard County FMP was updated in conjunction with the update of this NHMP. The same JSC was used to ensure harmony in goals, objectives, and actions. Both plans note that the *Ellicott City Safe & Sound* structural projects as mitigation actions as well as the action items related to flood mitigation structures for Howard County’s wastewater plant, Little Patuxent Water Reclamation Plant. The Flood Mitigation actions can be seen in [Appendix C: Flood Mitigation Actions](#).

Howard County Government Organization

The Howard County Government includes an executive branch, legislative branch, and judicial branch. The County Executive leads the executive branch, and the County Council, representing five Council Districts, leads the legislative branch. The County Council enacts local legislation and authorizes an annual budget.

¹⁶⁰ *Howard County Climate Forward: Climate Action and Resiliency Plan* (Draft Final Report 2023), <https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Flivegreenhoward.com%2Fwp-content%2Fuploads%2F2023%2F04%2FHoCo-Climate-Forward-Draft-Report-Appendices.pdf&data=05%7C01%7Ccmcraney%40howardcountymd.gov%7Cb05c8e00cf1046fc221408db34762a70%7C0538130803664bb7a95b95304bd11a58%7C1%7C0%7C638161454520127308%7CUnknown%7CTWFpbGZsb3d8eyJwIjoIMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=Xj9pkLoBTIVRiu2whL%2FH5gxEtrLvhFH2CsCSBO%2BsWFY%3D&reserved=0>.

¹⁶¹ *Id.* at 1

County Emergency Response Capabilities and Responsibilities

The Howard County Government is organized into many departments, offices, bureaus, and/or divisions. Several departments and offices are responsible for planning for and responding to natural hazard events that occur within the County. The primary departments/offices that plan for and respond to natural hazard events include:

- **Department of Fire and Rescue Services**

“[The Department of Fire and Rescue Services (DFRS) is] a combination system of nearly 900 career and volunteer providers operating from 14 stations across Howard County. The department is located between Baltimore City and the District of Columbia and provides and receives automatic aid to and from our surrounding partners in Prince George's, Anne Arundel, Baltimore, Carroll, Montgomery[,] and Frederick [C]ounties. The department is statutorily responsible for the administration of the affairs for the [C]ounty in fire suppression and prevention, fire training, arson investigation, rescue services and emergency medical services.”¹⁶²

- **Department of Inspections, Licenses, and Permits**

“The Department of Inspections, Licenses and Permits (DILP) is responsible for the approval and issuance of various permits, licenses and the enforcement of county building codes and standards. These include building, mechanical, plumbing, electrical, sign and property maintenance codes. The department inspects and licenses rental housing properties, mobile home parks, and animal licensing. It is responsible for staff duties associated with the Plumbing Advisory Board and the Board of Electrical Examiners.”¹⁶³

- **Department of Planning and Zoning**

“The Department of Planning and Zoning (DPZ) shapes the growth and future of Howard County by facilitating the development of safe, healthy, equitable, connected, and sustained communities, while respecting individual rights and protecting the County's natural environment, historical integrity and character.”¹⁶⁴

- **Department of Public Works**

“The Department of Public Works (DPW) advances the quality of life for our community by providing exceptional level of public service. Employees coordinate the daily functions, customer service, the capital improvement program and real estate services. Howard County Department of Public Works is composed of the Director's Office and the following Bureaus and Divisions:

- Bureau of Engineering
- Bureau of Environmental Services
- Bureau of Facilities
- Bureau of Highways

¹⁶² *Fire and Rescue Serv.*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/fire-and-rescue-services> (last visited Apr. 3, 2023).

¹⁶³ *Inspections, Licenses, & Permits*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/inspections-licenses-permits> (last visited Apr. 3, 2023).

¹⁶⁴ *Planning & Zoning*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/planning-zoning> (last visited Apr. 3, 2023).

- Bureau Of Utilities
 - Real Estate Services Division”¹⁶⁵
- **Police Department**
“The Howard County Police Department (HCPD) provides a secure environment for the citizens of Howard County by protecting life and property, reducing the opportunity for crime and disorder, enforcing the law, assisting victims and providing other police-related services as required by the community in a manner consistent with the values of a free society.”¹⁶⁶
- **Office of Emergency Management**
“The Howard County OEM develops and maintains emergency management plans, which encompass all hazards and phases of emergency management, and include stakeholder engagement and coordination across internal and external agencies and stakeholders. In addition to Countywide planning, the office provides technical guidance, facilitation support, and training and exercise to help the County prepare for natural, technological, and/or human-caused emergencies. OEM also manages and coordinates the County's response and recovery to emergencies and disasters through the EOC.”¹⁶⁷

The following statistics for emergency response resources are current as of the writing of this 2024 NHMP. However, they are subject to change and will be updated as needed.

- **Critical Facilities**
The list of County critical facilities and infrastructures was re-evaluated and updated in 2022. HCPD and OEM as needed identify the facilities and infrastructures that are considered the most critical to County Government operations. These critical facilities include Emergency Services, Key Government, Criminal Justice, Transportation, Water/Wastewater Treatment, Research, Major Retail, Schools, and Entertainment.
- **Fire Departments**
Howard County is served by DFRS. The County maintains 14 fire stations throughout the County.
- **Law Enforcement**
Howard County is served by HCPD. HCPD has two stations, Northern District (Headquarters) and Southern District. Also, the Maryland State Police – Waterloo Barrack is located in Howard County.
- **Medical Services**
Howard County General Hospital (HCGH) is an acute-care medical center and a member of Johns Hopkins Medicine. Sheppard Pratt Hospital in Ellicott City is a psychiatric facility serving a range of patients. Medstar Health is part of the largest healthcare provider in Maryland, and it has locations in the County. Altogether, Howard County has:
 - One inpatient hospital (HCGH);
 - Two hospice and palliative care facility;
 - Four nursing homes;
 - 14 large-assisted living facilities (17+ residents); and,
 - 69 small-assisted living facilities (one -16 residents).

¹⁶⁵ *Public Works*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/public-works> (last visited Apr. 3, 2023).

¹⁶⁶ *Police*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/police> (last visited Apr. 3, 2023).

¹⁶⁷ *Emergency Management*, HOWARD CNTY. MD, <https://www.howardcountymd.gov/emergency-management> (last visited Apr. 3, 2023).

- **Department of Recreation and Parks**

The Department of Recreation and Parks (DRP) maintains more than 50 parks and 9,768 acres of land. In addition, DRP manages and oversees recreation facilities, community centers, the Robinson Nature Center, historic sites, and natural resource areas. The Department owns and operates 27 historic sites, all of which are either stand-alone sites or structures located within County-owned parks¹⁶⁸. As of 2020, the Maryland Department of Natural Resources (DNR) owns over 9,200 acres within the County¹⁶.

DRP also fulfills many roles in supporting emergency response and recovery in the County as outlined in the Howard County Comprehensive Emergency Response and Recovery Plan (CERRP). DRP is imperative in organizing volunteers, transportation needs, and assisting in shelter operations.

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¹⁶⁸ *Howard County Land Preservation, Parks and Recreation Plan Update*, MD. DEPT. OF NAT. RES. (June 2022), <https://dnr.maryland.gov/land/Documents/Stewardship/Howard-2022-LPPRP-Draft.pdf>.

Community Capability Assessment

The following tables, based on the FEMA Community Capability Assessment Worksheet,¹⁶⁹ detail the County's capabilities in five areas:

- Planning and Regulation;
- Codes and Ordinances;
- Education and Outreach;
- Technical; and,
- Financial.

****Please note: the Capability Expansion column includes suggestions for capability expansion and not official mitigation action items at this time. Information in this column will be considered at annual reviews and moved to hazard mitigation action items as needed.**

TABLE 1: PLANNING AND REGULATORY CAPABILITIES

Title	Author / Owner	Effective Date	Next Update	Relation to Hazard Mitigation	Capability Expansion
Plan Howard 2030	Department of Planning and Zoning	2012	2023	This Plan includes several clauses in relation to hazard mitigation. A table summarizing these points is in Chapter 6.	This Plan is updated every 10 years and updated as necessary to incorporate new plans or studies.
Howard County Climate Action Plan	Department of County Administration--Office of Community Sustainability	2023	2028	This Plan will include recommendations to improve the County's ability to respond to and mitigate the effects of climate change.	Once this Plan is adopted by County Council, it will be incorporated into the Hazard Mitigation Plan.

¹⁶⁹ Region 3 Hazard Mitigation Plan Guidance: Community Capability Assessment Worksheet, FEMA, https://www.fema.gov/sites/default/files/documents/fema_community-capability-assessment_worksheet_region-three_06-2021.pdf (last visited February 17, 2023).

Howard County Comprehensive Emergency Response and Recovery Plan	Department of Fire and Rescue Services--Office of Emergency Management	2022	2023	This Plan outlines the overall strategy for how the County will organize and operate for response and recovery in the event of a planned event, incident, emergency, or disaster. It includes County Coordinating Functions (CCFs) that provide the structure for coordinating function-specific County response and recovery operations.	This plan is updated every year and as needed after an incident.
Community Rating System Program	Department of Public Works--Bureau of Environmental Sciences--Stormwater Management Division	2007	2025	Goals of Community Rating System (CRS) Program is to: reduce and avoid flood damage to insurable property, strengthen and support the insurance aspect of the NFIP, and foster comprehensive floodplain management.	Initiate and/or improve programs that elevate the County's CRS Class designation. Potential programs include: Elevation Certificates; Outreach Projects; Hazard Disclosure; Flood Protection Information; Flood Protection Assistance; Flood Insurance Promotion; Flood Hazard Mapping; Open Space Preservation; Higher Regulatory Standards; Stormwater Management; Floodplain Management Planning; Acquisition and Relocation; Flood Protection; Drainage System

					Maintenance; Flood Warning and Response; Dams.
Howard County Continuity of Government Plan	Department of Fire and Rescue Services--Office of Emergency Management	May-22	Mar-23	<p>As part of the Continuity of Government (COG) planning process, it incorporates the results of the Howard County Hazard Identification and Risk Assessment (HIRA). These results were considered when developing the County Essential Functions (CEFs) that enable an organization to provide vital services, exercise civil authority, maintain the safety of the general public, and sustain the industrial or economic base during an emergency.</p>	<p>Continuity Program Coordinator(s) who lead the bi-annual review and update process for the COG Plan attend trainings when possible, to ensure all best practices are being incorporated. In addition, all County departments are required to have their own COOP.</p>
2017 Howard County Economic Development Authority Strategic Plan	Howard County Economic Development Authority	2017	2024	<p>One of the Strategic Plan's tactics is to "dedicate resources for special projects" and this has included addressing unexpected situations, such as the 2016 flooding of Ellicott City.</p>	<p>This Plan could be expanded by OEM working with Howard County Economic Development Authority (EDA) to address/describe the hazards most likely to affect businesses in Howard County in the Plan.</p>

Howard County Flood Mitigation Plan	Department of Public Works-- Bureau of Environmental Sciences-- Stormwater Management Division	2018	2024	This Plan includes a flood-risk analysis to include the effect on critical infrastructure. It also includes policies, ordinances, and other projects that are already included in this NHMP's Implementation Plan table in Chapter 6. In addition, the Flood Mitigation Plan is updated on the same planning cycle and with the same Joint Steering Committee as the NHMP.	The most recent risk analysis was conducted with the Hazus tool, which didn't include all of the County's critical facilities. This new update will include all the County's critical facilities.
Transit Development Plan	Department of County Administration--Office of Transportation	2018	2023	This Plan allows the County to evaluate and prioritize how it can effectively and efficiently expand the transit system to achieve more ridership and reduce the demand for single occupancy vehicles and therefore, greenhouse gas emissions.	The next plan update in late 2023 will discuss the need to develop a transition plan toward zero emission transit vehicles.
Ellicott City Watershed Master Plan	Department of Planning and Zoning	2020	2023	This General Plan Amendment provides policies and implementing actions for protecting and enhancing flood-impacted Ellicott City and the surrounding Tiber-Hudson Watershed.	Ensure that best practices regarding riverine flood mitigation are included in the plan as new techniques develop.

TABLE 2: CODES AND ORDINANCE CAPABILITIES

Code / Ordinance Type	Name	Responsible Agency	Effective Date & Next Update	Relation to Hazard Mitigation	Capability Expansion
Building Code	"The Howard County Building Code" which includes the International Building Code and the Residential Code	Department of Inspections, Licenses, and Permits	2022/2024	By adopting the current codes, we ensure construction is kept up to date with the latest standards and technologies.	The International Code Council does a good job making sure the code is up to date and takes into account new building technologies. Howard County has a number of employees who participate in these committees to make sure we stay up to date on these advancements.
International Property Maintenance Code	2021 International Property Maintenance Code	Department of Inspections, Licenses, and Permits	2022/2024	The adoption of the property maintenance code is for rental properties only at this time. The adoption of this code makes sure rental properties are maintained so that they remain protected from hazards.	Howard County is currently evaluating utilizing this code to apply to critical structures like multistory buildings to make sure they remain structurally sound for the life of the structure.
Zoning Ordinance	Subtitle 2 Zoning	Department of Planning and Zoning		This Subtitle promotes practices that provide the best use of land and the stewardship of our environmental resources.	Continue to adopt best practices and developments in technology.
Floodplain Management	Section 3114 Floodplain	Department of Inspections,	2022/2024	Prevents new residential/nonresidential construction from happening	Adopt and implement higher standards.

Ordinance/NFIP Compliance		Licenses, and Permits		within designated floodplains with exceptions for existing structures and structures approved by public works. Also ensures that existing structures are elevated to 2 feet above the 100-year flood elevation.	
	Section 16.115-Floodplain Preservation	Department of Planning and Zoning	2022/2024	This Section delineates what can and can't be done within the 100-year floodplains to protect the floodplain.	Adopt and implement higher standards.
	Subtitle 7-Floodplain	Department of Planning and Zoning	2022/2024	This Subtitle works to minimize flood hazards by protecting floodplains, encouraging appropriate building practices, and ensuring the County meets NFIP requirements.	Adopt and implement higher standards.
Fire Department Inspections	Howard County Fire Prevention Code (Title 17, Subtitle 1, Sec. 17.104)	Department of Fire and Rescue Services	2021/2024	Provides authority for DFRS personnel to inspect non-residential properties in the County for compliance with fire and life safety regulations. Also allows DFRS to work with Public Works to review site plans for fire department accessibility, water supply, and other life safety issues.	Periodic revisions to keep up with changing best practices in fire prevention as well as developments in building construction and fire protection systems.

Stormwater Ordinance	Subtitle 5- Storm Drainage Systems	Department of Public Works		The purpose of this Subtitle is to provide for the proper functioning of the storm drainage systems in Howard County. It also requires the repair and maintenance of privately owned storm drainage facilities.	Adopt and implement higher standards. Update design storms for drainage infrastructure. Require downstream upgrades beyond the property lines of upstream development.
	Subtitle 9 Stormwater Management	Department of Public Works		This Subtitle establishes minimum requirements and procedures to control adverse impacts associated with stormwater runoff. Uses environmental site design to reduce stream channel erosion and local flooding.	Adopt and implement higher standards. Require management for more storm events and in more areas of the County. Require downstream upgrades beyond the property lines of upstream development.
Steep Slope Ordinance	Sec. 16.116- Protection of wetlands, streams, and steep slopes	Department of Planning and Zoning		This Section works to protect wetlands, streams, and steep slopes by restricting removal of vegetative cover and trees, paving, and new structures within a certain amount of feet.	Continue to adopt new best practices to better protect wetlands, streams, and steep slopes.

TABLE 3: EDUCATION AND OUTREACH CAPABILITIES

Activity Type	Name or Description of Effort	Responsible Agency/Organization	Relation to Hazard Mitigation	Capability Expansion
StormReady Certification	Falls under mitigation program.	Department of Fire and Rescue Services--Office of Emergency Management	Provides guidelines on how the County can improve hazardous weather operations. County must meet guidelines and renew every three years.	The County has recently become Weather-Ready Nation Ambassadors to further promote national resilience against extreme weather.
Seasonal Emergency Management and Mitigation Outreach	Preparedness messaging is sent out via social media by the Office of Emergency Management, County PIO, and other County social media pages prior to severe weather.	Office of Emergency Management; County Public Information Office; DFRS; etc.	This messaging allows members of the public to prepare for disasters before they arrive to mitigate their own risks. This reduces stress on County resources and shortens the recovery period.	County departments attend trainings and workgroups to promote best practices and to share success stories.
Community Organizations Focused on Emergency Preparedness	Howard County Community Organizations Active in Disaster (COAD)	Howard County Community Organizations in Disaster Executive Committee	The COAD's goal is to bring together Howard County non-profits, faith-based organizations, local businesses, and community groups in times of disaster to provide resources and assistance to those in need. The COAD works alongside the County and helps meet outstanding needs.	This program was started in 2019 and is growing. Additional training and tabletops are needed to improve capabilities.

	Radio Amateur Emergency Communications (RACES); Columbia Amateur Radio Association (CARA)	Radio Amateur Emergency Communications (RACES); Columbia Amateur Radio Association (CARA)	This group mitigates impacts from loss of communication before, during, and after an event.	Improved antenna coverage would improve this capability.
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Howard County Community Organizations Active in Disaster	Howard County Community Organizations in Disaster Executive Committee	The COAD's goal is to bring together Howard County non-profits, faith-based organizations, local businesses, and community groups in times of disaster to provide resources and assistance to those in need. The COAD works alongside the County and helps meet outstanding needs.	This program was started in 2019 and is growing. Additional training and tabletops are needed to improve capabilities.
Natural disaster or safety related school programs	Annual drills conducted at each school (14 drills are required each year)	Howard County Public School System (HCPSS)	Drills relate to natural disasters and evacuation, or shelter-in-place needed after an incident.	This capability is being fully leveraged.

Ongoing public education or information program (e.g. environmental education, fire safety, household preparedness, responsible water use, etc.)	Partnership with local libraries to exchange traditional lightbulbs with LED bulbs.	Office of Community Sustainability; Howard County Public Libraries	This project relates to hazard mitigation in that it helps people live more sustainably. The LED bulbs use far less energy than normal bulbs and can reduce the stress on electrical grids during extreme temperature events.	This program is new, so after it has had a chance to perform, opportunities for expansion will be noted.
	Social media posts focused on household preparedness, publication of Community Hazard Handbook, and presentations to educate the public	Office of Emergency Management	Through education on what hazards threaten the County and how to be prepared, the County can help citizens understand how to prepare for disasters to mitigate losses and reduce recovery time.	More targeted messaging to underserved populations and relationship building.

TABLE 4: TECHNICAL CAPABILITIES

Position Type	Full/Part Time	Title	Current Position Holder	Relation to Hazard Mitigation	Capability Expansion
Chief Building Officer	Full	Director (Building Official)	Robert J. Frances	Ensuring private properties or public properties are not built in hazardous areas and enforcing local codes by issuing citations for violations.	The Building Official has the ability to delegate to qualified deputies, division chiefs, and supervisors for the review, approval, and enforcement duties needed to ensure code compliance.
Civil Engineer--Construction	Full	Chief, Bureau of Engineering	Amah Binde	Ensuring projects are aligned with County code and are constructed in a way that mitigates against natural	Monitor and enhance use of project manager focused guides noted below.

Project Management				hazards that occur in that area.	
Civil Engineer-Design	Full	All Engineers in Transportation and Special Projects Division Engineers in Utility Design Division	Multiple	Ensures infrastructure is constructed in areas not at high risk to natural hazards. Knowledge of maps, topographical surveys, and design techniques allow for more resilient infrastructure.	Increase training on Baltimore Metro Council's (BMC) "Enhancing Climate Resilience" project deliverables in the focus areas of transportation, water, and stormwater. Also, to increase training on the BMC's "Climate Change Resource Guide and Toolkit."
Grant Administrator	There's no one grant administrator for the County, but most departments designate this responsibility to an employee.	n/a	There's no one grant administrator for the County, but most departments designate this responsibility to an employee.	Ensures or meets agency meets grant eligibility and opens the way for access to additional funding for mitigation projects.	Prioritize funding and increase training for grant management.

