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Resilient Maryland

A Collaborative Strategy for Promoting Statewide Resilience

Governor | Wes Moore
Lt. Governor | Aruna Miller
MDEM Secretary | Russell J. Strickland
Chief Resilience Officer | Mike Hinson

Maryland
DEPARTMENT OF EMERGENCY MANAGEMENT

MARYLAND OFFICE OF
RESILIENCE
A Resilient Maryland, Rooted in Community

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DEPARTMENT OF
EMERGENCY MANAGEMENT

About the Maryland Department of Emergency Management

MDEM is a national leader in Emergency Management that provides Maryland residents, organizations, and emergency management partners with expert information, programmatic activities, and leadership in the delivery of financial, technical and physical resources "to shape a resilient Maryland where communities thrive." We do this by being Maryland's designated source of official risk reduction and consequence management information.

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About the Maryland Office of Resilience

The Maryland Office of Resilience was created by law in 2022 and officially established in November 2023. The Office coordinates across state and local resilience efforts, provides strategic direction, and offers technical assistance to local governments. The office was created to do the following:

- *Develop a statewide resilience strategy*
- *Conduct outreach and provide technical assistance to local jurisdictions to support the development of local resilience strategies*
- *Prioritize vulnerable communities and ensure that investments are made with a focus on environmental justice*
- *Identify flood risk assessment and other resilience-related risk assessment tools*
- *Coordinate and administer federal prevention, protection, mitigation, and recovery–focused programs*
- *Administer State mitigation grants and loans*

Acknowledgements

This strategy was developed by...

The Maryland Office of Resilience (MOR) within the Maryland Department of Emergency Management (MDEM):

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Alan Lyons, courtesy of the Mid-Atlantic Center for Emergency Management & Public Safety (MACEM&PS) at Frederick Community College (FCC).

A complete list of acknowledgements, including all of the many partners that informed this document, is provided in Appendix A: Acknowledgements.

Letter from the Governor

Dear Marylanders,

Maryland stands at a crossroads. From the mountains of Western Maryland to the shores of the Chesapeake Bay, our communities are facing more intense disasters, compounded by climate change. We have already seen what happens when stronger storms, extreme temperatures, and increased flooding collide with aging infrastructure. Too often, our most vulnerable communities are hit the hardest. These are not distant threats. They are happening now.

As Maryland navigates mounting hazard risks and grapples with the impacts of climate change, we need a strategic, whole-of-government approach to build resilience. For this reason, the Maryland Office of Resilience was established to coordinate efforts across the state and develop a statewide resilience strategy.

Today, I am proud to release The Resilient Maryland Strategy. Developed through months of collaboration with all levels of government, community organizations, academic and technical experts, and private sector stakeholders, the strategy offers tangible actions to make Maryland more resilient to disasters and climate change. It also prioritizes actions that advance justice, equity, and community engagement.

At its core, this strategy is about protecting people – guaranteeing every Marylander the resources and support needed to stay safe and secure. It is about strengthening the systems we rely on before disasters strike while ensuring we are prepared for gray sky days. Whether by upgrading aging housing, preparing for extreme heat, or helping communities plan for future storms, resilience must be built into how we govern.

Through the Resilient Maryland Strategy, we are taking a clear and deliberate step to confront today's challenges and lay the groundwork for a stronger, more prepared tomorrow.

Sincerely,

Wes Moore
Governor

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Executive Summary

Purpose

Across Maryland, disasters are becoming more commonplace. The State is grappling with everything from natural hazards like flooding and extreme heat to human-caused hazards like cyber attacks and policy decisions that lead to food insecurity.

Climate change acts as a threat multiplier. Rising sea levels cause sunny day flooding in coastal communities and higher storm surge during tropical storms. More intense precipitation brings flooding further inland, overwhelming creeks and stormwater systems. Higher temperatures can become deadly for vulnerable populations.

Though climate and disaster risks are growing, Maryland has the opportunity to lead the way on resilience. Recognizing the need for action, the Maryland General Assembly passed, and Governor Wes Moore signed into law Senate Bill 630, which established the Maryland Office of Resilience (MOR) and charged it with leading a unified, statewide approach to resilience.[1]

This includes the development of a statewide strategy that presents 2-, 5-, and 10-year recommendations to advance resilience.

With input from over 100 stakeholders across local government, state government, nonprofits, the private sector, and universities, MOR developed this strategy.

The recommended actions included in this document could protect lives, livelihoods, and property from disasters and climate impacts.

Defining Resilience

MOR worked collaboratively with 37 different agencies and offices at the state and local level to define "resilience" for the State. Drawing from both survey data and national best practices, the following definition was adopted:

"Resilience is the ability of communities to adapt to the challenges of changing conditions and disasters, including human-caused and natural hazards – and to build, advance, and maintain capacities related to quality of life, health and well-being, durable systems, economic vitality, human made and nature-based infrastructure, and sustainable environmental systems."

Sectors & Focus Areas

The strategy is organized around five sectors, each of which has a dedicated chapter. There is also a chapter that discusses the current state of Maryland's resilience efforts and provides cross-sectoral recommendations.

The inclusion of sectors allowed MOR to cover a broad range of issues, include diverse perspectives, and develop strategies that address the unique stressors and needs of each sector.