Grant Writer	There's no one grant writer for the County, but most departments designate this responsibility to an employee.	n/a	There's no one grant writer for the County, but most departments designate this responsibility to an employee.	Knows how to find funding sources and write thorough applications that bring in additional mitigation funding.	Prioritize funding for and increase training opportunities for grant writing classes.
Chief Financial Officer	Full	Director of the Department of Finance	Rafiu Ighile	Ensures County projects are within budget and plans for capital budget projects. Many of these projects are large infrastructure projects that can lead to reduced vulnerability to natural hazards.	Ensure the Finance Director is looped into mitigation projects looking for funding to ensure County resources are being used efficiently and grants are pursued when needed.
Community Planner	Full	Director of the Department of Planning and Zoning	Amy Gowan	Ensures the County is growing in an organized way that is also aligned with public opinion. This can relate to hazard mitigation in that citizens want communities built in a way that mitigates the effects of natural hazards. It also helps ensure the resources citizens need are met.	Ensure the Director of DPZ is notified when mitigation grant opportunities are released as well as included in grant discussion meetings.

Emergency Manager	Full	Director of the Office of Emergency Management	Michael Hinson	Develops and maintains emergency management plans, which encompass all hazards and phases of emergency management. Also serves the function of educating the public in emergency preparedness.	Evaluate how mitigation grants are being discussed among County departments and if OEM needs to organize additional meetings with all possible stakeholders to discuss these opportunities.
GIS Coordinator	Full	Technical Serv Manager I	Rob Slivinsky	Assists in the creation of maps and tracking down data for analyzing hazards.	Hazus training to assist in risk analyses.
Floodplain Administrator	Full	Acting Director of Public Works	John Seefried	Responsible for ensuring that all existing and new construction is reasonably safe from flooding and that NFIP and local regulations are followed.	Improve the coordination of duties and responsibilities among DPW, DILP, and DPW. Improve the documentation process for decisions made related to review and permitting of floodplain development.

TABLE 5: FINANCIAL CAPABILITIES

Funding Resource Type	Name/Description	Responsible Agency/Organization	Relation to Hazard Mitigation	Capability Expansion
Capital Improvements Program	Capital Improvement Program (CIP)	County Council; Department of Finance	Allots funding for infrastructure planning, bridge repairs, and other large-scale projects.	This resource is being fully leveraged.

Funding Programs-Federal (Non-FEMA)	Community Development Block Grant Programs; US EDA grants; Natural Resources Conservation Service	Office of Emergency Management; Economic Development Authority	Allots funding for infrastructure planning, bridge repairs, and other large-scale projects.	This resource is being fully leveraged.
Utility Fees for Stormwater, Water, Sewer, Gas, or Electric Services	The County charges fees for water, sewer, and trash services. Gas and electric services are provided by private companies.	Department of Public Works	These fees are needed to allow for implementation of appropriate mitigation actions regarding utilities.	This resource is being fully leveraged.
FEMA Hazard Mitigation Assistance	Building Resilient Infrastructures and Communities; Flood Mitigation Assistance; Hazard Mitigation Grant Program	Department of Public Works--Bureau of Environmental Services--Stormwater Management Division; Department of County Administration--Office of Community Sustainability; Office of Emergency Management	These funding resources have been used in the past to fund flood mitigation projects and the updating of hazard mitigation plans.	<p>This capability can be expanded by completing Benefit Cost Analyses (BCA) in advance of grant openings and training employees to complete or hiring contractors to complete in-depth BCAs. This would increase access to grant funding.</p>

Emergency Management Funding	Emergency Management Performance Grant (EMPG)	Office of Emergency Management	This funding sustains the core capabilities of the five emergency management mission areas (prevention, protection, mitigation, response, and recovery). Promotes an all-hazards approach to emergency management.	This resource is being fully leveraged.
Funding Programs - State	State Homeland Security Program (SHSP)	Office of Emergency Management; Howard County Police Department; Department of Fire and Rescue Services	Funding promotes building capabilities to enhance national resilience to absorb disruptions and rapidly recover from incidents both natural and manmade.	Ensure national priorities required for SHSP grant applications are communicated to mitigation program manager in OEM.
General Obligation Bonds and/or Special Tax Bonds	The County has authority to incur debt through general obligation bonds, special tax bonds, and revenue bonds.	Department of Finance		
Impact Fees for New Development	The County levies development excise taxes on new developments.	Department of Finance		

Chapter 6: Mitigation Strategy

Requirements for Mitigation Strategy

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

- (i) The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
- (ii): The mitigation strategy shall include a section that identifies and analyses a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
- (iii): The mitigation strategy section shall include an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Mitigation Goals and Objectives

The mitigation strategy serves as the short and long-term road map to reduce the potential losses, vulnerabilities, and shortcomings identified in *Chapter 4: Hazard Identification, Profiling, and Risk Assessment*. It also considers the County's capabilities that can be mobilized to support hazard mitigation that were identified in *Chapter 5: Capability Assessment*. This mitigation strategy includes a list of goals and objectives, along with specific mitigation actions to address the goals and objectives. Actions are then prioritized, based on scoring criteria developed by the previous Joint Steering Committee along with additional considerations, such as climate change.

This chapter comprises the following six subsections:

- Mitigation Goals and Objectives
- Identification of Mitigation Actions
- Prioritization of Mitigation Actions
- Implementation Plan
- Funding Sources
- NFIP and Continued Compliance

Chapter Definitions

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

- Objectives – Define strategies or implementation steps to attain the identified goals. Compared to goals, objectives are more specific and measurable.
- Hazard Mitigation Projects – Projects are defined as specific actions taken to address defined vulnerabilities to existing buildings or systems. Potential funding sources are listed for each project.
- Mitigation Action Plan – Prioritized listing of actions (policies and projects), including a categorization of mitigation technique, hazards addressed, individual or organization responsible for implementation, estimated timeline for completion and list of potential funding sources.

Howard County's Mitigation Goals and Objectives

For the purposes of this Plan, goals are defined as general policy guidelines or broad statements that represent a vision for a community. Howard County's mission is to develop practical planning solutions for the variety of hazards that pose a risk to Howard County.

The following table contains the 2024 Howard County NHMP goals and objectives. The goals and objectives have been organized to be in harmony with the goals from the State Plan, categorized to match the goals in the Howard County FMP, and to be applicable at the local level. The Joint Steering Committee evaluated these from the 2019 NHMP and elected to keep these goals and objectives consistent for the 2024 NHMP.

PROPERTY PROTECTION		
Goal #	Description	Objectives
1	Identify future mitigation actions from lessons learned during preparedness, response, and recovery activities throughout the County.	Document and review after action reports (AAR) and improvement plans (IP) for various incidents, events, and hazards throughout the County to identify future mitigation actions.
		During response and recovery activities, solicit ideas and recommendations, as well as experiences, both positive and negative, to develop potential mitigation actions.
2	Identify and pursue available mitigation funding opportunities for future mitigation projects.	Identify and apply for grant opportunities that will support structural and non-structural hazard mitigation projects.
		Identify and apply for grant opportunities that will support hazard mitigation awareness and training programs.
		Providing information to business and property owners on potential funding sources for private property mitigation projects and actions.

PUBLIC EDUCATION AND AWARENESS		
Goal #	Description	Objectives
3	Engage and educate the community on the roles, responsibilities, and activities of the Office of Emergency Management (OEM).	Promote OEM activities and initiatives at County sponsored events and through County-operated media channels.
		Provide opportunities, events, and/or mechanisms for citizens to meet with, or speak to emergency management professionals.
4	Engage and educate the public on natural hazards and potential mitigation actions to encourage personal awareness and responsibility.	Develop and support disaster preparedness education and awareness programs that target residents, visitors, businesses, and elected officials.
		Support incentive programs, for both public and private sections, that promote structural retrofits where appropriate.
PREVENTIVE MEASURES		
Goal #	Description	Objectives
5	Reduce the potential impact of natural disasters on public and private property to protect people and minimize losses.	Discourage new development in high hazard areas through appropriate regulations and land use planning.
6	Ensure hazard mitigation goals are consistent with all other County plans and ordinances.	Incorporate hazard mitigation principles into new and existing County plans and ordinances.
		Encourage private business, industry, and institutional entities to integrate emergency plans with County mitigation/emergency plans, where appropriate.
7	Develop an accountability plan and a mechanism for tracking mitigation action implementation.	On an annual basis, examine mitigation action implementation progress, and encourage timeline completion.
NATURAL RESOURCE PROTECTION		
Goal #	Description	Objective
8	Protect natural resources and open spaces that provide flood, and other hazard mitigation functions.	Prioritize actions that protect natural resources while supporting community resiliency and other hazard mitigation efforts.
EMERGENCY SERVICES		
Goal #	Description	Objectives
9	Ensure critical facilities (fire stations, police stations, hospitals) and infrastructure (water and sewer facilities, electrical and other utilities,	Identify appropriate mitigation techniques for any critical facilities currently in the 100-year floodplain and direct construction of any future critical facilities out of the 100-year floodplain.

	and transportation systems) vital to disaster response and recovery, are less vulnerable to, and better able to withstand, natural hazards.	Ensure roads/access to facilities located near the 100-year floodplain are not impeded.
STRUCTURAL PROJECTS		
Goal #	Description	Objectives
10	Reduce potential disruption of the County's critical infrastructure during hazard events.	Ensure regular maintenance of the County's critical infrastructure that lies within the 100-year floodplain. Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofitting. Coordinate with the managing entities for any privately-owned infrastructure, including dams, retaining ponds, and berms, to encourage regular inspections on all structures, and improvements when and where warranted.
HISTORIC AND CULTURAL RESOURCES		
Goal #	Description	Objectives
11	Protect historical and cultural assets across the County from flooding and other natural hazards.	Utilize historical preservation data to identify protective measures for historical properties and cultural resources.

Further description of the action categories is found in the sections below.

Identification of Mitigation Actions

Mitigation Categories

This mitigation strategy addresses six mitigation categories while considering the County's capabilities to attain the Plan's goals and objectives. These include:

- Preventive Measures
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Public Outreach and Education

These categories formed the basis of the mitigation actions in the Plan update. Descriptions of these categories and examples for each category are included below:

1. Preventive Measures

- a. Measures include those actions that are performed to keep hazard related issues from exacerbating in the community. They are effective in reducing a community's future vulnerability, particularly in areas where development has not occurred. Examples of preventive actions include zoning and subdivision regulations; building code; hazard mapping; open space preservation; floodplain regulations; stormwater management; drainage system maintenance; and capital improvements programming.
2. Property Protection
 - a. Measures include those actions that can be undertaken by private homeowners, so their structures can: better withstand hazard events, be removed from hazardous locations, or can be insured to cover potential losses. Examples include acquisition; relocation; building elevation; critical facilities protection; retrofitting (i.e., wind proofing, flood proofing, seismic design standards, etc.); insurance; drainage; and safe room construction.
 3. Natural Resource Protection
 - a. Measures include those actions that can reduce the impact of hazards by preserving or restoring the function of natural systems. Natural systems that can be classified as high hazard include floodplains, wetlands, and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing water quality or recreational opportunities. These actions are usually implemented by parks, recreation, or conservation agencies. Examples include floodplain protection; fire resistant landscaping; erosion and sediment control; wetland restoration; habitat preservation; and slope stabilization.
 4. Structural Projects
 - a. Measures include those actions designed to reduce the impact of hazards by building new structures or hardening existing structures. Structural projects are usually designed by engineers and managed or maintained by public works staff. Examples include reservoirs; levees, dikes, and floodwalls; detention and retention basins; channel modification; and storm sewer construction.
 5. Emergency Services
 - a. Although emergency services are not necessarily considered mitigation techniques, these services minimize the impact of a hazard on people and property. Actions taken immediately prior to, during, or in response to a hazard event include warning systems; search and rescue operations; evacuation planning and management; and flood fighting techniques.
 6. Public Outreach and Education
 - a. Measures include those actions conducted to advise and educate residents, business owners, potential property buyers, and visitors about hazards and mitigation techniques that can be used to protect lives and property. Examples of measures used to educate and inform the public include outreach and education; training; demonstrations; real estate disclosure; and hazard expositions.

Mitigation Actions

As part of the update process, the JSC guided the development of new mitigation actions during meetings discussed in *Chapter 3: Planning Process*. Some mitigation action items were carried over from the old plan and annual updates and were marked as complete or edited, and some new action items were developed based on the goals and objectives of the Plan.

In the mitigation action table in this section, progress on actions is noted under the “Timeline” column. There are a total of 41 incomplete/ongoing action items as of this 2024 update. Nine action items from the previous update were completed with four being completed prior to the 2021 annual review and five being marked as completed after the 2021 annual review. Ten action items have been added to the table. Two of these additions have been edited from the most recent version of the Plan. The “New Task (as of Jan. ’23)” column marks which action items are new for the 2024-2029 Plan update. To create the implementation strategy for all the actions, each action item is placed in the table below, and the following are identified for each action:

- Related Hazards (all hazards that are addressed by the action)
- Lead Departments for Implementation
- Support Agency or Agencies
- Funding Source (Federal, State, County funds or grants)
- Estimated Cost
- New Task (as of Jan. ’23)
- General Timeline- Each action item is designated with one of the following timelines below. It is often difficult to establish a discrete timeline due to funding, staffing, and priority changes.
 - **Long-term-** This action is a new strategy or action that has been or will be adopted on a consistent basis for the foreseeable future by the County. It does not have a discrete ending. At every annual review of this Plan, these actions will be evaluated for effectiveness.
 - **Medium-term-** This action is a new strategy or action that has been or will be adopted on a consistent basis by the County and likely will not be complete for the next ten years.
 - **Short-term-** This action is a new strategy or action that has been or will be adopted on a consistent basis by the County and likely will not be complete for the next five years.
- Mitigation Category (Preventive Measures, Property Protection, Natural Resource Protection, Structural Projects, Emergency Services, or Public Outreach and Education)

A detailed description of each funding source listed in the table is provided immediately following the action table. The abbreviations used in the mitigation actions table refer to the funding resources listed in that section.

Evaluating Mitigation Actions for Cost-Effectiveness

In accordance with FEMA mitigation planning requirements, the NHMP JSC evaluated the cost-effectiveness of each of the actions listed in the table below. In many cases, the actions listed in the

table are part of larger mitigation strategies, or are studies intended to be precursors to potential mitigation actions, if the actions are determined to be feasible and cost-effective through more detailed evaluations. The County used two sources to develop the actions below:

- The previous NHMP
- Directly soliciting information from the JSC, County departments, and individuals with specific knowledge of certain kinds of hazards and actions

Project costs provided are estimates from the JSC member or subject matter expert who suggested the action item. Feasibility of the action items were discussed in the first Joint Steering Committee meeting and during the prioritization process. It is important to note that feasibility can often change year to year depending on budgets and County priorities.

Prioritization

The following questions were used by the JSC to determine the level (high, medium, and low) of importance to life safety, administrative, and economic considerations for each action. These priorities were translated into points and facilitated the ranking and identification of high priority projects as shown in the table below.

EVALUATION CRITERIA FOR PROJECT PRIORITIZATION						
Criteria	Points	High	Points	Medium	Points	Low
Life/Safety Impact (Scale from 0-10)	7-10	Significant impact on public safety for businesses, residents, properties	3-6	Direct impact on businesses, residents, properties	0-2	Minimal/negligible impact on businesses, residents, properties
Administrative/Tech Assistance (Scale from 0-5)	4-5	No additional staff or technical support needed to implement action	2-3	Some administrative and technical support needed to implement action	0-1	Significant administrative and technical support needed to implement action
Project Cost (Scale from 0-5)	4-5	Low cost (<\$25,000)	2-3	Moderate cost (\$25,000-\$100,000)	0-1	High cost to implement (>\$100,000)

Action items that received high numerical scores are ranked as having higher priority. For example, a project with a high score will have more impact on public safety, be relatively easy to accomplish due to not needing additional staff or technical support and be lower in cost. Action items that receive lower scores will tend to have higher costs, not as much direct or immediate impact on public safety and require more administrative and technical support.

Implementation Plan

Mitigation					Prioritization					Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category	
INCOMPLETE/ONGOING ACTIONS (AS OF JANUARY 2023)														
1	Continue to utilize FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	All Hazards	OEM		6	4	4	14	County Funds; UASI	Staff Time	No	Long-term	Public Education and Outreach	
2	Perform flood mitigation for Historic Ellicott City, consistent with the Ellicott City Safe and Sound Flood Mitigation Plan, by designing and constructing the North Tunnel, Maryland Avenue Culvert, Pond H-7, Pond H-4, Quaker Mill Pond, Pond NC-3, and Pond T-1, as well as performing other non-capital project efforts consistent with the Safe and Sound Plan.	Flooding	DPW		10	2	1	13	County, State, Federal Funds	\$200M	Yes	Medium-term	Structural Projects	
3	Encourage local businesses and local industry owners to develop a business continuity plan and provide educational materials.	All Hazards	OEM		5	4	4	13	County Funds; SHSP; EMPG	Staff Time	No	Long-term	Public Education and Outreach	
4	Ensure that applicable codes and ordinances, such as building codes, floodplain ordinances, wetland protection, and erosion and sediment control standards are consistently enforced.	All Hazards	DILP/DPZ		5	3	4	12	County Funds	Staff Time	No	Long-term	Preventive Measures	

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
5	Continue to update, maintain, and implement existing emergency plans, including but not limited to, recovery, response, and/or emergency operations plans.	All Hazards	OEM		5	3	4	12	EMPG; UASI; County Funds	Staff Time	No	Long-term	Emergency Services
6	Continue to conduct an annual snow emergency coordination meeting in the fall with the County departments involved in snow emergency response.	Severe Winter Weather	DPW-Highways	DPW-Utilities; DPW-Facilities	5	3	4	12	County Funds	Staff Time	No	Long-term	Emergency Services
7	When updating the County's area plans and comprehensive plan, include hazard mitigation considerations to reduce risk to natural hazards throughout the County.	All Hazards	DPZ		4	3	4	11	County Funds	Staff Time	No	Long-term	Preventive Measures
8	Continue to maintain and update an annual plan to supplement Public Work's snow removal teams with Department of Recreation and Parks and Fire Department personnel.	Severe Winter Weather	DPW-Highways	DRP; DFRS	4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services
9	Maintain the tree and brush trimming program within the right-of-way to protect access to critical facilities and to prevent emergency services from being disrupted due to falling trees or branches, before and/or after a hazard event.	All Hazards	DPW-Highways	Verizon; First Energy; Constellation Home	5	3	3	11	County Funds	Staff Time	No	Long-term	Emergency Services

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
10	Continue to educate key emergency management stakeholders (Executives Cabinet and Emergency Management Operations Group members) by conducting trainings and exercises.	All Hazards	OEM		4	3	4	11	UASI; EMPG; County Funds	\$50,000	No	Long-term	Emergency Services
11	Evaluate each County department's ability to maintain a suitable workforce during a protracted disaster.	All Hazards	OEM		4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services
12	Implement the operational strategies and Cistern Plan for dealing with rural water supply during protracted drought events.	Drought	DFRS		6	3	2	11	County Funds	Staff Time	No	Short-term	Emergency Services
13	Conduct annual training/exercises for Emergency Operations Center and Department Operations Center personnel on how to continuously staff the centers through a protracted disaster.	All Hazards	OEM		4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services
14	When updating zoning ordinance, consider provisions for identification of all hazard areas.	All Hazards	DPZ		4	3	4	11	County Funds	Staff Time	No	Short-term	Preventive Measures
15	Continue to enhance and develop mutual aid agreements with neighboring jurisdictions and State partners.	All Hazards	OEM		4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services
16	Continue to conduct training exercises for hazard events at least twice a year.	All Hazards	OEM		4	3	4	11	County Funds; EMPG	Staff Time	No	Long-term	Emergency Services

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
17	Continue to educate homeowners on the potential risk of earthquakes and on safety techniques to follow during and after an earthquake.	Earthquake	OEM		4	3	4	11	County Funds	Staff Time	No	Long-term	Public Education and Outreach
18	Collect information and develop a queryable database of specific hazard events that caused any damages to County infrastructure and critical facilities.	All Hazards	OEM	DPW-SWMD	4	3	4	11	County Funds	Staff Time	No	Medium-term	Emergency Services
19	Educate all building safety coordinators about safety, evacuations, appropriate assembly areas and shelter-in-place guidelines.	All Hazards	Risk Management		4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services
20	Implement a comprehensive critical infrastructure protection program that focuses on security and consequence management.	All Hazards	Physical Security Workgroup (HCPD, OEM, DFRS, DPW, DTCS, Risk Management, and Health Department)	External Partners through OEM	5	3	3	11	UASI; Capital Budget; County Funds	Staff Time	Yes	Short-term and when needed	Preventive Measures
21	Continue to place NOAA Weather Alert Radios in new designated critical facilities and County-owned buildings.	Weather related hazards	Administration; Risk Management	OEM	4	4	3	11	UASI; EMPG	\$5,000	No	Long-term	Public Education and Outreach

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
22	Work with County departments and strategic partners to better serve at-risk populations (elderly persons, unhoused populations, persons with access and functional needs) through effective public outreach on various hazards and monitor for gaps in providing emergency services to those populations.	All Hazards	OEM	DCRS	5	3	4	11	County Funds	Staff Time	Edited from Old Task	Long-term	Public Education and Outreach
23	Utilize tracking reports during the annual NHMP review process to identify potential barriers or hindrances to implementation of hazard mitigation activities and projects.	All Hazards	OEM		4	3	4	11	County Funds	Staff Time	No	Long-term	Preventive Measures
24	Continue to adopt the most updated version of the National Electrical Code (NEC).	All Hazards	DILP		4	3	4	11	County Funds	Staff Time	No	Long-term	Preventive Measures
25	Consider natural resource preservation and land use planning initiatives that ensure natural resource areas that provide hazard mitigation benefits, remain open spaces, to retain the natural benefits they provide.	All Hazards	DPZ; Admin. - OCS		4	3	4	11	County Funds	Staff Time	No	Long-term	Natural Resources
26	Continue to host annual workshops for local builders to discuss how to build homes that are more resistant to natural hazards.	All Hazards	DILP		4	3	4	11	County Funds	Staff Time	No	Long-term	Property Protection

Mitigation					Prioritization					Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category	
27	Continue regular maintenance program for the County's emergency generators that includes a schedule to change filters, etc.	All Hazards	DPW-Facilities		4	3	4	11	County Funds	Staff Time	No	Long-term	Emergency Services	
28	Maintain requirements to continue recognition as a Storm Ready Community (by the National Weather Service StormReady® Program).	All Hazards	OEM		3	3	4	10	County Funds	Staff Time	No	Short-term	Emergency Services	
29	Continue to conduct seminars in schools on various hazards that could threaten the County and provide informational packets on the County's natural and human-caused hazards.	All Hazards	OEM		3	3	4	10	County Funds	Staff Time	No	Long-term	Public Education and Outreach	
30	Establish a pre-EMAC personnel and equipment identification process to deploy County personnel and equipment to surrounding jurisdictions and/or regional/national disaster events.	All Hazards	OEM		4	2	4	10	County Funds; UASI	Staff Time	No	Short-term	Emergency Services	
31	Increase public awareness on wildfires by providing outreach and education on urban/wildland interface and increasing buffers and defensible spaces to reduce vulnerability	Wildfires	DFRS	DNR	3	3	4	10	EMPG	\$10,000	No	Long-term	Property Protection	
32	Finish Debris Management Plan and document lessons learned from recent events.	All Hazards	OEM; DPW-Environmental Services	DRP	3	3	4	10	County Funds	Staff Time	Yes	Short-term	Emergency Services	

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
33	Take down dead ash, oak, and tree of heaven trees that could potentially fall and hit a target and replant new trees to re-establish the vegetation and new tree canopy.	All Hazards	DRP		4	3	3	10	County Funds	\$200,000	Edited from Old Task	Medium-term	Natural Resources
34	Continue to evaluate and remove trees throughout the County's park system that are at risk of falling during storms and high wind events.	Tornado; Hurricane; Severe Winter Weather	DRP		4	2	3	9	County Funds	Staff Time	No	Long-term	Natural Resources
35	Establish pre-disaster debris contracts and craft debris site MOUs with appropriate County agencies and regions.	All Hazards	DPW-Environmental Services, Solid Waste (Operations Division)		3	3	3	9	County Funds	Staff Time	No	Short-term	Emergency Services
36	Consider the need for a policy that requires new County-owned Class 4 buildings and critical facilities to be hardened and safe rooms incorporated.	All Hazards	OEM; DPW-Facilities		4	2	3	9	BRIC; HMGP	Staff Time	Yes	Short-term	Emergency Services
37	Continue to perform routine maintenance to keep street trees healthy so they are less likely to fall or break during a severe weather event.	All Hazards	DPW -Highways		4	3	2	9	County Funds	Staff Time	No	Long-term	Natural Resources

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
38	Conduct an engineering study to identify and plan for flood risk mitigation alternatives, such as temporary or permanent flood barriers, elevating or relocating equipment, and/or other flood risk mitigation facility improvement at the County's wastewater treatment plant, the Little Patuxent Water Reclamation Plant.	Flood	DPW – Bureau of Engineering, Utility Design Division		5	3	1	9	County Funds	Staff Time	Yes	Short-term	Emergency Services
39	Sequentially construct flood risk mitigation measures such as temporary or permanent flood barriers, elevating or relocating equipment, and/or other flood risk mitigation facility improvements at the County's wastewater plant, the Little Patuxent Water Reclamation Plant.	Flood	DPW – Bureau of Engineering, Utility Design Division		5	3	1	9	County Funds; Grant and non-grant options	Staff Time	Yes	Medium-term	Structural Projects
40	Create templates for alert messaging for various scenarios.	All Hazards	PIO		0	5	4	9	County Funds	Staff Time	Yes	Short-term	Public Outreach and Education
41	Build water main along U.S. Route 29.	Water Availability	DPW -Utilities		5	2	1	8	County Funds	\$15M-\$18M	Edited from Old Task	Medium-term	Natural Resources
		ACTIONS COMPLETED AFTER 2021 UPDATE											
A	Install lightning alerting systems in DRP's eight regional parks.	Lightning	DRP; OEM		3	3	3	9	County Funds	\$15,000/year		Complete	Emergency Services
B	Identify existing County-owned Class 4 buildings.	All Hazards	DPW-Facilities		2	3	5	10	BRIC; HMGP	Staff Time		Complete	Emergency Services
C	Develop a County emergency water supply plan.	All Hazards	DPW-Utilities		10	1	1	12	County Funds	\$100,000-\$150,000		Complete	Emergency Services

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	New Task (as of Jan. '23) Yes/No	Timeline	Action Category
D	Establish a comprehensive critical infrastructure protection program that focuses on security and consequence management.	All Hazards	Physical Security Workgroup (HCPD, OEM, DFRS, DPW, DTCS, Risk Management, and Health Department)	External partners through OEM	10	5	5	20	UASI; Capital Budget; County Funds	Staff Time		Complete	Preventive Measures
E	Maintain NOAA Weather Alert radios located in designated critical facilities across the County.	All Hazards	Administration - Risk Mgmt.	OEM	2	5	5	12	UASI; EMPG	\$5,000		Complete	Public Education and Outreach
COMPLETED ACTIONS (PRIOR TO 2021 UPDATE)													
A	Develop an Emergency Preparedness, Training, and Exercise Plan that includes a regular maintenance plan and an annual budget.	All Hazards	OEM		2	5	5	12	EMPG; UASI; County Funds	Staff Time		Completed	Emergency Services
B	Review existing building codes every three years to ensure they have been deemed satisfactory in assessing serious damage caused by specific hazards.	All Hazards	DILP		2	5	5	12	County Funds	Staff Time		Ongoing/ Complete	Preventive Measures
C	Combine the Natural Hazards Mitigation Plan and Flood Mitigation Plan to ensure annual review cycles are synchronized.	All Hazards	OEM; DPW – SWMD		10	3	3	16	County Funds; EMPG	\$50,000-100,000		Completed	Preventive Measures
D	Install Tone Alert System in four locations within Ellicott City.	Flood	OEM		3	5	5	13	State Funds	\$250,000		Complete	Emergency Services

The table below identifies the highest priority projects based on their total scores.

Top Five Mitigation Actions	
Project Description	Score
Continue to utilize FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	14/20
Perform flood mitigation for Historic Ellicott City, consistent with the Ellicott City Safe and Sound Flood Mitigation Plan, by designing and constructing the North Tunnel, Maryland Avenue Culvert, Pond H-7, Pond H-4, Quaker Mill Pond, Pond NC-3, and Pond T-1, as well as performing other non-capital project efforts consistent with the Safe and Sound Plan.	13/20
Encourage local businesses and local industry owners to develop a business continuity plan and provide educational materials.	13/20
Ensure that applicable codes and ordinances, such as building codes, floodplain ordinances, wetland protection, and erosion and sediment control standards are consistently enforced.	12/20
Continue to update, maintain, and implement existing plans, including but not limited to, recovery, response, and/or emergency operations plans.	12/20

Funding Sources

The following sources provide funding for hazard mitigation projects.

Building Resilient Infrastructure and Communities (BRIC)

BRIC is administered by FEMA and provides grants to states, tribes, and local governments. The BRIC Program provides funds for hazard mitigation projects that reduce risks faced from disasters and natural hazards. The guiding principles are:

- Supporting communities through capability-and-capacity building
- Encouraging and enabling innovation
- Promoting partnerships
- Enabling large projects
- Maintaining flexibility
- Providing consistency

Emergency Management Performance Grant (EMPG)

The EMPG program provides resources to state and local governments to develop an all-hazards planning approach to emergency management and to sustain and enhance all-hazards emergency management capabilities. Every state is eligible for a percentage of the available funds and is intended to sustain the core capabilities of the five (prevention, protection, mitigation, response, and recovery) mission areas.

Community Development Block Grant (CDBG)

The CDBG Program supports community development activities to build stronger and more resilient communities. To support community development, activities are identified through an ongoing process. Activities may address needs such as infrastructure, economic development projects, public facilities installation, community centers, housing rehabilitation, public services, clearance/acquisition, microenterprise assistance, code enforcement, homeowner assistance, etc.¹⁷⁰

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 NFIP insurable structures with a focus on RL 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 FMPs; 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.

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.

Urban Areas Security Initiative (UASI)

The UASI program assists high-threat, high-density urban areas in efforts to build and sustain the capabilities necessary to prevent, protect against, mitigate, respond to, and recover from acts of terrorism. The UASI program is intended to provide financial assistance to address the unique multi-discipline planning, organization, equipment, training, and exercise needs of high-threat, high-density urban areas, and to assist these areas in building and sustaining capabilities to prevent, protect against, mitigate, respond to, and recover from threats or acts of terrorism.

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. Howard County can meet match requirements through various funding sources.

¹⁷⁰ *Community Development Block Grant*, HUD EXCHANGE, <https://www.hudexchange.info/programs/cdbg/> (last visited Feb. 22, 2023).

State Homeland Security Program (SHSP)

The SHSP is a core assistance program that provides funds to build capabilities at the state, local, and territorial levels, to enhance national resilience, to absorb disruptions, and to rapidly recover from incidents both natural and human-caused as well as to implement the goals and objectives included in state homeland security strategies and initiatives.

Annual Budgets

The 2019 Year Capital Improvement Program (CIP) was approved by the County Council and is allotted \$198,855,000 for infrastructure planning, bridge repairs, and other large-scale projects. The projected five-year CIP for FY 2019-2024 is \$ 5,235,826,000.

Funding through Taxing Authority

The County can fund mitigation projects through its taxing authority. It also has the authority to incur debt through general obligation bonds, special tax bonds, and revenue bonds.

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

Continued Compliance with the National Flood Insurance Program (NFIP)

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

- Floodplain Identification and Mapping Risk
- Responsible Floodplain Management
- Flood Insurance

Flood Identification and Mapping

- According to Subtitle 7-Floodplain, Section 16.704- Use and Interpretation of FIRMs, "If a preliminary flood insurance rate map and/or a preliminary flood insurance study has been provided by FEMA...Upon the issuance of a letter of final determination by FEMA, the preliminary flood hazard data shall be used and shall replace the flood hazard data previously provided from FEMA for the purposes of administering these regulations." Adoption of the latest effective FIRMs and compliant floodplain management ordinance occurred by the map effective date, November 6, 2013.
- The County makes the FIRM and Flood Insurance Studies available to the public. These documents are housed in the County's SWMD (BES). They are also available at County libraries

and digital copies are available on the County's website and Digital Flood Insurance Rate Map (DFIRM) tool (https://data.howardcountymd.gov/gdfirm/main_Web.aspx).

- The County reviews Letters of Map Revisions (LOMRs) based on Fill (LOMR-F) and/or Conditional LOMR-F requests and signs a Community Acknowledgement Form for the applicant to submit to FEMA. If during the subdivision review process a new development determines a reduction in the floodplain delineation of the FIRM floodplain, the developer is required to submit a LOMR to FEMA.
- The County provides advice to community residents regarding elevation certificates and Letter of Map Amendment (LOMA) applications. Elevation Certificates are provided to the public upon request if their property is within or close to the high-risk flood zone.
- The County maintains records of approved letters of map change. Digital copies of Letters of Map Change (LOMC) are available on the County's website and DFIRM Tool (https://data.howardcountymd.gov/gdfirm/main_Web.aspx).

Floodplain Management

- According to Title 16-Planning, Zoning, and Subdivisions and Land Development Regulations, Subtitle 7-Floodplain, Section 16.708, "The Director of the Department of Public Works is appointed to administer and implement floodplain regulations as contained in this Code and is referred to as the Floodplain Administrator." Duties are delegated to staff in the Department Public Works, the Department of Planning and Zoning, and the Department of Inspections, Licenses, and Permits.
- Adoption of the latest effective FIRMs and compliant floodplain management ordinance, which includes minimum NFIP floodplain management criteria as well as higher local standards, occurred by the map effective date, November 6, 2013. Restrictions on floodplain use are enforced through the subdivision and building permit process. Floodplain restrictions are included in Howard County Code Title 3—Buildings and Title 16—Planning, Zoning, and Subdivisions and Land Development Regulations, Article II. Design Standards and Requirements and Subtitle 7 Floodplain.
- All proposed development requires plans to go through the County's subdivision approval process or to acquire a building permit for new structures. However, County Code prohibits any new structures in the 100-year floodplain.
- Subtitle 17-Floodplain, Section 16.705 Requirements and Restrictions Applicable to the Floodplain includes regulations related to development in special flood hazard areas.
- All new structures are required to be at least two feet above the 100-year base flood elevation (BFE).
- Post-disaster damage assessment efforts within the County are carried out by the Department of Inspections, Licenses, and Permits (DILP). DILP is responsible for conducting preliminary damage assessments and is entrusted with ensuring that significant personnel are trained to conduct rapid substantial damage assessments immediately following an emergency. A working group will be responsible for coordinating activities after a flood event, to ensure that applicable mitigation actions are brought to the County Executive and County Council for potential

adoption/implementation.¹⁷¹ Regulations outlining how the county implements provisions related to rebuilding after substantial damage has occurred are outlined in Title 3 – Building Code, Section 3114 Floodplain.

Flood Insurance

- The County is committed to educating residents about the value and availability of flood insurance. An annual letter is sent to residents within tax bills explaining the importance of flood insurance and where it may be obtained. Information is also shared year-round on DPW's website and through outreach events.
- The County will assist residents by phone, email, or in-person in interpreting the FIRM and County flood studies to determine the resident's property's floodplain status and offers advice regarding elevation certificates and LOMA applications if asked.
- The previous Community Assistance Visit (CAV) was conducted on May 15, 2018, and Howard County was found to meet the requirements for continued participation in the NFIP.

¹⁷¹ 2024 Flood Mitigation Plan Update, HOWARD CNTY. MD <https://www.howardcountymd.gov/sites/default/files/2023-02/2023%20FMP%20Draft.pdf>.

Chapter 7: Plan Monitoring and Maintenance

Requirements for NHMP Monitoring and Maintenance

44 C.F.R. § 201.6(c)(4): The plan must include a plan maintenance process that includes:

- (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
- (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
- (iii) Discussion on how the community will continue public participation in the plan maintenance process.

Update Process Summary

Upon completion, the Plan was presented to MDEM and FEMA for review and approval in Spring 2023 and received final approval by County Council in Fall 2023. This County NHMP update is intended to be a living document that will undergo periodic review, adjustments, and improvements according to the monitoring and maintenance schedule. This Chapter establishes a method to monitor how the Plan will be evaluated and maintained in the future.

Distribution

The 2024 NHMP update is posted on Howard County's OEM website. Notice of the Plan's online availability was distributed to the following groups through direct email, press releases, and social media posts:

- The organizations, agencies, and elected officials who received notices of public meetings;
- Citizens who attended public meetings and provided contact information;
- Followers of Howard County OEM on social media; and,
- People on Howard County OEM's email distribution list.

Monitoring, Evaluation, and Progress Reports

This 2024 NHMP update will be monitored by the County for three related purposes:

1. Maintain current hazard risk information;
2. Ensure mitigation projects and actions reflect the current priorities of the County, the NHMP/FMP JSC, and the general public; and,
3. Comply with FEMA and MDEM requirements for NHMP maintenance, and to maintain eligibility for federal disaster assistance and mitigation grants.

OEM is responsible for coordinating the JSC, and the Committee shall monitor and maintain the NHMP update. OEM and the JSC shall continuously monitor the NHMP for the purposes described above and for the update triggers discussed in the next subsection.

Following adoption of this Plan, OEM shall annually convene a meeting of representatives from the JSC to discuss and determine implementation accomplishments and/or implementation obstacles and recommended solutions. Although the individuals filling the JSC positions may change from year to year, future members will continue to represent the same departments and organizations involved in this current update.

Plan Evaluation

An annual report form is included at the end of this Chapter to provide annual updates to the County on the status of each County mitigation project. This form will be completed by OEM after each annual mitigation meeting based on feedback from the appropriate lead agency, to document the status of each hazard mitigation action taken under their jurisdiction. Each action proposed in the Plan will be categorized as one of the following: completed, in progress, not started, modified, or cancelled. The JSC will assist OEM with the preparation of a status report of the mitigation actions based on the annual report forms. OEM's status report of the mitigation actions, based on the annual report forms, will also be sent to MDEM and FEMA Region 3 for reporting and documentation purposes.

After the annual report forms are filled, the JSC will evaluate the effectiveness of the Plan in achieving its goals and objectives by going through an examination of the forms and ensuring that each project is moving forward. In addition, the JSC will consider the percentages of each mitigation action category (i.e., how many actions fall under each category and how many are being completed or held up). This will allow JSC members to consider if additional action categories need to be created or removed for efficiency and to reflect County priorities. At the time of this update, the percentages for each mitigation action category are below:

- Emergency Services: 19 action items (~46%)
- Public Education and Outreach: 7 action items (~17% of all actions)
- Preventive Measures: 6 action items (~15%)
- Natural Resources: 5 action items (~12%)
- Property Protection: 2 action items (~5%)
- Structural Projects: 2 action items (~5%)

Circumstances to Initiate NHMP Review and Updates

Circumstances or conditions under which Howard County will initiate NHMP reviews and updates include the following:

- On the recommendation of the County Executive, or on its own initiative, the County may initiate an NHMP review at any time.
- At approximately the one-year anniversary of the NHMP's re-adoption, and approximately at the same anniversary every year thereafter.
- After a natural hazard event that appears to significantly change the apparent risk to County assets, operations, and/or citizens.
- When activities within the County, region, or State significantly alter the potential effects of natural hazards on County assets, operations, and/or community members. Examples include completed mitigation projects that reduce risk, actions, or circumstances that increase risk.

In addition to the circumstances listed above, revisions that warrant changing the text of this NHMP or incorporating new information may be prompted by a number of circumstances, including identification of specific new mitigation projects, completion of multiple mitigation actions, or meeting eligibility requirements for specific funding mechanisms. Minor revisions may be handled by addenda.

Major comprehensive review of and revisions to the Howard County NHMP will be conducted on a five-year cycle. Adoption of this Plan occurred in the Winter of 2024, and the NHMP will enter its next review cycle in 2027, with adoption of revisions anticipated by early 2029. The JSC will reconvene as required to conduct comprehensive evaluation and revision, including the identification and prioritization of additional mitigation action items.