Five Sectors

The five sectors were identified based on a survey of relevant Maryland plans, a review of resilience strategies from other states, and feedback from agency partners.

A summary of each sector is provided on the next page.

Environment & Natural Systems

Restoring and protecting Maryland's environment and natural ecosystems to enhance ecosystem services in the face of environmental change and help communities harness benefits such as risk reduction, carbon sequestration, cleaner air and water, health, recreation, ecotourism, habitat diversity, and natural resource conservation. Maryland's natural resources play a critical role in lessening the impacts of natural hazards and climate change, while building overall community and ecological resilience.

Critical Infrastructure

Ensuring that Maryland's critical infrastructure systems and assets - namely, core transportation assets, drinking water and wastewater systems, energy assets, communications systems, hazardous materials sector, safety and security assets, and military installations - can recover quickly or withstand hazards and changing conditions. Resilient critical infrastructure is fundamental and enables all other systems to function.

Note: Critical infrastructure is an expansive category that has been defined in various ways. This definition was created with extensive input to capture core risks and set parameters for discussion.

Community & Local Government Capacity

Supplying local governments with tools, expertise, and resources that build their capacity to take equitable local resilience action through planning, stormwater management, land use, community engagement, partnerships with businesses, historic and cultural resource planning, and more. Greater local capacity not only catalyzes local action, but also unlocks dollars for resilience.

Food Systems

Strengthening Maryland's food & farm systems by increasing the production and procurement of locally- and sustainably-grown foods and ensuring the availability and accessibility of nutritious & culturally appropriate food to all communities over time, even in the face of supply chain disruptions (e.g., natural hazards, economic shocks, public health emergencies). Long-term food system resilience depends on inclusivity and structural, distributional, and intergenerational equity for all consumers, producers, and food system workers in Maryland.

Housing

Making the State of Maryland a desirable and affordable home for all residents by fostering attainable, resilient, and quality housing opportunities. Accessible housing that withstands and adapts to emerging hazards is vital to a functioning and growing economy, generational wealth planning, and economic justice.

Focus Areas

In addition to the sectoral structure, three cross-cutting focus areas guided both the development and prioritization of these recommendations:

1

Justice & Equity

Supporting equitable community engagement and environmental justice, by considering the voices and experiences of marginalized communities and prioritizing investments that make underserved and overburdened communities resilient to climate change and other hazards.

Environmental justice requires a systems approach that strives to dismantle discriminatory policies and practices that result in disproportionate impacts on overburdened and underserved communities.

2

Place-Based Resilience

Advancing community-led resilience projects in areas that are disproportionately affected by hazards and stressors, by fostering collaboration across local, regional, and state agencies and combining resources to optimize resilience benefits. A collaborative, place-based approach to resilience will lead to transformation instead of one-off projects.

3

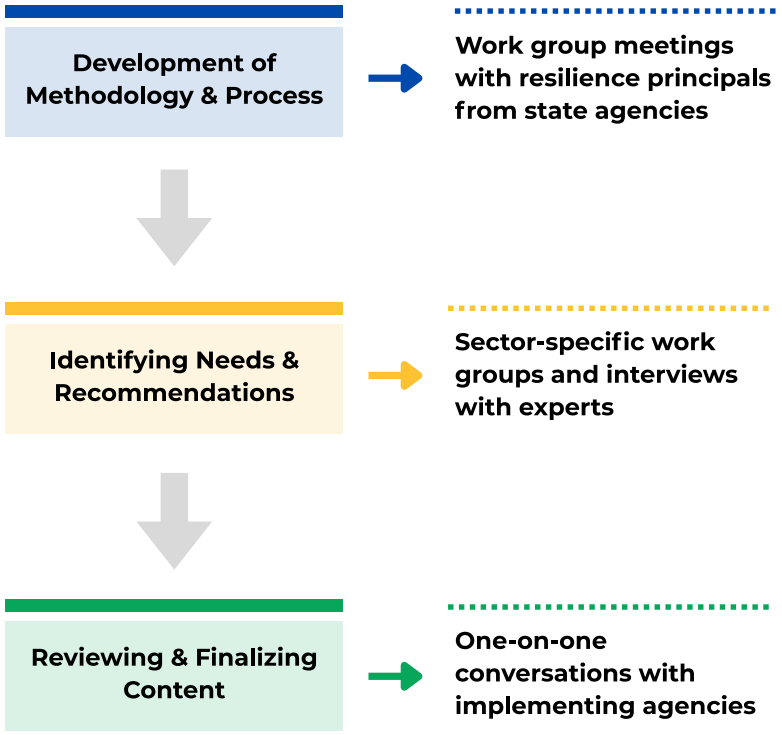
Robust Economy & Job Creation

Promoting an equitable, robust and competitive economy while creating new jobs that support resilience & preparing the workforce for future hazards.

Stakeholder Engagement

MOR engaged over 100 stakeholders in the development of this strategy. These individuals brought a wide array of expertise representing all regions of the state, all levels of government, and various organization types.