Benefit Cost Analysis

A Benefit Cost Analysis (BCA) determines the cost effectiveness of a project to minimize damage or prevent damage from future hazard events. Determining the benefit-cost ratio of the proposed mitigation project will provide the communities, as well as project developers, additional knowledge about the feasibility of the proposed mitigation alternative. If the costs outweigh the benefits, then other, more effective alternatives may be identified to accomplish the Plan's goals. Federal funding mechanisms often require a BCA, so this will be considered during each review of this Plan's future projects.

Continued Public Involvement

The preparation of this Plan involved the public throughout the process through public meetings and via newspapers, the internet, and social media. Howard County is dedicated to continuing to solicit public participation during the five-year update as required by FEMA. Copies of the NHMP update will be provided to the public libraries and will be available on the County's website along with a mechanism for

submitting comments. Additionally, after annual updates, changes will be posted to Howard County OEM's website and promoted to the public via social media and press release.

Upon adoption of the updated 2024 NHMP, the public will be notified of any substantial changes to the document prior to the next scheduled update in early 2029. Any substantial changes proposed by the JSC will be distributed to the list of stakeholders identified in *Chapter 3: Planning Process*. Any substantial changes proposed by the JSC will be distributed to the list of stakeholders identified in [*Appendix E: Joint Steering Committee Detailed List*](#).

Plan Adoption

Requirements for Adoption by the Local Governing Body

44 CFR § 201.6(c)(5): [The local hazard mitigation plan must include] Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan.

[Adoption Documentation will be inserted here when the plan is adopted by County Council—likely during Fall of 2023]

Hazard Mitigation Plans Sample Annual Report Form

Natural Hazard Mitigation Plan Annual Report Form

Progress Report Period: _____ To: _____

Next Plan Update: _____ Project ID: _____

Project Type: _____

Responsible County Agency(ies)/Address/Contact>Title/Phone>Email:

Project Description:

Project Status: _____

How many people were protected by this action? _____

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

Explain:

Obstacles/challenges/delays incurred:

Method to resolve obstacle/challenge/delay:

Next steps to be accomplished over the next reporting period:

DRAFT

Appendix A: Meetings

2024 Howard County Hazard Mitigation/Flood Mitigation Plan Update

Joint Steering Committee Meeting #1

September 21, 2022: 1:00pm-4:00pm

Ligon Building, 3450 Courthouse Drive, Ellicott City, MD 21043



HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT

Director
Mike Hinson

County Executive
Calvin Ball

Howard County
2024-2029 Hazard Mitigation and Flood Mitigation Plan Update

Steering Committee Meeting #1

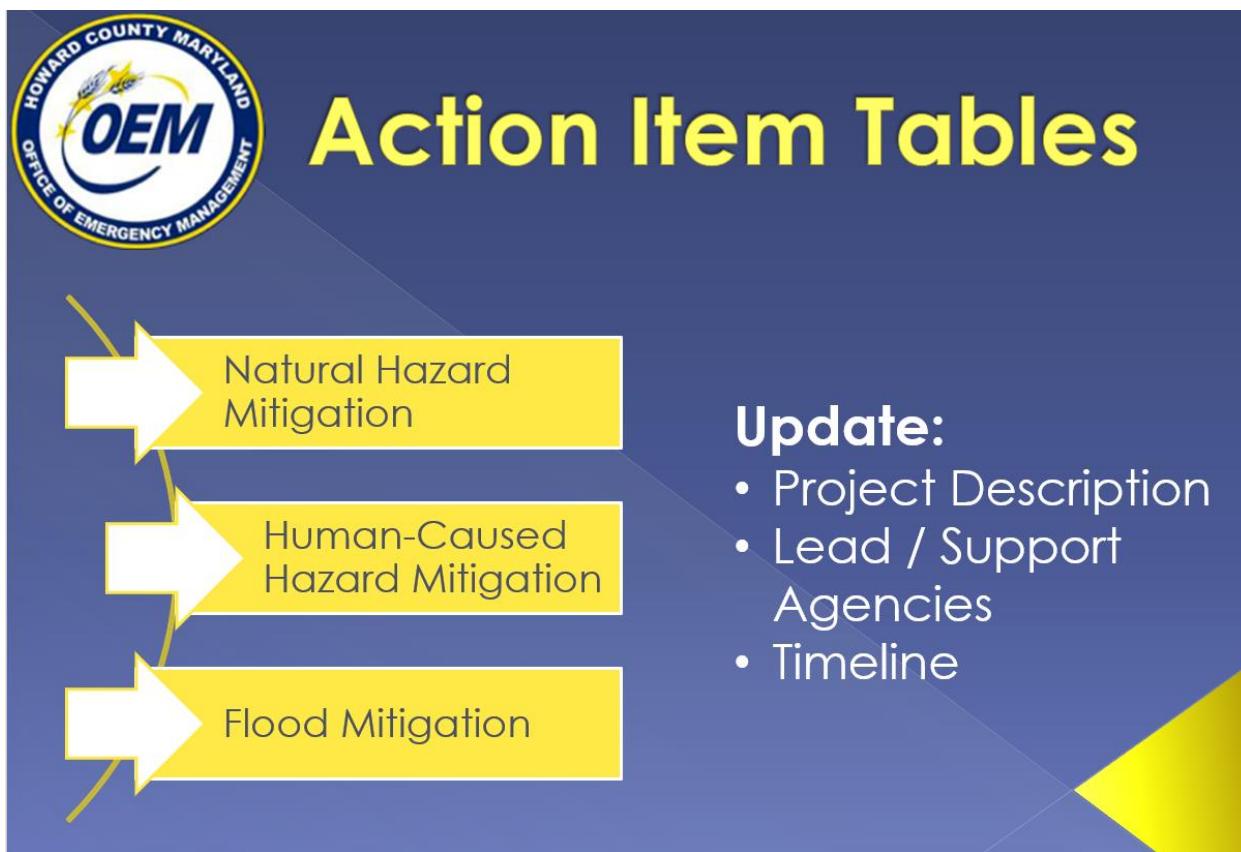
Agenda

Date: September 21, 2022

Time: 1:00-3:00 PM

- 1) Introductions
 - a) Howard County Office of Emergency Management
 - i) Housekeeping items
 - b) Introductions around the room
 - c) Introductions online
- 2) Project Overview Presentation
 - a) Purpose and background
 - b) Planning process
 - c) Roles and Responsibilities
 - d) Tentative Project Schedule/Milestones
 - e) Current Status
- 3) Mitigation Action Table Update Exercise
 - a) Natural Hazard Mitigation Plan Table
 - b) Human-Caused Hazard Mitigation Plan Annex Table
 - c) Flood Mitigation Plan Table
- 4) Open Discussion

FIGURE 63: SAMPLE SLIDE FROM OEM PRESENTATION AT JSC MEETING 1



Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Michael Tennison, a consultant from the University of Maryland Center for Health and Homeland Security, led the first Joint Steering Committee (JSC) meeting on September 21, 2022. Participants, including partners from a variety of relevant County departments as well as community stakeholders, convened virtually and in-person for a hybrid meeting held in the OEM conference room.

After introductions, OEM provided an overview of hazard mitigation planning, including the County's mitigation plans and annexes, federal mitigation funding, the planning process, the goals and objectives of hazard mitigation, the roles and responsibilities of JSC members, and OEM's timeframe of milestones for the 2024 five-year update. Next, OEM introduced the action item tables related to natural hazard mitigation, human-caused hazard mitigation, and flood mitigation.

OEM went through each action item in all three tables, requesting feedback and updates regarding the current status of each item, their descriptions, the departments in charge of them, their funding mechanisms, and their estimated duration. The group also discussed new action items that had already begun or that will be needed in the future. This process prompted lengthy interdepartmental deliberation and problem solving that improved participants' individual and collective situational awareness of the hazard risks in the County and the County's diverse efforts to mitigate them.

Next steps include implementing JSC participants' suggested updates to the action item tables and following up with them to iron out the details. Additionally, OEM will provide them with a quantitative framework to reprioritize existing action items and prioritize new ones. Beyond these tasks, OEM will plan for the first public meeting, integrate findings from the forthcoming 2022 Howard County HIRA, and use Hazus GIS data to update risk information in the plan.

First Steering Committee Meeting Attendance (Hybrid) (JSC Members in Gray)		
Affiliation	Name	Title
Department of Fire & Rescue Services—Office of Emergency Management	Lauren Chilton	Emergency Management Specialist II
Department of Fire & Rescue Services—Office of Emergency Management	Michaela Salem	Emergency Management Specialist I
Department of Fire & Rescue Services—Office of Emergency Management	Dan Scotten	Emergency Management Specialist I (no longer with County)
Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Christine Lowe	Engineering Specialist III
Department of Public Works: Bureau of Engineering	Kris Singleton	Engineering Specialist III
Howard County Community Organizations Active in Disaster	Jim Ehle	Chair (no longer the Chair)
Howard County Health Department—Bureau of Infection Control and Public Health Preparedness	Lenora Painter	Bureau Director
Department of Fire & Rescue Services—Office of Emergency Management	Maria Bernadzikowski	Deputy Director (now Assistant Chief Administrative Officer)
Department of Public Works—Bureau of Engineering; Utility Design Division	Zack Knight	Program Manager
Howard County Administration	Shaina Hernandez	Senior Advisor for Policy (no longer with the County)
Howard County Administration—Office of Human Resources—Risk Management	Matt Zervas	Assistant Risk Manager

Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Brian Cleary	Engineering Specialist III
Howard County Administration—Office of Community Sustainability	Avery Farrell	Climate Action Coordinator
Howard County Public School System	Alan Moss	Safety and Security Planning Manager
Department of Technology and Communications Services—GIS	Rob Slivinsky	Geographical Information Systems Coordinator
Participating as Howard County Resident/Maryland Department of Environment—Waterway Permits	William Seiger	Howard County Resident
Howard EcoWorks	Lori Lilly	Executive Director
Department of Recreation and Parks—Bureau of Parks	Bryan Moody	Bureau Chief
Department of Public Works—Bureau of Facilities	Sharon Walsh	Bureau Chief
Baltimore County Office of Emergency Management	David Bycoffe	Director
Department of Planning and Zoning—Comprehensive and Community Planning Division	Kristin O'Connor	Division Chief
Constellation Home (formerly Baltimore Gas and Electric)	Marche Taylor Templeton	External Affairs Manager
Howard County Police Department—Operational Preparedness and Support Division	Ron Jason Baker	Lieutenant
Howard County Police Department—Operational preparedness and Support Division	Kelly Tibbs	Sergeant
Howard County Police Department—Operational Preparedness and Support Division	Todd Leppert	Captain

Department of Inspections, Licenses, & Permits— Operations Division	Bob Firmani	Division Chief
Department of Public Works	John Seefried	Assistant to the Director
Howard County Administration—Office of Community Sustainability	Lindsay DeMarzo	Planning Supervisor
Department of Planning and Zoning—Resource Conservation Division	Beth Burgess	Division Chief
Department of Fire & Rescue Services—Office of Emergency Management	Michael Hinson	Director
Department of Public Works: Bureau of Environmental Services	Mark DeLuca	Bureau Chief
Department of Public Works: Bureau of Facilities	Robert Hollenbeck	Deputy Chief
Department of Public Works: Bureau of Facilities	Kenn Hamm	Assistant to the Chief
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Mark Richmond	Division Chief
Department of Fire & Rescue Services—Operations Command	Gordon Wallace	Deputy Chief
Department of Inspections, Licenses, & Permits—Plans Review Division	Don Mock	Division Chief
Department of Public Works: Bureau of Highways	Subin George	Engineering Specialist III
Department of Community Resources and Services	Jackie Scott	Director
Columbia Association	Monica McMellon-Ajayi	Director of Human Resources, Equity, and Inclusion
Department of Technology and Communication Services	Brandee Ganz	Director (now County Executive's Chief Administrative Officer)

Department of Fire & Rescue Services—Office of Emergency Management	Callie Gorgol	Senior Emergency Management Specialist (now Acting Deputy Director)
Department of Technology and Communication Services	Matthew Harvey	Technical Services Manager I
Department of Public Works	Arthur Shapiro	Acting Director (now Bureau Chief of Utilities)
Department of Planning and Zoning	Brian Shepter	Deputy Director (now County Executive's Deputy Chief of Staff)

DRAFT

2024 Howard County Hazard Mitigation/Flood Mitigation Plan Update

Joint Steering Committee Meeting #2

February 1, 2023: 1:00pm-3:00pm

Carroll Building, 3450 Courthouse Drive, Ellicott City, MD 21043



HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT

Director
Mike Hinson

County Executive
Calvin Ball

Howard County 2024-2029 Hazard Mitigation and Flood Mitigation Plan Update

Steering Committee Meeting #2

Agenda

Date: February 1, 2023

Time: 1:00-3:00 PM

- 1) Introduction
 - a) Howard County Office of Emergency Management
 - i) Check-in procedures
 - b) Project Update
 - i) First Public Meeting
- 2) Hazard Identification and Risk Assessment (HIRA)
 - a) Natural Hazard Risk Rankings
 - b) HIRA Incorporation into HMP instead of Hazus
- 3) Risk Assessment
 - a) Update on use of Hazus
- 4) Next Steps
- 5) Open Discussion
- 6) Mitigation Action Item Prioritization
 - a) Current Scores
 - b) Q&A on Workbooks
 - i) If attendees have already submitted their workbooks and have no questions, they may leave at this time.
- 7) Adjourn

FIGURE 64: SAMPLE SLIDE FROM OEM PRESENTATION AT JSC MEETING 2



Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Michael Tennison, a consultant from the University of Maryland Center for Health and Homeland Security, led the second Joint Steering Committee (JSC) meeting on February 1, 2023. Participants, including partners from a variety of relevant County departments as well as community stakeholders, convened virtually for meeting held in the OEM conference room.

After introductions, OEM updated the JSC on its progress updating the Natural Hazard Mitigation Plan (NHMP), including the status of each chapter. OEM recapped the first public meeting with a summary of the presentation and discussion. Next, OEM presented findings from the County's newly updated 2023 Hazard Identification and Risk Assessment (HIRA) and discussed the elements to be incorporated into the NHMP, such as the recalculated risk rankings and two additional hazards, space weather and pest infestation/zoonotic infection. After presenting the anticipated timeline for remaining NHMP update milestones, OEM reviewed the prioritization rubric that JSC members used to re-rank all hazard mitigation action items and to rank new items. OEM then provided an overview of highlights from the prioritizations. Finally, OEM led a discussion about the integration of other County plans into the NHMP, such as the forthcoming Climate Action Plan.

Attendance (JSC Members in Gray)

Affiliation	Name	Title
Department of Public Works—Bureau of Utilities	Arthur Shapiro	Bureau Chief
Department of Planning & Zoning—Resource Conservation Division	Beth Burgess	Division Chief
Participating as Howard County Resident/Maryland Department of the Environment—Waterway Permits	William Seiger	Howard County Resident
Department of Inspections, Licenses, & Permits—Operations Division	Bob Firmani	Division Chief
Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Brian Cleary	Engineering Specialist III
Department of Fire & Rescue Services—Office of Emergency Management	Caleb Goodie	Emergency Management Specialist II (no longer with the County)
Department of Fire & Rescue Services—Office of Emergency Management	Lauren Chilton	Emergency Management Specialist II
Department of Fire & Rescue Services—Office of Emergency Management	Hannah Robinson	Emergency Management Specialist II
Howard County Administration—Office of Transportation	Chris Eatough	Bicycle and Pedestrian Coordinator (standing in for Bruce Gartner)
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Christine Lowe	Engineering Specialist III
Baltimore County Office of Emergency Management	David Bycoffe	Director
Department of Inspections, Licenses, & Permits—Plans Review Division	Don Mock	Division Chief

Howard County Administration—County Executive's Office	Felix Facchine	Assistant Chief of Staff
Department of Technology and Communication Services	Glenn Hansen	Public Safety IT Project Manager
Department of Community Resources & Services	Jackie Scott	Director
Howard County Police Department—Operational Preparedness and Support Division	Ron Jason Baker	Lieutenant
Department of Public Works: Bureau of Facilities	Kenn Hamm	Assistant to the Chief
Department of Public Works: Bureau of Highways	Kris Jagarapu	Bureau Chief
Department of Planning & Zoning—Comprehensive and Community Planning Division	Kristin O'Connor	Division Chief
Howard EcoWorks	Lori Lilly	Executive Director
Department of Public Works: Bureau of Environmental Services	Mark DeLuca	Bureau Chief
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Mark Richmond	Division Chief
Department of Public Works: Bureau of Facilities	Zach Hollenbeck	Deputy Chief
Department of Public Works: Bureau of Utilities	Ross Beschner	Deputy Chief
Department of Public Works: Bureau of Facilities	Sharon Walsh	Bureau Chief
Department of Fire & Rescue Services—Special Operations	Stephen Hardesty	Battalion Chief

2024 Howard County Natural Hazard Mitigation/Flood Mitigation Plan Update

Joint Steering Committee Meeting #3 (Virtual)

April 19, 2023: 1:00pm-3:00pm

Howard County OEM WebEx Meeting Room

FIGURE 65: SAMPLE SLIDE FROM OEM PRESENTATION AT JSC MEETING 3

The screenshot shows a WebEx meeting interface. At the top, there's a menu bar with options like File, Edit, Share, View, Audio & Video, Participant, Meeting, and Help. Below the menu, there are five participant video thumbnails: Michael Tennison (Me), Lauren Chilton (Host), Stephen Hardesty, Bob Firmani, and Brian F. Cleary. The main content area displays a presentation slide with a blue background. On the left side of the slide, the text "Plan Review Checklist for FEMA" is visible. To the right of this text, there is a vertical list of six items, each enclosed in a blue rounded rectangle:

- Element A: Planning Process
- Element B: Risk Assessment
- Element C: Mitigation Strategy
- Element D: Plan Maintenance
- Element E: Plan Update
- Element F: Plan Adoption

At the bottom of the slide, there are several control buttons: Unmute, Start video, Share, and other meeting controls. In the top right corner of the slide, there is a yellow circular logo for the Howard County Office of Emergency Management (OEM) with the text "HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT" and "OEM".

Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Michael Tennison, a consultant from the University of Maryland Center for Health and Homeland Security, led the third Joint Steering Committee (JSC) meeting on April 19, 2023. Participants, including partners from a variety of relevant County departments as well as community stakeholders, convened virtually for a meeting held in the OEM WebEx virtual meeting room.

After introductions, OEM updated the JSC on recent public meetings about the Natural Hazard Mitigation Plan and Flood Mitigation Plan held on March 22, 2023, and March 29, 2023. Next, OEM discussed the feedback from JSC members and from the public regarding drafts of both plans, and how

this feedback was incorporated into the final drafts. OEM discussed the addition of several new action items, as well as their descriptions and prioritization in the Implementation Plan; no JSC members dissented to these items. OEM also discussed FEMA's regulatory requirements for Natural Hazard Mitigation Plan, and how the Plan includes a "Plan Review Checklist" that identifies the sections and page numbers that satisfy each requirement.

Finally, the JSC voted to approve the Natural Hazard Mitigation Plan Update with a motion to approve from Lt. Jason Baker and a second from Lenora Painter. There was no dissension. The Flood Mitigation Plan Update was approved as well with a motion to approve from Mark Richmond and a second from Lenora Painter. Through approval, the JSC authorized release of both plan updates to MDEM and FEMA for review.

Attendance (JSC Members in Gray)

Affiliation	Name	Title
Department of Fire & Rescue Services--Office of Emergency Management	Lauren Chilton	Emergency Management Specialist II
University of Maryland Center for Health and Homeland Security	Michael Tennison	Senior Law and Policy Analyst and Consultant to Howard County OEM
Department of Inspections, Licenses, & Permits—Operations Division	Bob Firmani	Division Chief
Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Brian Cleary	Engineering Specialist III
Department of Fire & Rescue Services—Office of Emergency Management	Lauren Chilton	Emergency Management Specialist II
Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Christine Lowe	Engineering Specialist III
Department of Inspections, Licenses, & Permits—Plan Review	Don Mock	Division Chief
Howard County Police Department—Operational Preparedness and Support Division	Ron Jason Baker	Lieutenant

Howard County Police Department—Operational Preparedness and Support Division	Kelly Tibbs	Sergeant
Department of Planning & Zoning—Comprehensive and Community Planning Division	Kristin O'Connor	Division Chief
Howard EcoWorks	Lori Lilly	Executive Director
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Mark Richmond	Division Chief
Department of Fire & Rescue Services—Special Operations	Stephen Hardesty	Battalion Chief
Department of Recreation and Parks—Bureau of Parks	Bryan Moody	Bureau Chief
Baltimore Gas and Energy	Marche Taylor Templeton	External Affairs Manager
Howard County Health Department—Bureau of Infection Control and Public Health Preparedness	Lenora Painter	Bureau Director
Department of Public Works—Bureau of Highways—Traffic Engineering Division	Jennifer Woo	Division Chief
Department of Public Works—Bureau of Engineering—Utility Design Division	Zack Knight	Project Manager
Howard County Administration—Office of Human Resources—Risk Management	Matt Zervas	Assistant Risk Manager

Appendix B: Survey Results

Community Hazard Survey

The Community Hazard Survey was released through multiple County channels and was left open for about a month. A total of 334 responses were received, with a 59% completion rate.

Posting	Date
Survey posted on OEM Nextdoor Account	9/16/2022
Survey sent via email to Community Organizations Active in Disaster	9/20/2022
Survey sent via email to the Local Emergency Planning Committee	9/27/2022

Announcement Documentation

Samples of the survey release announcement are included below.

FIGURE 66: HOWARD COUNTY OEM NEXTDOOR ACCOUNT POST

A screenshot of a Nextdoor post from the "Howard County OEM" account. The post is titled "Howard County Office of Emergency Management" and includes a profile picture of a person named Caleb Goodie. The post text describes the Community Hazard Survey, its purpose, and provides a link to the survey. It also mentions the survey's duration, anonymity, and data usage. The post concludes with a thank you message and contact information for the Office of Emergency Management. At the bottom, there is a SurveyMonkey logo and a link to the survey page.

C Howard County Office of Emergency Management ✓ ...
Emergency Management Specialist Caleb Goodie • Edited 16 Sep

Howard County Community Hazard Survey. The Howard County Office of Emergency Management is in the process of updating our Hazard Identification and Risk Assessment (HIRA). As part of this effort, you are all invited to complete the Howard County Community Hazard Survey. This survey is designed to provide insight on the attitudes of Howard County residents towards a wide range of human-caused and natural hazards. Results will be incorporated into our 2022-23 HIRA. Please find the survey at: <https://www.surveymonkey.com/r/9TYFSFR>

The survey should take about 25 minutes to complete. Results are anonymous and all demographic data is entirely optional, and will only be used in aggregate data analysis.

Thank you for your willingness to support Howard County's preparedness efforts. Any questions about the contents of the survey can be directed to the Office of Emergency Management at emergencymanagement@howardcountymd.gov or (410) 313-6030.

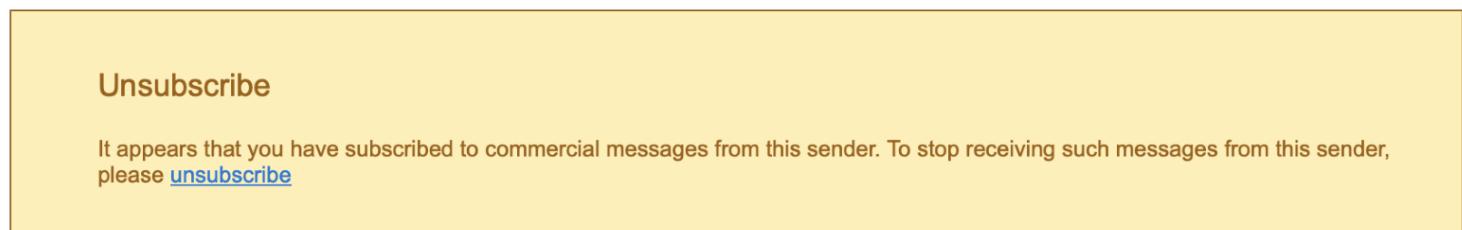
2022 Community Hazard Survey surveymonkey.com >

Posted to Subscribers of Howard County Office of Emergency Management

FIGURE 67: HOWARD COUNTY OEM NEXTDOOR ACCOUNT POST (EMAIL CONFIRMATION)

From: Nextdoor <reply@rs.email.nextdoor.com>
Sent: Friday, September 16, 2022 3:09:29 PM
To: Goodie, Caleb <cgoodie@howardcountymd.gov>
Subject: Howard County Community Hazard Survey

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]



A screenshot of a Nextdoor post. The post is from "Emergency Management Specialist Caleb Goodie" (@AGENCY). The subject is "Howard County Community Hazard Survey Hello Howard County Residents, The...". Below the subject, there is a "See more" link. The post has a profile picture of a person with a purple circle, the name "Caleb Goodie", and the title "Emergency Management Specialist Caleb Goodie AGENCY". Below the author information are icons for messaging, heart, +1, and smiley face, followed by a "Share" button. A large green "View post" button is at the bottom of the post area.

FIGURE 68: EMAIL TO COAD TO TAKE COMMUNITY HAZARD SURVEY

2022 Community Hazard Survey

✉ ↲ ↳



● Chilton, Lauren <lchilton@howardcountymd.gov>

To: [REDACTED]

Tuesday, September 20, 2022 at 1:17 PM

Good afternoon, COAD Leadership,

OEM is working on updating its Hazard Identification and Risk Analysis (HIRA). We would like to reach as many people in the County as possible by using an online survey. Anyone in the County can take the 2022 Community Hazard Survey using the following link: <https://www.surveymonkey.com/r/FLK7GX2>.

We would greatly appreciate if you could circulate this survey among COAD members.

Thank you!



Lauren Chilton, MIA

She/Her/Hers

Emergency Management Specialist II

Howard County Office of Emergency Management

Phone: 410-313-0713

[Website](#)

[Facebook](#)

[Twitter](#)

URGENT

FIGURE 69: EMAIL TO LEPC TO TAKE COMMUNITY HAZARD SURVEY

[MARKETING] Follow Up from September LEPC Meeting



○ Howard County OEM <emergencymanagement@howardcountymd.gov>
To: Chilton, Lauren

Tuesday, September 27, 2022 at 11:59 AM


Just Following Up!

Local Emergency Planning Committee

Howard County LEPC met on September 15, 2022 from 10:30 AM to 12:00 PM at Howard Community College. Attendees also could watch and participate in the meeting online through WebEx. There were about 47 attendees overall!

Important Links and Notes:

- [LEPC Page for Slides and Meeting Recording](#)
- [2022 Community Hazard Survey](#) - Please take this survey to help OEM gather information for our Hazard Identification and Risk Analysis!
- If you would like a [free NOAA Weather Radio](#), please email emergencymanagement@howardcountymd.gov to arrange pick up.
- Next LEPC meeting will likely be in early December or in January. This could change due to the holiday season. Details to come!

Thank you for your participation!



Results

The results of this survey were used by the Hazard Identification and Risk Assessment (HIRA) Steering Committee when calculating scores risk scores.

The survey went through a set of questions for each of the 25 hazards (both natural and human-caused). For this Plan, we will only be examining the results for the eleven natural hazards that were identified by the (HIRA) Steering Committee. The following four questions were asked about each natural hazard:

1. Please rate your confidence in Howard County's ability to respond to and recover from this hazard. (Answer choices were Extremely Low, Low, Moderate, and High)
2. Please rate your confidence in your own ability to protect yourself and your family from this hazard. (Answer choices were Extremely Low, Low, Moderate, and High)

3. How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County? (Answer choices were Not Concerned, Mildly Concerned, Somewhat Concerned, and Extremely Concerned)
4. How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County? (Answer choices were Not Concerned, Mildly Concerned, Somewhat Concerned, and Extremely Concerned)

Extreme Temperature Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	9.32%	21.61%	41.53%	27.54%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	5.08%	17.37%	46.61%	30.93%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	14.41%	33.90%	35.59%	16.10%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	25.11%	32.34%	29.36%	13.19%

Lightning Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	7.05%	8.37%	35.24%	49.34%

Please rate your confidence in your own ability to protect yourself and your family from this hazard.	8.93%	18.30%	39.73%	33.04%
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Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	36.44%	28.44%	24.89%	10.22%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	51.79%	23.66%	17.41%	7.14%

Severe Winter Weather Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	3.86%	10.14%	42.03%	43.96%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	1.95%	6.34%	50.24%	41.46%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	18.93%	37.86%	33.50%	9.71%
How concerned would you be for your ability to maintain your current standard of living and	39.81%	32.04%	19.90%	8.25%

quality of life if this hazard event were to occur in Howard County?				
--	--	--	--	--

Flood Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	8.05%	22.31%	46.19%	22.46%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	7.69%	18.38%	41.88%	32.05%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	16.67%	36.32%	32.05%	14.96%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	26.50%	32.91%	28.21%	12.39%

Tornado Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	7.50%	13.50%	48.50%	30.50%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	13.00%	27.50%	48.00%	11.50%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned

How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	12.00%	29.00%	33.50%	25.50%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	31.00%	26.50%	26.50%	16.00%

Drought Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	11.24%	30.62%	42.64%	15.50%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	11.20%	27.41%	44.02%	17.37%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	18.68%	31.13%	32.30%	17.90%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	15.44%	31.66%	31.66%	21.24%

Hurricane Hazard Results

Question	Extremely Low	Low	Moderate	High

Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	7.36%	16.45%	47.62%	28.57%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	6.11%	19.65%	53.71%	20.52%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	9.65%	29.82%	31.16%	22.37%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	20.26%	33.48%	29.52%	16.74%

Wildfire Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	4.57%	16.24%	50.25%	28.93%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	14.80%	32.65%	34.69%	17.86%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	16.75%	27.92%	35.03%	20.30%

How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	26.40%	28.93%	28.43%	16.24%
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Earthquake Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	12.60%	22.83%	46.46%	18.11%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	16.54%	31.10%	40.94%	11.42%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	9.02%	34.12%	34.12%	22.75%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	18.25%	35.71%	27.38%	18.65%

Space Weather Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	33.33%	31.37%	26.96%	8.33%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	36.95%	34.48%	21.18%	7.39%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	19.70%	29.56%	27.59%	23.15%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	23.65%	30.05%	24.14%	22.17%

Pest Infestation/ Zoonotic Infection Hazard Results

Question	Extremely Low	Low	Moderate	High
Please rate your confidence in Howard County's ability to respond to and recover from this hazard.	11.68%	23.83%	47.20%	17.29%
Please rate your confidence in your own ability to protect yourself and your family from this hazard.	8.92%	20.19%	56.81%	14.08%

Question	Not Concerned	Mildly Concerned	Somewhat Concerned	Extremely Concerned
How concerned would you be for the physical safety of yourself and your loved ones if this hazard event were to occur in Howard County?	5.63%	35.68%	38.50%	20.19%
How concerned would you be for your ability to maintain your current standard of living and quality of life if this hazard event were to occur in Howard County?	19.16%	35.51%	31.31%	14.02%

Short Form Surveys

In addition to the above survey, shorter surveys were developed for different groups to gather public comments on natural hazards and emergency preparedness. Surveys were distributed (with a virtual option as well) at the following events:

- January 13th Columbia Rotary Club after Emergency Preparedness presentation (3 were filled out).
- January 20th Oakland Mills Career Fair at OEM's booth (22 were filled out).
- March 22nd Howard County OEM and Stormwater Management Division's Public Meeting on the Natural Hazard Mitigation Plan and Flood Mitigation Plan.
- March 29th Howard County OEM and Stormwater Management Division's Virtual Public Meeting on the Natural Hazard Mitigation Plan and Flood Mitigation Plan.

The questions slightly varied in wording depending on the audience. The following flier was distributed for citizens to either take the survey in person or scan the QR code and take it online:

DRAFT

Natural Hazard Mitigation Plan Survey

The Howard County Office of Emergency Management (OEM) invites you to participate in a survey to gather public feedback for the 5-year update of our Natural Hazard Mitigation Plan. To view the current plan and feedback form, please go to this link: <https://www.howardcountymd.gov/emergency-management/2024-2029-howard-county-hazard-mitigation-plan-update>

Your feedback from this survey will be incorporated into the updated plan which will be in effect from January 2024-2029. A rough draft was posted to the OEM website in February of 2023 for public comment, and this period ends on April 7, 2023.

To take this survey online, please go to the link or use the QR Code:
<https://www.surveymonkey.com/r/XQWW3VR>



What natural hazards are you most concerned could impact you or your home? Please check all that apply.

- Floods
- Tornadoes
- Fire
- Snow/Ice
- Earthquake
- Other:

Do you feel prepared for the hazards/threats you checked? Please explain.

Yes
No

Tell us something that would improve your ability to recover from a natural disaster, for example, a flood?

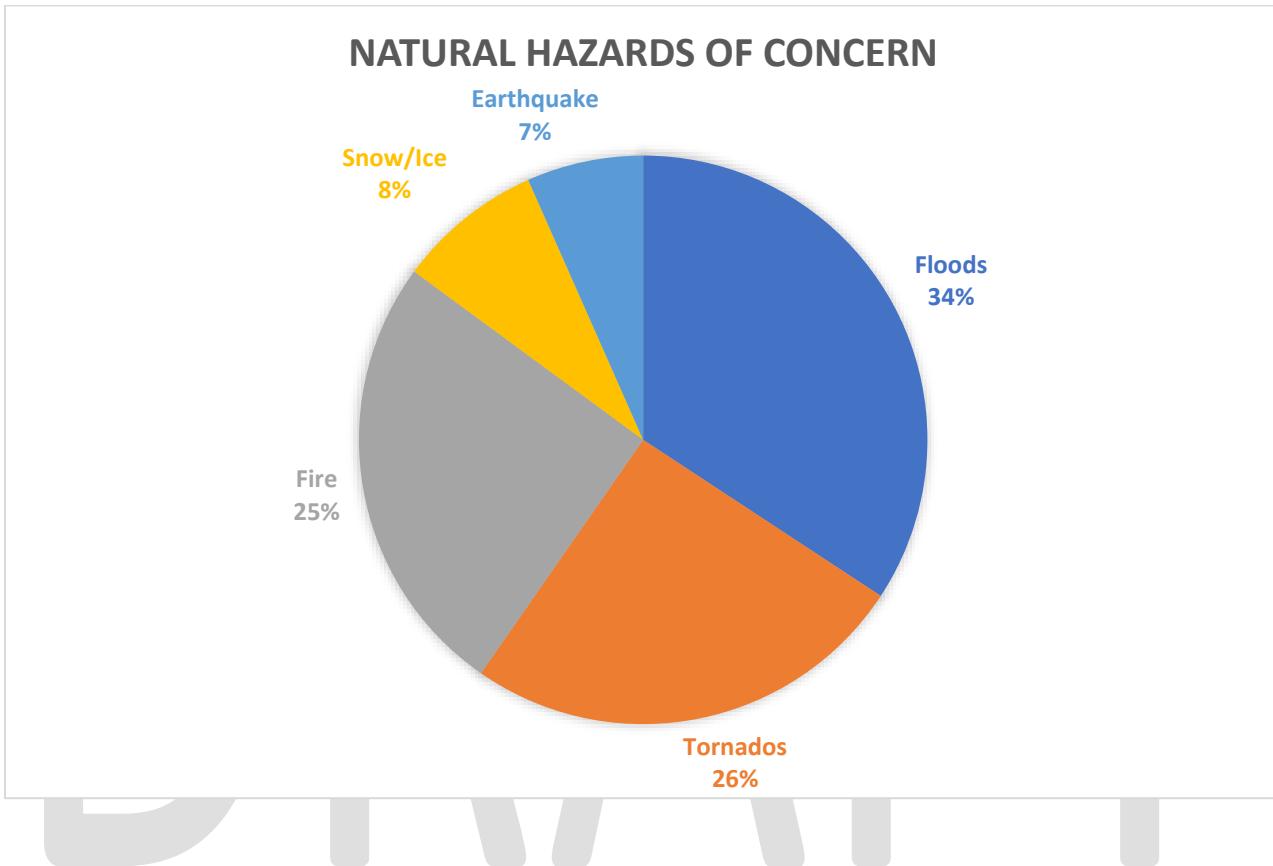
In the context of being prepared for natural disasters and recovering from them, what needs in your community do you see that are not being met? Please explain.

Does your home have any of the following for emergencies?

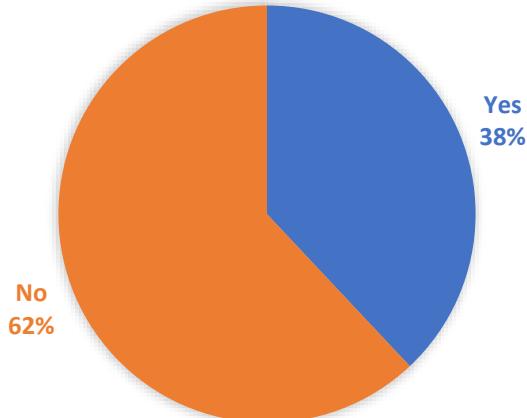
- Emergency Kit or "Go Bag"
- Evacuation Plan
- An Alternate Source of Power

Results

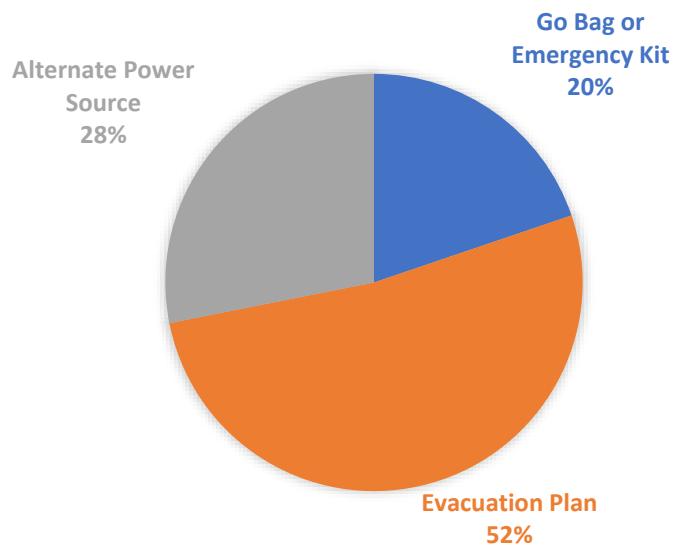
The results of the short form surveys with 26 respondents can be found in the table below:



DO YOU FEEL PREPARED FOR THE HAZARDS YOU CHECKED?



DO YOU HAVE THE FOLLOWING FOR EMERGENCIES?



For the long answer portion of the survey, most respondents noted that they would feel more prepared if they had access to additional financial security options, generators, food caches, advanced notice of emergencies, and to make emergency plans with their households.