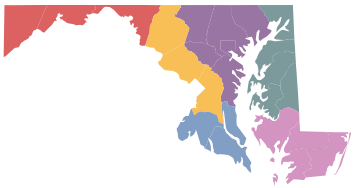
This multitude of perspectives helped MOR drill down into specific challenges and gaps, ultimately shaping the recommendations in this document. The major stages of this process, and the methodology for each, are diagrammed below:



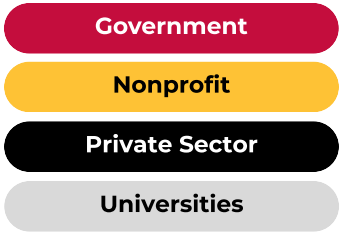
120 Parters Engaged

5 Sector Work Groups

20+ Expert Interviews



All MD Regions Represented



Broad Cross-Section of Sectors

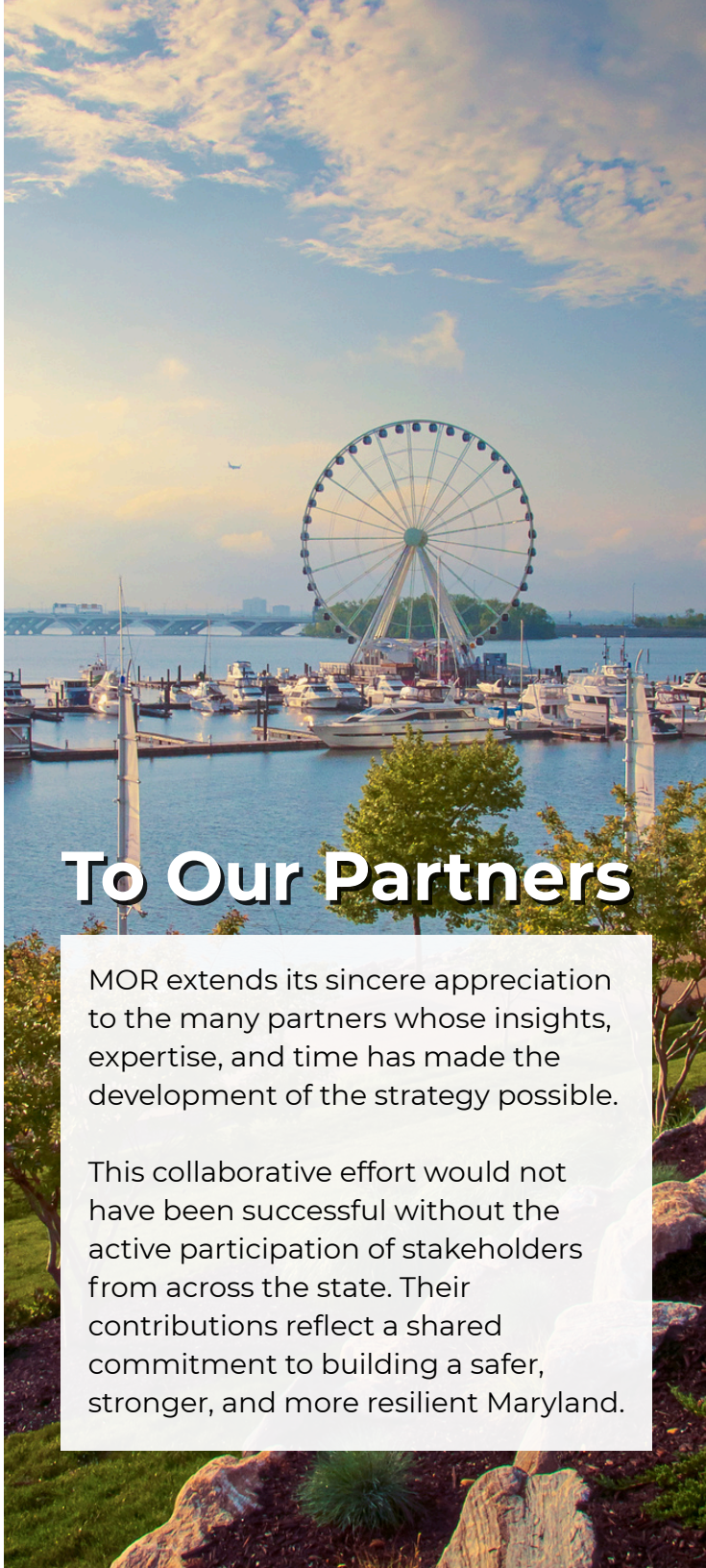
Prioritization Criteria

To ensure that this strategy is both impactful and actionable, recommendations were evaluated through a structured set of prioritization criteria. All recommendations were required to:

- Align with the Maryland Office of Resilience's definition of resilience
- Clearly fall within the State's purview
- Have an identified implementation lead

Beyond these baseline requirements, recommendations were evaluated based on their alignment with three key focus areas: advancing justice and equity, supporting place-based resilience, and contributing to a robust economy and job creation.

Additional considerations included a recommendation's ability to reduce hazard risk, its feasibility within 2, 5, or 10-year timelines, the strength of evidence supporting it, and its potential to be scaled or replicated.



To Our Partners

MOR extends its sincere appreciation to the many partners whose insights, expertise, and time has made the development of the strategy possible.

This collaborative effort would not have been successful without the active participation of stakeholders from across the state. Their contributions reflect a shared commitment to building a safer, stronger, and more resilient Maryland.

Summary of Hazards & Climate Impacts

Maryland is no stranger to disasters. Past events have ranged from flooding in all regions of the State to deadly heatwaves to cyber attacks. Climate change acts as a risk multiplier for natural hazards, bringing higher temperatures, stronger storms, and more frequent flooding. As Maryland's risk profile evolves, so too should its approach to resilience.

MOR reviewed existing hazard plans and datasets from multiple agencies to determine the most pervasive hazards across the State. These are discussed briefly below. Each of the sector-specific chapters dives deeper into the hazards that are most pertinent to that sector, as well as the chronic stressors that make those hazards more severe.

Flooding (Riverine, Coastal)

Flooding is Maryland's most widespread and episodic hazard, affecting the entire state from the mountainous western region all the way to the Atlantic coast.

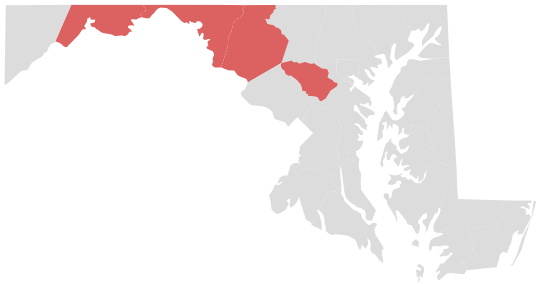
Floodwaters can disrupt transportation systems, damage agricultural and natural landscapes, degrade soil quality, and threaten homes, businesses, and public safety.

Many of the communities impacted by coastal and riverine flooding have historical and cultural assets which face risk, in addition to the aging and failing infrastructure which threatens local resources.

In 2020, roughly *133,700 properties in Maryland* faced a substantial risk of flooding.[2] Flooding affects approximately 15,000 lane miles of state-maintained roads.[3]

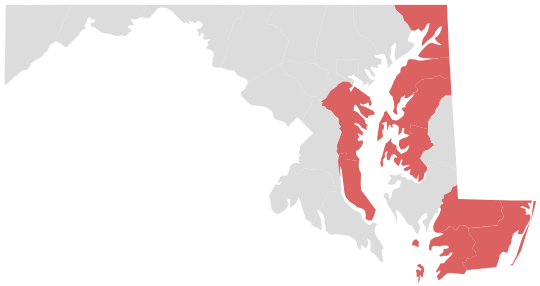
Map at top right marks jurisdictions (red) with "moderate" to "very high" calculated risk from riverine flooding per FEMA NRI.

Map at middle right marks (red) jurisdictions with "moderate" to "very high" calculated risk from coastal flooding per FEMA NRI.



Jurisdictions Most At-Risk (alphabetically)

- Allegany County
- Frederick County
- Howard County
- Washington County



Jurisdictions Most At-Risk (alphabetically)

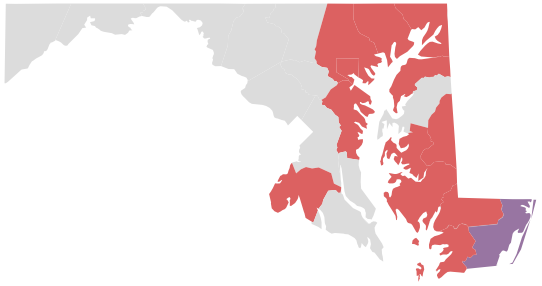
- Anne Arundel County
- Calvert County
- Cecil County
- Kent County
- Queen Anne's County
- Somerset County
- Talbot County
- Wicomico County
- Worcester County

Sea Level Rise

Sea level rise is a chronic stressor that makes flooding worse, causes saltwater intrusion on natural and working lands, and alters ecosystems.

Sea levels are projected to rise *between 1 and 1.5 feet from 2000 to 2050* in Maryland, causing coastal flooding to occur more frequently and extend further inland.[4] In 2021, Crisfield faced 80 days of high tide flooding. Rising sea levels also threaten working lands and coastal forests on the Eastern Shore.[5] As one example, from 2011 and 2017, the number of visible salt patches on coastal Maryland farmland increased by 93%.[6]

Map at right marks jurisdictions with >$400M total home value at risk of coastal flooding by 2050 due to sea level rise per Climate Central Surging Seas Risk Mapping initiative. ***Red:*** *At least $400M total home value at risk.* ***Purple:*** *At least $2B total home value at risk.*



Jurisdictions Most At-Risk (alphabetically)

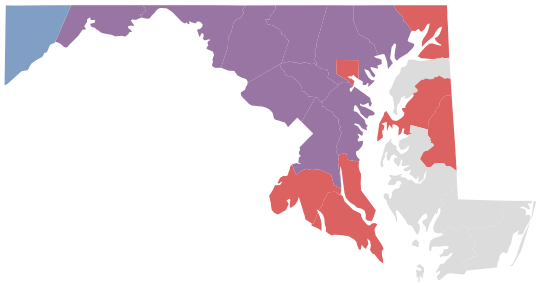
- Anne Arundel County
- Baltimore City
- Dorchester County
- Somerset County
- Worcester County

Extreme Temperatures

By mid-century, Maryland is projected to experience *47.7 days above 90° F per year* under a high future climate scenario. This is 190% greater than the 16.5 days above 90° under a baseline scenario.[7] Urban areas with limited tree cover and dense development are especially vulnerable to the heat island effect, which traps heat and keeps temperatures high even at night.