Appendix C: Flood Mitigation Actions

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category	
INCOMPLETE/ONGOING ACTIONS (AS OF JAN 2023 UPDATE)													
1	Notify the public when the County conducts sampling and analysis of public drinking water supply sources to raise awareness for private property owners who have private wells and who may wish to test and analyze their drinking water. Health Department is limited to well water testing in areas exposed to flooding.	Flooding	DPW - Utilities, Health Dept; PIO		5	3	4	12	County Funds	Staff Time; Water sampling costs	Ongoing	Public Education and Outreach	
2	Conduct sampling and analysis of public drinking water supply sources, in flooded areas, immediately after a major (100yr) flood event and issue boil water advisories as needed. Health Department is limited to well water testing in areas exposed to flooding.	Flooding	DPW - Utilities; Health Dept		6	3	3	12	County Funds	Staff Time; Water sampling costs, Laboratory Costs	Ongoing	Public Education and Outreach	
3	Continue to monitor and remove significant debris blockages to minimize debris accumulation within the County-owned stream channels. A part of Safe and Sound Program and debris management plan.	Flooding, Tornado/ Wind Storm, Winter Storm/ Nor'easter	DPW Environmental Services; Highways/OEM	OCS	5	3	4	12	County Funds	Staff Time	Ongoing	Preventive Measures	

Mitigation							Prioritization				Implementation			
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category		
4	Update the County floodplain ordinance to comply with the Model Floodplain Management Ordinance prepared by MDE.	Flooding	DPW-SWMD	DILP; DPZ; Office of Law	4	4	4	12	County Funds	Staff Time	Ongoing	Preventive Measures		
5	Continue to update as needed and enforce Title 3-Buildings and Title 16-Planning, Zoning and Subdivision and Land Development Regulations, Article II-Design Standards and Requirements, and Subtitle 7-Floodplain: namely Section 3114 Floodplain, which defines building codes in and adjacent to floodplains; Section 16.115, which protects streams, wetlands, and steep slopes from future development; and all of Subtitle 7, which defines the County's authority and all other regulations related to floodplains.	Flooding	DPZ; DILP; DPW SWMD		4	3	4	11	County Funds	Staff Time	Ongoing	Preventive Measures		
6	Continue to update as needed and enforce the incorporation of State and local storm water management regulations and progressive techniques into all development plans.	Flooding	DPZ		4	3	4	11	County Funds	Staff Time	Ongoing	Preventive Measures		
7	Considering the impacts of climate change, evaluate infrastructure on frequently flooded roadways to determine whether the roads/bridges/culverts need to be upgraded to lessen the frequency of flooding. Prioritize projects and seek funding.	Flooding	DPW - Bureau of Engineering, Transportation and Special Projects Division; DPW-SWMD		5	3	3	11	County Funds; Federal Grants for roads (and County match)	Staff Time for County roads; – County conveying information to SHA for State roads	Ongoing /As needed	Structural Projects		

Mitigation					Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category	
8	When beaver dams are identified and located, continue to monitor the dams. Dismantle dams if they pose a flooding threat.	Flooding	DRP		3	4	4	11	County Funds	Staff Time	Ongoing /As needed	Natural Resources	
9	Review and reevaluate the existing codes for County retaining walls.	Flooding	DILP		3	4	4	11	County Funds	Staff Time	Ongoing	Structural Projects	
10	Evaluate the new FEMA floodplain, including non-structure hazards within 100 feet of the flood zone on an as needed basis.	Flooding	DPW SWMD, Department of Technology and Comm. Services		3	4	4	11	County Funds	Staff Time	Ongoing	Preventive Measures	
11	Continue to work on issues related to floodplain identification and mapping risk; responsible floodplain management; and flood insurance. Continue to ensure compliance with the National Flood Insurance Program.	Flooding	DPZ, DPW SWMD, DILP		4	3	4	11	County Funds	Staff Time	Ongoing	Preventive Measures	
12	Integrate relevant flood mitigation considerations from other studies into the overall County flood mitigation strategy as applicable.	Flooding	DPW SWMD, OEM		4	3	4	11	County Funds	Staff Time	Ongoing	Preventive Measures	
13	Inventory existing culverts that are maintained by the Department of Public Works, Bureau of Highways and create an addressable GIS layer.	Flooding	DPW, Bureau of Highways; Bureau of Engineering; Bureau of Environmental Services; Department of Technology and Comm. Services, GIS Unit		3	3	4	10	County Funds	Staff Time	Ongoing	Structural Projects	

Mitigation					Prioritization				Implementation			
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category
14	Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.	Flooding	DILP		3	3	4	10	County Funds	Staff Time	Ongoing	Preventive Measures
15	Assess the use of environmental site design projects to increase stormwater capacity and public education.	Flooding	DPW SWMD; DPZ; DRP; Office of Community Sustainability		3	3	4	10	Watershed Protection and Restoration Fund; County Funds	Staff Time	Ongoing	Public Education and Outreach
16	Identify and pursue incentives to mitigate private and public properties from flood hazards through the following techniques: elevation, acquisition/demolition, and dry/wet floodproofing.	Flooding	SWMD; DPZ; DILP	County Admin.	5	3	2	10	County Funds; Grant and non-grant options	Staff Time	Ongoing	Property Protection
17	Assess County-owned flood/channel walls after a major flood inundation event to determine if the structural integrity of any wall may be compromised and recommend repairs as needed to reduce the chances of wall failure.	Flooding	DPW - Transportation and Special Projects		4	3	3	10	County Funds	Staff Time	Ongoing	Structural Projects
18	Continue to administer the Forest Mitigation Program to establish new forests in parkland and along streams and rivers, to protect against erosion and uprooting trees.	Flooding	DRP	OCS	3	3	4	10	Fee-in-lieu of forest conservation funds	Staff Time	Ongoing	Natural Resources

Mitigation						Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category		
19	Change the “Frequently Flooded Roads” map to “Flood Prone Roads” map, update, and include Old Ellicott City Roads.	Flooding	DPW-Bureau of Environmental Services, Stormwater Management Division	DPW-Bureau of Highways; Department of Technological and Communication Services	2	4	5	11	County Funds	Staff Time	1-2 years	Emergency Services		
19	Assess all County-owned retaining walls to see if they need to be reinforced and prioritize that work.	Flooding	DPW - Bureau of Engineering, Transportation and Special Projects Division, DPW-SWMD		3	3	3	9	County Funds	Staff Time	Ongoing	Structural Projects		
20	Continue to work with property owners to increase vegetation in riparian buffers through the Plant-It-Green program, which consists of supplying free trees to plant adjacent to the streams to reduce velocity of storm water and to stabilize soil.	Flooding	DRP	OCS	3	3	3	9	County Funds; Watershed Protection and Restoration Fund; CoastSmart Grant	\$50,000-100,000	Ongoing	Public Education and Outreach		
21	Assess, implement, and maintain stream restoration and bank stabilization techniques on County-controlled property to reduce bank erosion, as needed.	Flooding	DPW SWMD		4	3	2	9	County Funds	Staff Time	Ongoing	Natural Resources		

Mitigation						Prioritization				Implementation				
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency		Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category	
22	Conduct an engineering study to identify and plan for flood risk mitigation alternatives, such as temporary or permanent flood barriers, elevating or relocating equipment, and/or other flood risk mitigation facility improvements at the County's wastewater treatment plant, the Little Patuxent Water Reclamation Plant.	Flooding	DPW- Bureau of Engineering, Utility Design Division			5	3	1	9	County Funds	Staff Time	Ongoing	Emergency Services	
23	Sequentially construct flood risk mitigation measures, such as temporary or permanent flood barriers, elevating or relocating equipment, and/or other flood risk mitigation facility improvements at the County's wastewater treatment plant, the Little Patuxent Water Reclamation Plant.	Flooding	DPW-Bureau of Engineering, Utility Design Division			5	3	1	9	County Funds; Grant and non-grant options	Staff Time	Long-range	Emergency Services	
COMPLETED ACTIONS (AS OF JAN 2023 UPDATE)														
A	Identify all designated historic properties that are located in the County's 100-year floodplains.	Flooding	OEM, DPZ - Hist Pres.; DPW			2	3	3	8	MHT; FEMA HMA; County Funds	Staff Time	Complete	Preventive Measures	
B	Assess the vulnerability historic and cultural resources located in the 100-year floodplain, and determine appropriate mitigation techniques that account for historic integrity, significance, and designation.	Flooding	OEM; DPZ - Hist Pres.			2	3	3	8	County Funds	Staff Time	Complete	Preventive Measures	

Mitigation					Prioritization				Implementation			
Action ID	Project Description	Hazard(s) Mitigated	Lead Agency	Support Agency	Life/Safety Impact	Admin/Tech Assistance	Cost Ranking	Total	Funding Source	Est. Cost	Timeline	Action Category
C	Collect structural elevation-related data for historic buildings/structures in the floodplain, including but not limited to, elevation of the first floor, lowest opening, and lowest adjacent grade, and incorporate that data into the appropriate existing County GIS layer(s).	Flooding	DPZ - Hist Pres.		2	3	3	8	County Funds	Staff Time	Ongoing	Preventive Measures

DRAFT

Appendix D: Press Releases, Notices, and Public Participation

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

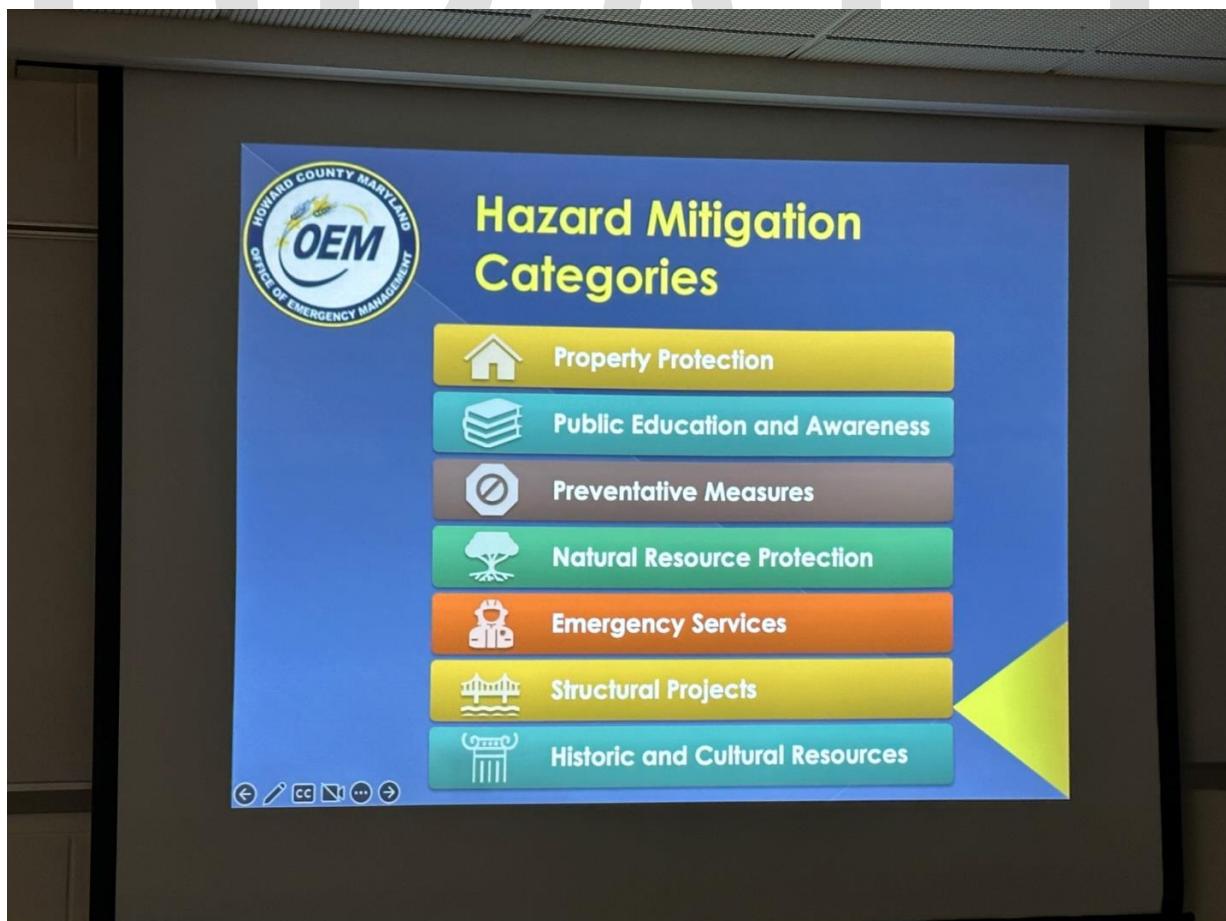
Federal:

44 CFR § 201.6(c)(1): The plan must include “Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.”

Public Meeting #1

November 17, 2022: 5:30pm-7:00pm

Gary J. Arthur Community Center, Dayton Room, 2400 Rte 97, Cooksville, MD



Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Mark Richmond, Howard County Department of Public Works, Stormwater Management Division (SWMD), led the first hazard mitigation public meeting on November 17, 2022. Additional participants included Mike Hinson, OEM Director, and Michael Tennison, a consultant from the University of Maryland's Center for Health and Homeland Security (CHHS) supporting OEM, and one member of the public attended.

After introductions, OEM provided an overview of hazard mitigation, including the planning process for the Natural Hazard Mitigation Plan, funding mechanisms, the relevant County plans and annexes, and the specific goals of hazard mitigation. Next, OEM discussed the incorporation of the County's Hazard Identification and Risk Analysis (HIRA), which identifies the natural and human-caused hazards in the County and quantifies the level of risk they pose. OEM also explained the role of mitigation action items in the Natural Hazard Mitigation Plan and the Flood Mitigation Plan, as well as how the items are updated and prioritized by the subject matter experts on the Joint Steering Committee.

OEM then displayed a map of frequently flooded roads in the County and asked the public for any additional roads that they did not see noted on the map. After discussing the map, OEM explained how members of the public can find and use an interactive version of the flood map on the County website. OEM concluded the presentation with a timeline for the remainder of the five-year update cycle, how the public can access the previous hazard mitigation and flood plans online and provide comments to OEM and DPW, and further contact information to get in touch with OEM and DPW.

Questions from the public generated a lively, wide-ranging discussion that lasted for the remainder of the meeting, focused on the following topics:

- The incorporation of climate change in the mitigation plans;
- The different operational and planning considerations with respect to debris management before, during, and after a storm;
- The role and composition of the Joint Steering Committee;
- The nature of the County's flood warning systems;
- 100-year flood plain studies;
- The evaluation criteria used to prioritize mitigation action items; and
- The difference between emergency response plans and hazard mitigation plans.

Notices regarding meetings were distributed through the County Website, Social Media, and Press outlets. Howard County Government, and OEM both maintain a Twitter Page as well as a Facebook. Notices regarding the Planning process and meetings were distributed through the County PIO Office which has distribution channels including newspaper, television, and partnering agencies. Samples of these informational releases and invitations are included below.

Public Meeting #1 Events Page Screenshot (with zoom in)

Howard County MARYLAND County Executive Calvin Ball Services Government Select Language Search

Search Enter keyword to search for events SEARCH

22 Results for: CLEAR ALL

Department/Office Date

11/01/2022 To 11/18/2022

SHOW RESULTS

17 NOV

THURSDAY NOVEMBER 17

at Gary J. Arthur Community Center 2400 Rte 97, Cockeysville, MD 5:30 pm - 7:00 pm

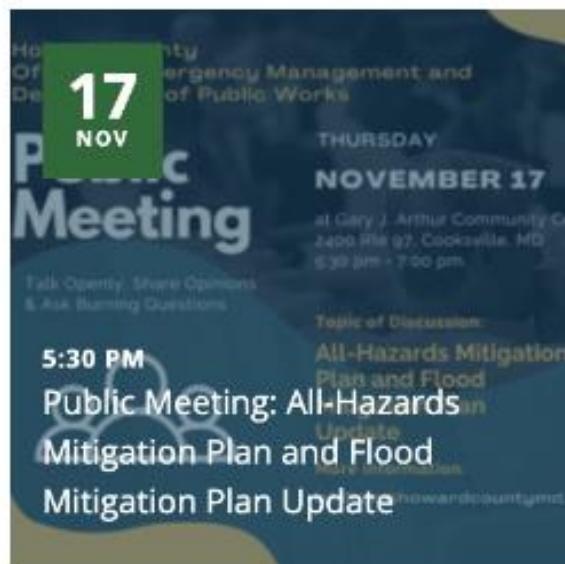
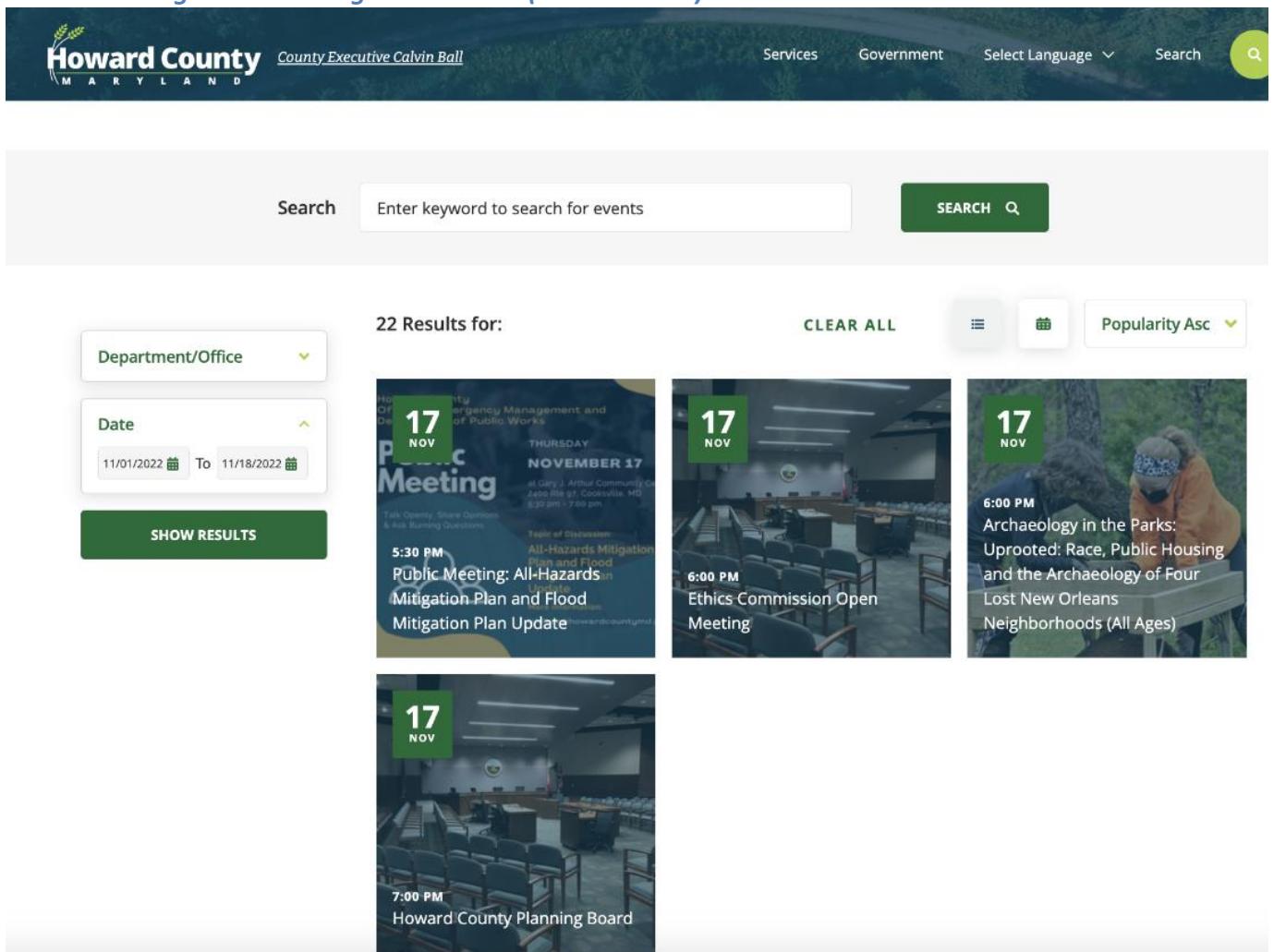
Topic of Discussion: All-Hazards Mitigation Plan and Flood Mitigation Plan and Flood Mitigation Plan Update

5:30 PM Public Meeting: All-Hazards Mitigation Plan and Flood Mitigation Plan and Flood Mitigation Plan Update

6:00 PM Ethics Commission Open Meeting

6:00 PM Archaeology in the Parks: Uprooted: Race, Public Housing and the Archaeology of Four Lost New Orleans Neighborhoods (All Ages)

7:00 PM Howard County Planning Board



Public Meeting #1 Press Release

Friday, October 28, 2022 at 11:17:56 Eastern Daylight Time

Subject: Howard County's Office of Emergency Management to Host Public Meeting to Review Hazard Mitigation Plans
Date: Friday, October 28, 2022 at 11:15:23 AM Eastern Daylight Time
From: Bresani, Alexandra
To: Bresani, Alexandra
Attachments: ATP Scan In Progress.eml

The following news release went out to the media this morning.

pioNEWSrelease.jpg



October 28, 2022

Media Contacts:

Mark Miller, Administrator, Office of Public Information, 410-313-2022
Lauren Chilton, Office of Emergency Management, 410-313-6030 (All-Hazards)
Mark S. Richmond, Stormwater Management Division, 410-313-6413 (Flood)

Howard County's Office of Emergency Management to Host Public Meeting to Review Hazard Mitigation Plans

ELlicott CITY, MD – Howard County's Office of Emergency Management (OEM) will hold a public meeting on Thursday, November 17th from 5:30 to 7:00 p.m. in the Dayton Room at the [Gary J. Arthur Community Center](#), 2400 MD 97 in Cooksville, to gather public input and discuss the County's All-Hazards Mitigation Plan and Flood Mitigation Plan. These plans define goals and actions that can be taken to mitigate impacts from a variety of hazards, including flooding, within the County. Every five years, the County is required to [update these plans](#).

Staff members from OEM and County's Department of Public Works (DPW) will be on hand to explain both plans, answer any questions, and gather public comments.

Those unable to attend the meeting who would like to view the information and/or have questions regarding the All-Hazards Mitigation Plan should contact Ms. Lauren Chilton with OEM at 410-313-6030 or by email at emergencymanagement@howardcountymd.gov. For information and/or questions regarding the Flood Mitigation Plan, please contact Mr. Mark S. Richmond with DPW's Stormwater Management Division at 410-313-6413 or by email at stormwater@howardcountymd.gov.

An interpreter for people who are deaf or hard of hearing will be available if requested seven

Page 1 of 2

working days prior to the meeting. Please call DPW at 410-313-3440 (voice) or use Relay at 7-1-1, between 8:00 a.m. and 5:00 p.m., Monday through Friday.

For questions or more information about the meeting, contact Ms. Lauren Chilton, OEM, at 410-313-6030 or email emergencymanagement@howardcountymd.gov.

###

Public Meeting #1 Twitter Post

← **HoCoOEM**
847 Tweets

HoCoOEM @HoCoOEM · Nov 3
All are invited on 11/17 to the Gary J. Arthur Community Center in the Dayton room for a public meeting to gather input & discuss the update for the All-Hazards Mitigation & Flood Mitigation Plans. To view the current plan and provide comments, go to [howardcountymd.gov/emergency-manage](http://howardcountymd.gov/emergency-management)

Howard County
Office of Emergency Management and
Department of Public Works

Public Meeting

Talk Openly, Share Opinions
& Ask Burning Questions



THURSDAY
NOVEMBER 17
at Gary J. Arthur Community Center
Dayton Room
2400 Rte 97, Cooksville, MD
5:30 pm - 7:00 pm

Topic of Discussion:
**All-Hazards Mitigation
Plan and Flood
Mitigation Plan
Update**

More information:
Ichilton@howardcountymd.gov

Public Meeting #1 Facebook Post



Howard County Office of Emergency Management

Published by Lauren Chilton · November 3 at 10:00 AM ·

...

All are invited to join @HoCoOEM and the Department of Public Works Thursday, 11/17, at the Gary J. Arthur Community Center in the Dayton room for a public meeting to gather input & discuss the update for the All-Hazards Mitigation & Flood Mitigation Plans. To view the current plan and provide comments, go to <https://www.howardcountymd.gov/.../2024-2029-howard...>

**Howard County
Office of Emergency Management and
Department of Public Works**

Public Meeting

Talk Openly, Share Opinions
& Ask Burning Questions



THURSDAY

NOVEMBER 17

at Gary J. Arthur Community Center
Dayton Room
2400 Rte 97, Cooksville, MD
5:30 pm - 7:00 pm

Topic of Discussion:

**All-Hazards Mitigation
Plan and Flood
Mitigation Plan
Update**

More information:

lchilton@howardcountymd.gov

[See insights and ads](#)

[Boost post](#)

1 Share

Like

Comment

Share



Write a comment...



Public Meeting #1 Attendance

PUBLIC MEETING #1 NATURAL HAZARD MITIGATION PLAN & FLOOD MITIGATION PLAN UPDATE
DATE: NOVEMBER 17TH, 2022

Name	Organization (if none, write "resident")	Please write your email if you would like to join our Local Emergency Planning Committee email list.
Michael Tennison	CHHS	
Lauren Chilton	OEM	
Ali Abbasi	RIVUS	
Mike Hinson	OEM	
Mark Richmond	D PW-SWM	

DRAFT

Public Meeting #1 Agenda



HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT

Director
Mike Hinson

County Executive
Calvin Ball

Howard County 2024-2029 Hazard Mitigation and Flood Mitigation Plan Update

Public Meeting #1 Agenda

Date: November 17, 2022
Time: 5:30-7:00 PM

- 1) Introductions**
 - a) Howard County Office of Emergency Management
 - b) Department of Public Works-Stormwater Management Division
- 2) Natural Hazard Mitigation Plan and Flood Mitigation Plan Presentation**
- 3) Frequently Flooded Roads Map Discussion**
- 4) Project Schedule**
- 5) How to Review the Plans and Provide Feedback**
- 6) Open Discussion**
- 7) Closing Remarks**

Thank you so much for attending our first public meeting to gather input for the Natural Hazard Mitigation Plan and Flood Mitigation Plan. We hope you enjoy today's presentation! Please find some helpful information below.

Link to review plans and provide feedback:

<https://www.howardcountymd.gov/emergency-management/2024-2029-howard-county-hazard-mitigation-plan-update>

Link to take the Community Hazard Survey:

<https://www.surveymonkey.com/r/F8GXQY9>

Contacts

For the Natural Hazard Mitigation Plan, please contact Lauren Chilton at:

- lchilton@howardcountymd.gov
- 410-313-0713

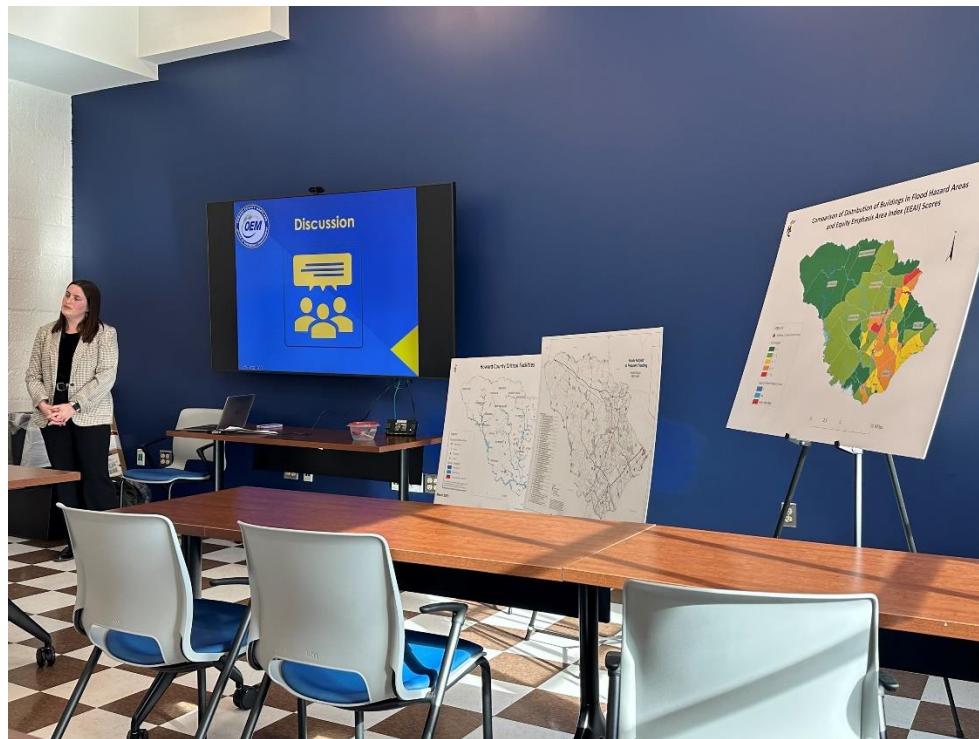
For the Flood Mitigation Plan, please contact Mark Richmond at:

- msrichmond@howardcountymd.gov
- 410-313-6444

Public Meeting #2

March 22, 2023: 4:00pm-5:00pm

Harriet Tubman Cultural Center, 8045 Harriet Tubman Lane, Columbia, MD



Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Mark Richmond and Christine Lowe, Howard County Department of Public Works, Stormwater Management Division (SWMD), led the second hazard mitigation public meeting on March 22, 2023. Five residents attended the meeting.

OEM's presentation included elements from the first public meeting and the Joint Steering Committee meetings, as well as original content and activities. After introductions, OEM provided an overview of hazard mitigation, including the planning process for the Natural Hazard Mitigation Plan, funding mechanisms, the relevant County plans and annexes, and the specific goals of hazard mitigation. Next, OEM discussed the incorporation of the County's now completed 2023 Hazard Identification and Risk Assessment (HIRA), which identifies the natural and human-caused hazards in the County and quantifies the level of risk they pose.

OEM explained the role of mitigation action items in the Natural Hazard Mitigation Plan and the Flood Mitigation Plan, as well as how the items are updated and prioritized by the subject matter experts on the Joint Steering Committee. After summarizing the big changes that occurred during this NHMP update, including a discussion of emerging hazard trends, the new HIRA, and updates to the action

items, OEM concluded with a timeline for the remainder of the project and described how the public can submit feedback regarding the current draft of the updated NHMP.

The presentation included three posters for the public participants to view:

- Map of Howard County Critical Facilities and 100-year floodplain
- Map of Roads Subject to Frequent Flooding
- Map of Flood Hazard Areas Overlapping with Equity Emphasis Area Index Scores

Additionally, public participants were encouraged to fill out surveys regarding personal hazard preparedness and subjective hazard risk perception.

The last phase of the meeting involved a lengthy discussion with the public participants about a wide range of their hazard mitigation topics of interest, including:

- The calculation of future trends (a subcomponent of “likelihood” in the equation Risk = Likelihood x Consequence) in the hazard risk assessments, and the incorporation of aging power grid infrastructure in the risk assessments;
- The capability assessment section of the plan, including the funds, resources, ordinances, and other plans from across the County government that can be leveraged for hazard mitigation;
- The capacity of the stormwater system to handle increasing rain loads;
- The percent of residents in flood hazard areas with flood insurance;
- County programs to maintain optimal tree canopy for processing carbon dioxide;
- FEMA’s National Risk Index and its Community Resilience scoring system; and
- The different hazard preparedness needs of different age groups.

Public Meeting #2 Events Page Screenshot (with zoom in)

The screenshot shows the Howard County Events page. At the top, there is a navigation bar with links for Services, Government, Select Language, and Search. Below the navigation is a banner with the word "Events". The main content area has a search bar with placeholder text "Enter keyword to search for events" and a "SEARCH" button. On the left, there is a "Filter By" section with dropdown menus for Department/Office (set to "Department/Office") and Date (set to "03/20/2023" to "03/30/2023"). A "SHOW RESULTS" button is also present. To the right, there are three event cards:

- Event 22 MAR:** 4:00 PM - 2nd Public Meeting: Natural Hazard Mitigation Plan and Flood Mitigation Plan Update
- Event 23 MAR:** 11:00 AM - Spring Doormat DIY
- Event 29 MAR:** 12:00 PM - Virtual Public Meeting: Natural Hazard Mitigation Plan and Flood Mitigation Plan Update

The bottom portion of the screenshot is a large, blurred zoomed-in view of the first event card for March 22 at 4:00 PM.

Public Meeting #2 Press Release



410-313-2022 / FAX 410-313-3390 / www.howardcountymd.gov

Office of Public Information
3430 Courthouse Drive
Ellicott City, Maryland, 21043

Mark Miller, Administrator
msmiller@howardcountymd.gov

March 6, 2023

Media Contacts:

Mark Miller, Administrator, Office of Public Information, 410-313-2022
Lauren Chilton, Office of Emergency Management, 410-313-6030 (All-Hazards)
Mark S. Richmond, Stormwater Management Division, 410-313-6413 (Flood)

Howard County's Office of Emergency Management to Host Public Meetings to Review Natural Hazard Mitigation Plan and Flood Mitigation Plan

ELLIOTT CITY, MD – This March, Howard County's Office of Emergency Management (OEM) will hold two public meetings to gather public input and discuss the County's [Natural Hazard Mitigation Plan and Flood Mitigation Plan](#). The first meeting will take place in-person on Wednesday, March 22nd from 4:00 p.m. to 5:00 p.m. in the Frances Hackley Multipurpose Room at the [Harriet Tubman Cultural Center](#) in Columbia. The second meeting will take place virtually on Wednesday, March 29th from noon to 1:00 p.m. To register to participate in March 29th's virtual meeting, click [HERE](#).

The County's Natural Hazard Mitigation Plan and Flood Mitigation Plan define goals and actions that can be taken to mitigate impacts from a variety of hazards, including flooding, within the county. The County is required to update these plans every five years.

A brief presentation will be presented at the start of each meeting by staff members from OEM and the County's Department of Public Works (DPW), who will remain on hand to answer any questions and gather public comments. Exhibit boards and activities will also be available at the in-person meeting on the 22nd. Meeting summaries will be posted on OEM's "2024-2029 Howard County Hazard Mitigation Plan Update" [website](#) following the meetings.

Those unable to attend either meeting who would like to view the information and/or have questions regarding the Natural Hazard Mitigation Plan, should contact Ms. Lauren Chilton with OEM at 410-313-6030 or email emergencymanagement@howardcountymd.gov. For information and/or questions regarding the Flood Mitigation Plan, please contact Mr. Mark S. Richmond with DPW's Stormwater Management Division at 410-313-6413 or email stormwater@howardcountymd.gov.

– more –

Page 2
March 6, 2023

Howard County's Office of Emergency Management to Host Public Meetings to Review Natural Hazard Mitigation Plan and Flood Mitigation Plan *(continued)*

An interpreter for people who are deaf or hard of hearing will be available if requested seven working days prior to the meeting. Please call DPW at 410-313-3440 (voice) or use Relay at 7-1-1, between 8:00 a.m. and 5:00 p.m., Monday through Friday.

For questions or more information about these meetings, contact Ms. Lauren Chilton with OEM at 410-313-6030 or email emergencymanagement@howardcountymd.gov.

###



HOWARD COUNTY
OFFICE OF EMERGENCY MANAGEMENT



REVIEW OF HOWARD COUNTY HAZARD MITIGATION PLANS

WEDNESDAY, MARCH 22ND @ 4PM

Frances Hackley Multipurpose Room at the
Harriet Tubman Cultural Center
8045 Harriet Tubman Lane in Columbia, MD



JOIN US!

To discuss the County's Natural Hazard Mitigation Plan and Flood Mitigation Plan. These plans define goals and actions that can be taken to mitigate impacts from a variety of hazards, including flooding, within the County.

Members of both OEM and the Department of Public Works (DPW) will be on hand to explain both plans, answer any questions, and gather public comments.

CONTACT US



410-313-6030



@HoCoOEM



@HoCoOEM

*For questions or
more information
about the meeting,
contact
Ms. Lauren Chilton,
OEM, at 410-313-6030
or email
emergencymanagement@howardcountymd.gov.*

Public Meeting #2 Attendance

HOWARD COUNTY NATURAL HAZARD MITIGATION PLAN & FLOOD MITIGATION PLAN PUBLIC MEETING #2
DATE: MARCH 22, 2023

Name	Organization (if none, "resident")	Please write your email if you would like to join our Local Emergency Planning Committee email list.
Diane Cooper	resident	
Paul KWIATKOWSKI	RESCIENT	
Christine Lowe	HOCo - DPW - SWMD	
Carol Freeman	resident	
CLAIRE KWIATKOWSKI	KCI	
BOB FRANCES	Ho Co. D.I.L.P.	
Lauren Chilton	Ho Co OEM	
Michael Ternison	Univ of MD Center for Health + Homeland Security	
Mark Richmond	Ho Co - DPW - SWMD	



Public Meeting #2 Agenda



HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT

Director
Mike Hinson

County Executive
Calvin Ball

Howard County 2024-2029 Hazard Mitigation and Flood Mitigation Plan Update

Public Meeting #2

Agenda

Date: March 22, 2022

Time: 4:00 PM-5:00 PM

- 1) Introductions
 - a) Howard County Office of Emergency Management
 - b) Department of Public Works-Stormwater Management Division
- 2) Natural Hazard Mitigation Plan and Flood Mitigation Plan Presentation
 - a) Purpose and Background
 - b) Plan Contents
 - c) Risk Analysis Results
 - d) Action Items
 - e) Big Changes
 - f) Next Steps
 - g) Open Discussion
 - h) How to Provide Feedback
- 3) Room Displays & Activities
 - a) Attendees are free to walk around and examine the four display tables, participate in related activities, or ask additional questions. Attendees are free to leave at any time.
 - b) Tables
 - i) Table 1: Learn if your home/property is in a flood zone.
 - ii) Table 2: Multiple maps will be displayed, and attendees are invited to mark areas they have noticed are more hazardous, such as frequently flooded roads.
 - iii) Table 3: Look at the list of natural hazards in Howard County, rank them from highest risk to lowest risk, and then compare to Howard County's Hazard Identification and Risk Assessment rankings.
 - iv) Table 4: Fill out a quick survey on preparedness for natural hazards.

Thank you so much for attending our second public meeting to gather input for the Natural Hazard Mitigation Plan and Flood Mitigation Plan. Please find some helpful information below.

Link to review plans and provide feedback:

<https://www.howardcountymd.gov/emergency-management/2024-2029-howard-county-hazard-mitigation-plan-update>

Contacts

For the **Natural Hazard Mitigation Plan**, please contact Lauren Chilton at:

- lchilton@howardcountymd.gov
- 410-313-0713

For the **Flood Mitigation Plan**, please contact Mark Richmond at:

- msrichmond@howardcountymd.gov
- 410-313-6444

Hazard Risk Ranking Activity

Starting with the highest risk (1), please rank the following hazards from highest risk to lowest risk.

Space Weather

Lightning

Wildfire

Extreme Temperature

Pest Infestation/Zoonotic
Infection

Flood

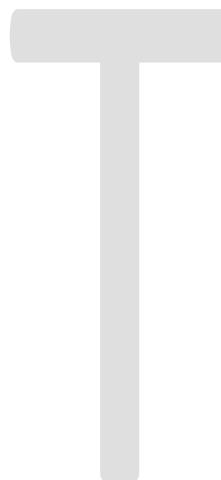
Earthquake

Tornado

Drought

Hurricane/Tropical
Cyclone

Severe Winter Weather





Natural Hazard Mitigation Plan Survey

The Howard County Office of Emergency Management (OEM) invites you to participate in a survey to gather public feedback for the 5-year update of our Natural Hazard Mitigation Plan. To view the current plan and feedback form, please go to this link: <https://www.howardcountymd.gov/emergency-management/2024-2029-howard-county-hazard-mitigation-plan-update>

Your feedback from this survey will be incorporated into the updated plan which will be in effect from January 2024-2029. A rough draft was posted to the OEM website in February of 2023 for public comment, and this period ends on April 7, 2023.

To take this survey online, please go to the link or use the QR Code:
<https://www.surveymonkey.com/r/XQWW3VR>



What natural hazards are you most concerned could impact you or your home? Please check all that apply.

- Floods
- Tornadoes
- Fire
- Snow/Ice
- Earthquake
- Other:

Do you feel prepared for the hazards/threats you checked? Please explain.

Yes
No

Tell us something that would improve your ability to recover from a natural disaster, for example, a flood?

In the context of being prepared for natural disasters and recovering from them, what needs in your community do you see that are not being met? Please explain.

Does your home have any of the following for emergencies?

- Emergency Kit or "Go Bag"
- Evacuation Plan
- An Alternate Source of Power

Public Meeting #3 (virtual)

March 29, 2023: 12:00pm-1:00pm

Howard County WebEx Virtual Meeting Room



Lauren Chilton of the Howard County Office of Emergency Management (OEM), with assistance from Mark Richmond and Christine Lowe, Howard County Department of Public Works, Stormwater Management Division (SWMD), led the third hazard mitigation public meeting on March 27, 2023. Ten residents attended the meeting.

For the first phase of the meeting, OEM gave the same presentation as in the second public meeting. The intent for the presented material was to have an in-person public meeting as well as a virtual public meeting in order to reach the broadest range of residents. See above, in the Public Meeting #2 section, for a summary of the presentation. After wrapping up the presentation with information about how the public can provide comments on the current draft of the NHMP update, OEM opened the meeting for public questions. The questions and ensuing discussion focused on the following topics:

- The difficulty of mitigating certain low-probability, high-consequence space weather hazards, such as a nearby gamma-ray burst;
- The Howard County frequently flooded roads map;
- The progress of several long-term, multi-phase flood mitigation action items; and
- The prospect of a color-coded weather alert system.