The Maryland Department of Health (MDH) has recorded a sharp increase in heat-related illness, hospitalizations, and deaths since 2020, with the greatest impact felt by vulnerable communities, including children and seniors. Higher temperatures can also cause higher energy demand and lead to greater wear on roads, utilities, and building systems.

Map at right marks jurisdictions with "moderate" to "very high" calculated risk from heat wave (red), cold wave (blue), or both (purple) per FEMA NRI.



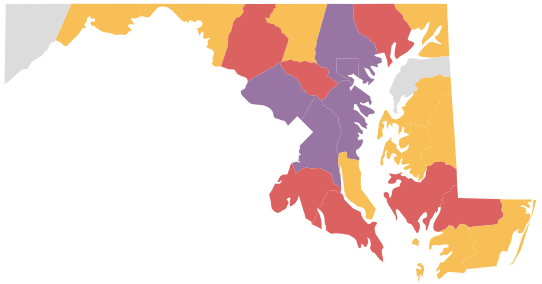
Jurisdictions Most At-Risk (alphabetically)

- Allegany County
- Anne Arundel County
- Baltimore County
- Carroll County
- Frederick County
- Harford County
- Howard County
- Montgomery County
- Prince George's County
- Washington County

Severe Weather Events

With climate change, severe weather events – hurricanes, tropical systems, tornadoes, and winter storms – *are becoming more frequent*.[8] As observed in recent years, severe storms can have devastating impacts nationwide, causing rapid and unprecedented levels of damage.

Map at right marks jurisdictions with "moderate" to "very high" calculated risk from hurricane, winter storm, or tornado, per FEMA National Risk Index (NRI). ***Yellow:*** *Risk from 1 listed hazard.* ***Red:*** *Risk from 2 listed hazards.* ***Purple:*** *Risk from all 3 listed hazards.*



Jurisdictions Most At-Risk (alphabetically)

- Anne Arundel County
- Baltimore City
- Baltimore County
- Montgomery County
- Prince George's County

Human-Caused Hazards

Human-caused hazards are entirely or predominantly caused by human activities. They may include acute shocks that are economic, social, or related to health emergencies. As one example, Maryland has experienced cyber attacks on its local governments, State government, healthcare system, and schools. Vulnerabilities in software programs can leave public and private sector entities open to attackers.

Not only can cyber attacks disrupt core constituent services, but when core technologies and infrastructure are attacked, the effects can ripple out across sectors. For instance, a cyberattack on a utility provider's control system may not just corrupt data; it can shut down water treatment plants, disrupt electricity flow to hospitals, or halt traffic management systems.

While Maryland is taking the initiative to shore up its cyber resilience and protect critical infrastructure, this remains a key area of concern. In addition to cyber attacks, other human-caused hazards can impact transportation systems and supply chains. Policy decisions can also have hazardous effects, such as increased food insecurity.

Summary of Goal & Recommendations

This strategy presents a focused set of recommendations designed to advance statewide resilience over the next 2, 5, and 10 years.

In total, there are **20 goals and 50 recommendations,** which are embedded throughout the document.

To view the Goals in the entirety of their details, please see the Roster of Goals & Recommendations.

A summary of each goal and its recommendations is provided below:

GOAL 1 - Institutionalize resilience across Maryland's funding and regulations.

GOAL 2 - Coordinate state funding and direct it toward places with high hazard risk and social vulnerability.

GOAL 3 - Collaborate on and take action to address emerging climate challenges.

GOAL 4 - Strengthen emergency response in the face of federal changes by sharing resources with neighboring states and non-governmental partners.

GOAL 5 - Enhance the state's digital resilience through continued IT modernization and development of key cybersecurity governance and operations capabilities.

GOAL 1 - Prioritize resilience as a criteria for conservation & restoration investments.

GOAL 2 - Improve resilience data collection, governance, coordination, access, and usability for local governments and state agencies.

GOAL 3 - Identify innovative approaches and foster structures for working with private property owners & nongovernmental funders.

GOAL 1 - Enhance and support the power grid's reliability and resilience in the face of escalating community reliance and a developing threat landscape.

GOAL 2 - Support transportation system resilience.

GOAL 3 - Strengthen the resilience of additional critical infrastructure, such as military installations, water and wastewater, and dams.

GOAL 1 - Establish regionally-based technical assistance to help local jurisdictions advance resilience.

GOAL 2 - Provide tools and guidance that increase local capacity to plan, fund, and implement resilience efforts.

GOAL 3 - Protect and rapidly restore small business operations statewide.

GOAL 1 - Increase adoption of climate-smart agricultural practices in Maryland.

GOAL 2 - Increase sustainable local food production and access.

GOAL 3 - Improve the ability of Maryland's food system to adapt to and recover from supply chain disruptions.

GOAL 1 - Make existing housing stock more resilient while emphasizing affordability.

GOAL 2 - Support resilient and affordable growth.

GOAL 3 - Bolster Maryland's property insurance market in the face of climate change to protect homeowners and renters.

Measuring Success

Measuring resilience is inherently complex. Understanding this requires distinguishing between two complementary types of measurement: process metrics and outcome metrics.

- **Process metrics** track the implementation of resilience-building activities, such as planning, coordination, capacity-building, or policy changes. These metrics reflect what has been done.