Public Meeting #3 Events Page Screenshot (with zoom in)

The screenshot shows the Howard County Events page. At the top, the Howard County logo and the text "County Executive Calvin Ball" are visible. The main title "Events" is centered above a search bar. The search bar includes a placeholder "Enter keyword to search for events", a "SEARCH" button, and a magnifying glass icon. Below the search bar, there are filter options: "Filter By: Department/Office" (dropdown), "Date" (dropdown showing "03/20/2023" to "03/30/2023"), and a green "SHOW RESULTS" button. To the right, there are buttons for "3 Results for:", "CLEAR ALL", "grid view", and "Popularity Asc". The results are displayed in a grid format:

Date	Event Name	Time	Description
22 MAR	2nd Public Meeting: Natural Hazard Mitigation Plan and Flood Mitigation Plan Update	4:00 PM	
23 MAR	HOME Sweet HOME	11:00 AM	Spring Doormat DIY
29 MAR	Virtual Public Meeting: Natural Hazard Mitigation Plan and Flood Mitigation Plan Update	12:00 PM	

A large green circular zoom-in button is located at the bottom right of the screenshot area.

Public Meeting #3 Press Release



410-313-2022 / FAX 410-313-3390 / www.howardcountymd.gov

Office of Public Information
3430 Courthouse Drive
Ellicott City, Maryland, 21043

Mark Miller, Administrator
msmiller@howardcountymd.gov

March 6, 2023

Media Contacts:

Mark Miller, Administrator, Office of Public Information, 410-313-2022
Lauren Chilton, Office of Emergency Management, 410-313-6030 (All-Hazards)
Mark S. Richmond, Stormwater Management Division, 410-313-6413 (Flood)

Howard County's Office of Emergency Management to Host Public Meetings to Review Natural Hazard Mitigation Plan and Flood Mitigation Plan

ELICOTT CITY, MD – This March, Howard County's Office of Emergency Management (OEM) will hold two public meetings to gather public input and discuss the County's [Natural Hazard Mitigation Plan and Flood Mitigation Plan](#). The first meeting will take place in-person on Wednesday, March 22nd from 4:00 p.m. to 5:00 p.m. in the Frances Hackley Multipurpose Room at the [Harriet Tubman Cultural Center](#) in Columbia. The second meeting will take place virtually on Wednesday, March 29th from noon to 1:00 p.m. To register to participate in March 29th's virtual meeting, click [HERE](#).

The County's Natural Hazard Mitigation Plan and Flood Mitigation Plan define goals and actions that can be taken to mitigate impacts from a variety of hazards, including flooding, within the county. The County is required to update these plans every five years.

A brief presentation will be presented at the start of each meeting by staff members from OEM and the County's Department of Public Works (DPW), who will remain on hand to answer any questions and gather public comments. Exhibit boards and activities will also be available at the in-person meeting on the 22nd. Meeting summaries will be posted on OEM's "2024-2029 Howard County Hazard Mitigation Plan Update" [website](#) following the meetings.

Those unable to attend either meeting who would like to view the information and/or have questions regarding the Natural Hazard Mitigation Plan, should contact Ms. Lauren Chilton with OEM at 410-313-6030 or email emergencymanagement@howardcountymd.gov. For information and/or questions regarding the Flood Mitigation Plan, please contact Mr. Mark S. Richmond with DPW's Stormwater Management Division at 410-313-6413 or email stormwater@howardcountymd.gov.

— more —

Page 2
March 6, 2023

Howard County's Office of Emergency Management to Host Public Meetings to Review Natural Hazard Mitigation Plan and Flood Mitigation Plan *(continued)*

An interpreter for people who are deaf or hard of hearing will be available if requested seven working days prior to the meeting. Please call DPW at 410-313-3440 (voice) or use Relay at 7-1-1, between 8:00 a.m. and 5:00 p.m., Monday through Friday.

For questions or more information about these meetings, contact Ms. Lauren Chilton with OEM at 410-313-6030 or email emergencymanagement@howardcountymd.gov.

###



HOWARD COUNTY
OFFICE OF EMERGENCY MANAGEMENT



Calvin Ball
County Executive



VIRTUAL MEETING TO REVIEW HOWARD COUNTY HAZARD MITIGATION PLANS

WEDNESDAY, MARCH 29TH @ 12PM

Virtual Public Meeting

[Sign up here today!](#)



JOIN US!

We will be virtually discussing the County's Natural Hazard Mitigation Plan and Flood Mitigation Plan. These plans define goals and actions that can be taken to mitigate impacts from a variety of hazards, including flooding, within the County.

Members of both OEM and the Department of Public Works (DPW) will be online to explain both plans, answer any questions, and gather public comments virtually.

CONTACT US



410-313-6030



@HoCoOEM



@HoCoOEM

*For questions or
more information
about the meeting,
contact
Ms. Lauren Chilton,
OEM, at 410-313-6030
or email
emergencymanagement@howardcountymd.gov.*

Register Virtually ***HERE!***

Public Meeting #3 Attendance

Participants	
Name	Join/Leave
Lauren Chilton	11:50 / 12:49
Michael Tennison	11:51 / 12:49
John Seefried	11:57 / 12:40
Mark Richmond	11:58 / 12:49
Gayle Killen - Historic ...	11:59 / 12:49
Christine Lowe	11:59 / 12:49
Ken Conca	12:00 / 12:40
Joel	12:07 / 12:49
Winnie Carpenter	12:09 / 12:44
sam dove	12:11 / 12:14
elizabeth krahel	12:12 / 12:33
Hannah Robinson	12:16 / 12:49
Paul Kwiatkowski	12:24 / 12:40

Public Meeting #3 Agenda



HOWARD COUNTY OFFICE OF EMERGENCY MANAGEMENT

Director
Mike Hinson

County Executive
Calvin Ball

Howard County 2024-2029 Hazard Mitigation and Flood Mitigation Plan Update

Public Meeting #3

Agenda

Date: March 29, 2022

Time: 12:00 PM-1:00 PM

- 1) Introductions
 - a) Howard County Office of Emergency Management
 - b) Department of Public Works-Stormwater Management Division
- 2) Natural Hazard Mitigation Plan and Flood Mitigation Plan Presentation
 - a) Purpose and Background
 - b) Plan Contents
 - c) Risk Analysis Results
 - d) Action Items
 - e) Big Changes
 - f) Next Steps
 - g) Open Discussion
 - h) How to Provide Feedback: Website and Survey

Thank you so much for attending our third public meeting to gather input for the Natural Hazard Mitigation Plan and Flood Mitigation Plan. Please find some helpful information below.

Link to review plans and provide feedback:

<https://www.howardcountymd.gov/emergency-management/2024-2029-howard-county-hazard-mitigation-plan-update>

Contacts

For the **Natural Hazard Mitigation Plan**, please contact Lauren Chilton at:

- lchilton@howardcountymd.gov
- 410-313-0713

For the **Flood Mitigation Plan**, please contact Mark Richmond at:

- msrichmond@howardcountymd.gov
- 410-313-6444

Invitation to Neighboring Jurisdictions to Review the NHMP

Several neighboring jurisdictions' OEM offices and the Baltimore Metropolitan Council were invited to review the Plan on March 22, 2023. The email below was sent to the following jurisdictions (emails blacked out for security and security):

- City of Annapolis
- Anne Arundel County
- City of Baltimore
- Baltimore County
- Carroll County

Invitation to Review: Howard County Natural Hazard Mitigation Plan and Flood Mitigation Plan
2024-2029

CL Chilton, Lauren <lchilton@howardcountymd.gov> Wednesday, March 22, 2023 at 1:21 PM [REDACTED]

Hello regional partners,

Howard County OEM recently posted the first draft of our Natural Hazard Mitigation Plan Update as well as our Flood Mitigation Plan Update for 2024-2029. We would love to get some feedback from other OEMs in the region as well as the BMC if you have the time. Our public comment period ends on April 7th at 5 PM.

You can access the documents on [this page](#). There are also links here that will take you to our feedback form!

Please let me know if you have any questions or want to chat about the plans!

Thank you,

 Lauren Chilton, MIA
She/Her/Hers
Emergency Management Specialist II
Howard County Office of Emergency Management
Phone: 410-313-0713

Appendix E: Joint Steering Committee Detailed List & Invitation

Affiliation	Name	Title
Baltimore County Office of Emergency Management	David Bycoffe	Director
Columbia Association	Nick Mooneyhan	Open Space Operations Manager
Columbia Association	Monica McMellon-Ajayi	Director of Human Resources, Equity, and Inclusion
Constellation Home (formerly known as BGE)	Marche Taylor Templeton	External Affairs Manager
Department of Community Resources & Services	Jackie Scott	Director
Department of Fire & Rescue Services—Office of Emergency Management	Michael Hinson	Director
Department of Fire & Rescue Services—Office of Emergency Management	Maria Bernadzikowski	Deputy Director (now Assistant Chief Administrative Officer)
Department of Fire & Rescue Services—Office of Emergency Management	Lauren Chilton	Emergency Management Specialist II
Department of Fire & Rescue Services—Operations Command	Gordon Wallace	Deputy Chief
Department of Fire & Rescue Services—Special Operations	Stephen Hardesty	Battalion Chief
Department of Inspections, Licenses, & Permits	Bob Frances	Director
Department of Inspections, Licenses, & Permits—Operations Division	Bob Firmani	Division Chief
Department of Inspections, Licenses, & Permits—Plans Review Division	Don Mock	Division Chief
Department of Planning & Zoning—Comprehensive and Community Planning Division	Kristin O'Connor	Division Chief
Department of Planning & Zoning—Resource Conservation Division	Beth Burgess	Division Chief

Department of Public Works	John Seefried	Acting Director ((Assistant to the Director)
Department of Public Works: Bureau of Engineering	Kris Singleton	Engineering Specialist III
Department of Public Works: Bureau of Environmental Services	Mark DeLuca	Bureau Chief
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Mark Richmond	Division Chief
Department of Public Works: Bureau of Environmental Services—Stormwater Management Division	Brian Cleary	Engineering Specialist III
Department of Public Works: Bureau of Environmental Services--Stormwater Management Division	Christine Lowe	Engineering Specialist III
Department of Public Works: Bureau of Facilities	Sharon Walsh	Bureau Chief
Department of Public Works: Bureau of Facilities	Kenn Hamm	Assistant to the Chief
Department of Public Works: Bureau of Facilities	Robert Hollenbeck	Deputy Chief
Department of Public Works: Bureau of Highways	Kris Jagarapu	Bureau Chief
Department of Public Works: Bureau of Highways—Traffic Division	Jennifer Woo	Division Chief
Department of Public Works: Bureau of Utilities	Arthur Shapiro	Bureau Chief
Department of Public Works: Bureau of Utilities	Ross Beschner	Deputy Chief
Department of Public Works: Bureau of Engineering—Utility Design Division	Zack Knight	Program Manager
Department of Recreation and Parks-Bureau of Parks	Bryan Moody	Bureau Chief
Department of Technology and Communication Services	Glenn Hansen	Public Safety IT Project Manager
Department of Technology and Communication Services—GIS Information Systems	Rob Slivinsky	Geographical Information Systems Coordinator
Howard County Administration	Brian Shepter	Deputy Chief of Staff
Howard County Administration—Office of Community Sustainability	Lindsay DeMarzo	Planning Supervisor

Howard County Administration—Office of Community Sustainability	Leah Miller	Energy Manager
Howard County Administration—Office of Community Sustainability	Elissa Reineck	Planning Specialist I
Howard County Administration—Office of Human Resources—Risk Management	Matt Zervas	Assistant Risk Manager
Howard County Administration—Office of Human Rights and Equity	Yolanda Sonnier	Administrator
Howard County Administration--Office of Law	Cynthia Peltzman	Principal Attorney
Howard County Administration--Office of Transportation	Bruce Gartner	Administrator
Howard County Community Organizations Active in Disaster	Jim Ehle	Chair (is no longer Chair of COAD)
Howard County Economic Development Authority	Larry Twele	CEO and President
Howard County Economic Development Authority	Christopher Moyer	Business Development and Marketing/Managing Director
Howard EcoWorks	Lori Lilly	Executive Director
Howard County Health Department—Bureau of Infection Control and Public Health Preparedness	Lenora Painter	Bureau Director
Howard County Health Department—Emergency Preparedness Planning & Training	Amy Skaggs	Coordinator
Howard County Police Department—Operational Preparedness and Support Division	Ron Jason Baker	Lieutenant
Howard County Police Department—Operational Preparedness and Support Division	Kelly Tibbs	Sergeant
Howard County Police Department—Operational Preparedness and Support Division	Rocco Sovero	Police Tech Corporal
Howard County Public School System	Alan Moss	Safety & Security Planning Manager
Participating as Howard County Resident/Maryland Department of Environment—Waterway Permits	William Seiger	Howard County Resident
University of Maryland Center for Health and Homeland Security	Michael Tennison	Senior Law and Policy Analyst and Consultant to Howard County OEM

The above members of the JSC received an email invitation to participate on August 9, 2022, ***including the members from utility companies, private businesses, and non-profits***. Email addresses are omitted for security and privacy purposes. The following departments, businesses, and non-profits received an invitation:

- Baltimore Gas and Electric
- Howard County Government
 - Administration
 - Department of Community Resources and Services
 - Department of Fire and Rescue Services
 - Department of Inspections, Licenses, and Permits
 - Department of Planning and Zoning
 - Department of Public Works
 - Department of Recreation and Parks
 - Department of Technology and Communication Services
 - Howard County Police Department
 - Howard County Public School System
- Howard County Health Department
- Non-Profits
 - Columbia Association
 - Community Organizations Active in Disaster
 - Howard County Economic Development Authority
 - Howard EcoWorks
 - University of Maryland Center for Health and Homeland Security (consulting group assisting with the update)

Requesting Your Participation-Hazard Mitigation Plan Update

CL Chilton, Lauren <lchilton@howardcountymd.gov>

Tuesday, August 9, 2022 at 3:17 PM

Hello, everyone!

If you are receiving this email, you previously served as a member of the Joint Steering Committee (**JSC**) for the County's Hazard Mitigation Plan or you have been identified as a subject matter expert from your agency or department. It's now time to complete the 5-year update (2024-2029), so we are requesting your assistance to serve on the **JSC** as a subject matter expert. If you are unable to serve on the **JSC** for any reason, please designate someone in your place with similar expertise. **Please reply to this email to confirm your participation or if you will be designating someone else by COB 8/16/22.**

Our first meeting will be held on Wednesday, September 21st from 1 PM to 3 PM in the Policy Room in the Howard County EOC (Ligon Building) at 3450 Court House Drive. There will be a virtual option to attend as well. A calendar invite will follow this email.

This Plan must get a thorough update every 5 years and be approved by FEMA for Howard County to qualify for Hazard Mitigation grant projects. Our Hazard Mitigation Plans include the Natural Hazards Mitigation Plan (NHMP) and its two annexes, the Human-Caused Hazard Mitigation Plan (HCHMP), and the Historic and Cultural Resources Hazard Mitigation Plan (HCRHMP). We will also be updating the Flood Mitigation Plan (FMP), which is managed by the Department of Public Works-Storm Water Management Division.

These Plans include information about our County to include demographics, hazard statistics, trends, and topography. Most importantly, they list our most threatening hazards and detail mitigation actions that will be taken to address the potential impacts of these hazards. These plans are then used for that five-year period to keep track of our progress for each action.

This process will include a few meetings of the **JSC**. You will receive an invitation to each meeting at least two weeks in advance. The agenda or reading materials will also be sent to you at least two weeks in advance. You will also be receiving sections of the Plan for feedback throughout the process depending on your area and expertise.

I will be your point of contact throughout this process, and I will be assisted by Michael Tennison, who is also cc'd on this email.

We look forward to working with you,



| Lauren Chilton, MIA

DRAFT

Appendix F: Local Mitigation Plan Review Tool

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

Plan Information	
Jurisdiction(s)	Howard County, Maryland
Title of Plan	2024-2029 Howard County Natural Hazard Mitigation Plan Update
New Plan or Update	Update
Single- or Multi-Jurisdiction	Single-jurisdiction
Date of Plan	2023
Local Point of Contact	
Title	Mike Hinson Director
Agency	Office of Emergency Management
Address	Emergency Management 3450 Courthouse Drive Ellicott City, MD 21043
Phone Number	410-313-5911
Email	MHinson@howardcountymd.gov

Additional Point of Contact	
Title	Callie Gorgol Deputy Director
Agency	Office of Emergency Management
Address	Emergency Management 3450 Courthouse Drive Ellicott City, MD 21043
Phone Number	410-313-0748
Email	cgorgol@howardcountymd.gov

Review Information	
State Review	
State Reviewer(s) and Title	Aliyah Russell – Hazard Mitigation Project Officer Marcia Barben – Hazard Mitigation Project Officer Bridget Cantwell – Hazard Mitigation Contractor Crystal Zhao – Hazard Mitigation Project Officer Nevin Stambaugh – Hazard Mitigation Project Officer
State Review Date	5/11/2023
FEMA Review	
FEMA Reviewer(s) and Title	Joshua Norris, Hazard Mitigation Planner, MD FIT
Date Received in FEMA Region	Submission #1: 5/30/2023
Plan Not Approved	Submission #1: 7/7/2023. Revisions required.
Plan Approvable Pending Adoption	Submission #2: 8/16/2023. Required revisions addressed.
Plan Approved	

Plan Review Checklist

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?		
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?		
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		
A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?		
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?		
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?		
ELEMENT A REQUIRED REVISIONS		
Required Revision:		

Element B: Risk Assessment

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))		
B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?		
B1-b. Does the plan include information on the location of each identified hazard?		
B1-c. Does the plan describe the extent for each identified hazard?		
B1-d. Does the plan include the history of previous hazard events for each identified hazard?		
B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?		
B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?		
B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))		
B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards?		
B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?		
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?		

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
ELEMENT B REQUIRED REVISIONS		
Required Revision:		

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?		
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?		
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?		
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?		
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?		

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?		
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?		
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?		
ELEMENT C REQUIRED REVISIONS		
Required Revision:		

Element D: Plan Maintenance

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?		
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?		

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.		
D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?		
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?		
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?		
D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?		
ELEMENT D REQUIRED REVISIONS		
Required Revision:		

Element E: Plan Update

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?		

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		
E2-a. Does the plan describe how it was revised due to changes in community priorities?		
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?		
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?		

ELEMENT E REQUIRED REVISIONS

Required Revision:

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or page number)	Met / Not Met
F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?		
F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?		
ELEMENT F REQUIRED REVISIONS		
Required Revision:		

Element G: High Hazard Potential Dams (Optional)

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?		
HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?		
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?		
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?		
HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies?		
HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals?		
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?		
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?		
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?		
HHPD Required Revisions		
Required Revision:		

Element H: Additional State Requirements (Optional)

Element H Requirements	Location in Plan (section and/or page number)	Met / Not Met
This space is for the State to include additional requirements		

Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

Element A. Planning Process

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element B. Risk Assessment

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element C. Mitigation Strategy

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element D. Plan Maintenance

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element E. Plan Update

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element G. HHPD Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element H. Additional State Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Appendix G: Hazard Definitions

100 Year Flood: A magnitude of flooding event that has a 1% (1/100) annual probability of occurring.

100 Year Floodplain: An area that has a 1% (1/100) annual probability of experiencing flooding. This may also be referred to as a **Base Flood**.

500 Year Flood: A magnitude of flooding event that has a .2% (1/500) annual probability of occurring.

500 Year Floodplain: An area that has a .2% (1/500) annual probability of experiencing flooding.

Base Flood Elevation: The elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year.¹⁷²

Special Flood Hazard Area: An area having special flood, mudflow or flood-related erosion hazards and shown on a Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM) Zone A, AO, A1-A30, AE, A99, AH, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1-A30, V1-V30, VE or V.¹⁷³

¹⁷² National Flood Insurance Program, Glossary. <https://www.floodsmart.gov/definitions>. Last Accessed Jul 14, 2023

¹⁷³ National Flood Insurance Program, Glossary. <https://www.floodsmart.gov/definitions>. Last Accessed Jul 14, 2023