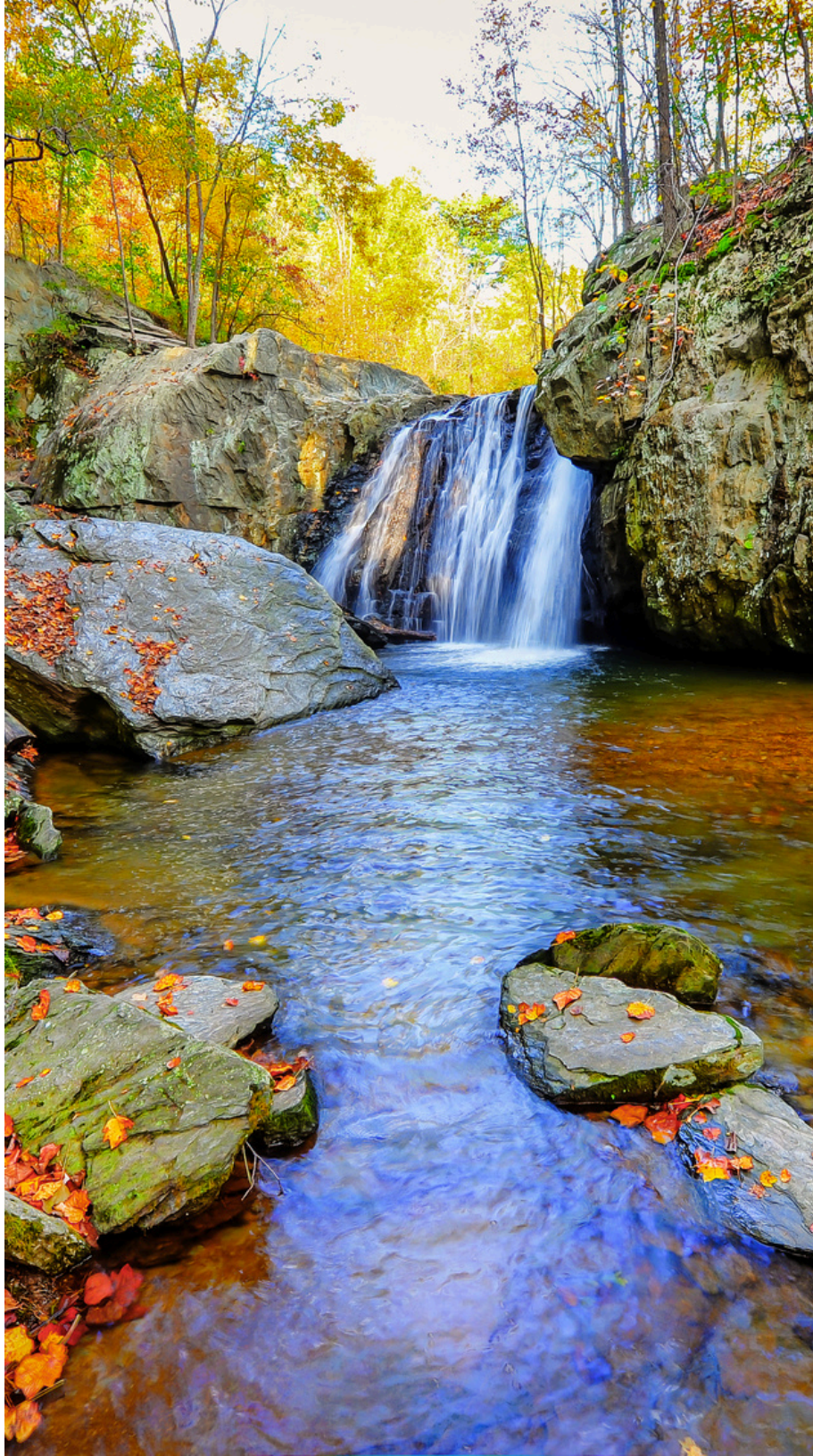
- **Outcome metrics** measure the actual effects of those activities and efforts, such as reduced vulnerability, faster recovery, or stronger community systems.

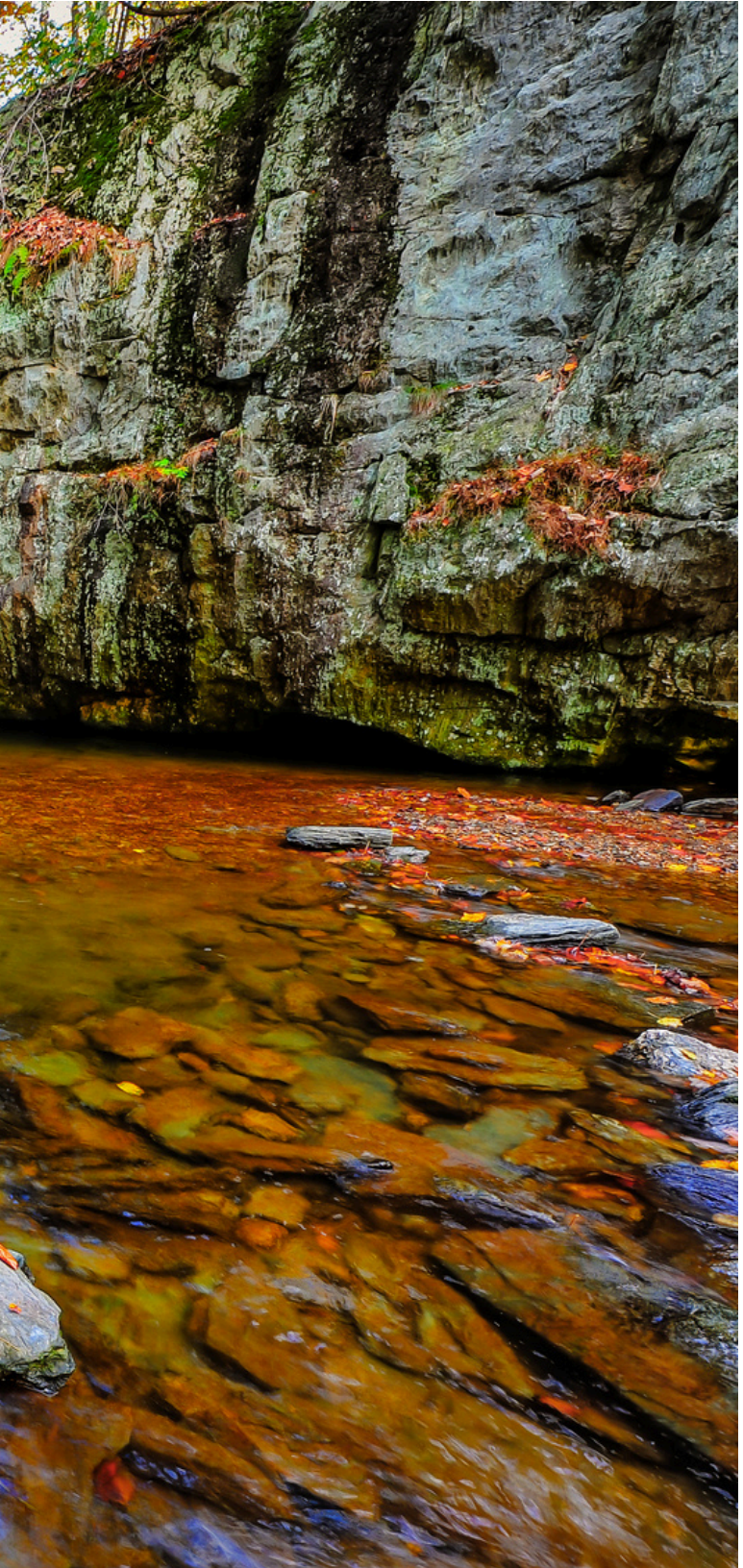
For this first iteration of the strategy, MOR will utilize process metrics, tracking the State's progress toward achieving recommendations laid out in this document. To do this, MOR will request updates from State agencies at least twice per year and develop an annual progress report to show the State's accomplishments.

This information will ultimately be used to create a dashboard. To complement this effort, MOR will also collect local stories and real-world examples of impact that illustrate how resilience projects are improving lives, strengthening systems, and addressing community needs.

At this time, MOR has not produced outcome metrics. Over time, Maryland could establish a dedicated, statewide initiative to develop a robust framework for resilience outcome metrics. Doing so will require collaboration across agencies, engagement with researchers and communities, and sustained investment in evaluation tools and data systems.

While complex, this work is essential to understanding whether current strategies are making a lasting impact and to guiding future decisions and investments.





References - Executive Summary

1. Laws - Statute Text, Code of Maryland 1201. https://mgaleg.maryland.gov/mgawebsite/Laws/StatuteText?article=gps&section=14-1201&enactments=False&archived=False

2. *The First National Flood Risk Assessment.* (2020). First Street Foundation. https://assets.firststreet.org/uploads/2020/06/first_street_foundation__first_national_flood_risk_assessment.pdf

3. Fuchs, M. (2021, May 25). New Study Reveals Impact of Flooding on Maryland's Transportation Infrastructure. *The Pew Charitable Trusts*. https://www.pew.org/en/research-and-analysis/articles/2021/05/25/new-study-reveals-impact-of-flooding-on-marylands-transportation-infrastructure

4. *Sea-Level Rise Projections.* (2023, June 20). University of Maryland Center for Environmental Science. https://www.umces.edu/sea-level-rise-projections

5. Specht, J., Sharif, Van Dolah, Ferreira, de Souza de Lima, Dalke, & Egan. (2024). *Collaborative Adaptation Planning for a Resilient Crisfield.* https://storymaps.arcgis.com/stories/fbe0ca80c30c44b5a94dfc4c8da32cc1

6. Mondal, P., Walter, M., Miller, J., Epanchin-Niell, R., Gedan, K., Yawatkar, V., Nguyen, E., & Tully, K. L. (2023). The spread and cost of saltwater intrusion in the US Mid-Atlantic. *Nature Sustainability, 6*(11), 1352–1362. https://doi.org/10.1038/s41893-023-01186-6

7. *Mid-Atlantic Regional Climate Impacts Summary and Outlook: Summer 2024*. (2024). Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA). https://www.midatlanticrisa.org/climate-summaries/2024/09.html#:~:text=The%20Mid%2DAtlantic%20region%20could,scenario%20(SSP3%2D7.0).

8. Summers, J. K., Lamper, A., McMillion, C., & Harwell, L. C. (2022). Observed Changes in the Frequency, Intensity, and Spatial Patterns of Nine Natural Hazards in the United States from 2000 to 2019. *Sustainability*, 14(7), 4158. https://doi.org/10.3390/su14074158

Maryland's Hazards & Climate Impacts

Maryland takes an approach to resilience that considers all hazards and climate impacts, recognizing that each region and community faces unique risks. In order to target resilience actions toward the greatest risks and needs, it is essential to understand which hazards and climate impacts are particularly consequential to the State. This chapter discusses Maryland's overall risk profile, while each sector-specific chapter breaks down risks even further.

Existing Tools & Processes to Assess Risks

Maryland has processes and tools to identify and prioritize threats and hazards, several of which are led by the Maryland Department of Emergency Management (MDEM).

Threat & Hazard Identification and Risk Assessment

MDEM updates its Threat and Hazard Identification and Risk Assessment (THIRA) every three years in accordance with FEMA requirements.[1]

Through the THIRA process, Maryland's communities are asked three key questions:

- **What threats and hazards can affect our community?**
- **If they occurred, what impacts would those threats and hazards have on our community?**
- **Based on those impacts, what capabilities should our community have?**

The THIRA is used to rank the most significant threats and hazards based on their likelihood and consequence (see graphic on this page). It goes hand-in-hand with the Stakeholder Preparedness Review (SPR), an annually updated process in which local jurisdictions pinpoint gaps in their emergency response capabilities.

Through these processes, communities identify which threats and hazards would overwhelm their response capabilities and provide context for those threats and hazards by developing scenarios that describe how the community and assets would be impacted. This exercise allows communities to set capability targets that are specific, measurable, actionable, relevant to potential threats, and time-bound.

Risk Assessment Calculation

(Consequence) x (Likelihood) = (Risk)	
1	Very Low
2	Low
3	Medium
4	High
5	Very High

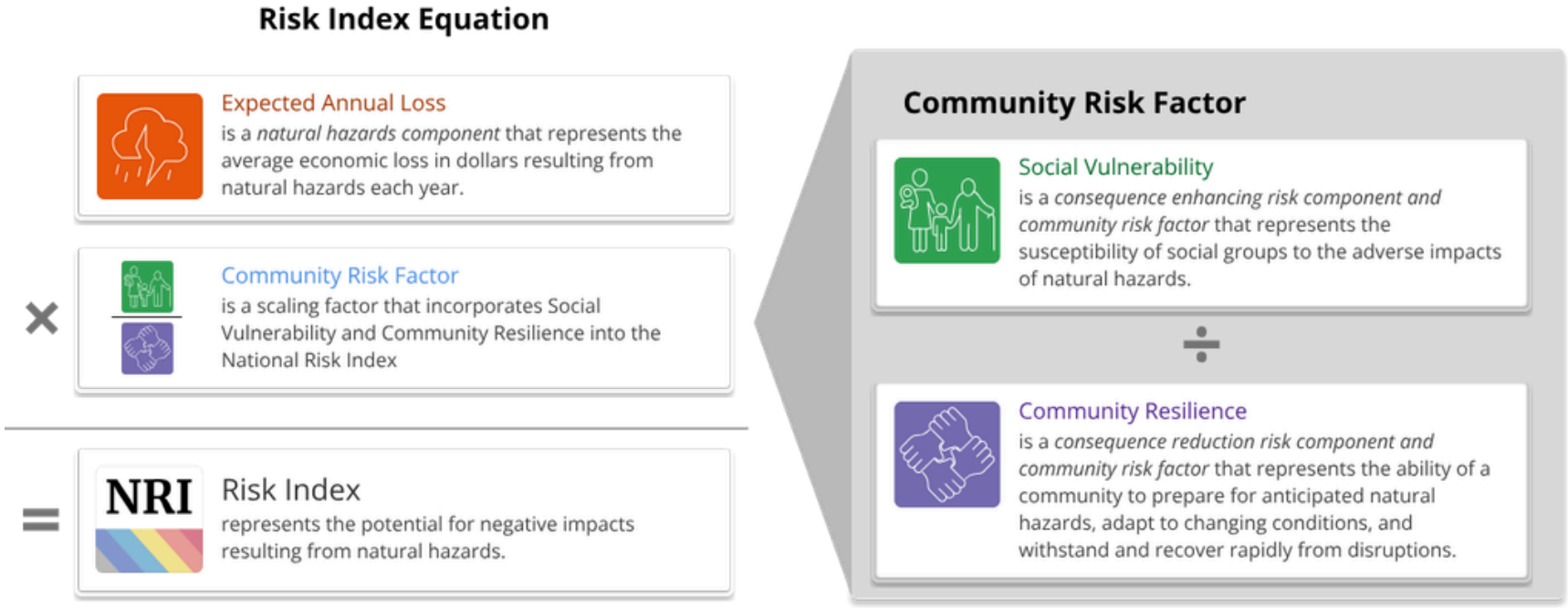
Risk Assessment Components

Likelihood Value

1	This event is not expected to occur within this county. (Never)
2	There is the potential for this event to occur, but it is very unlikely in this county.
3	This event could occur, but it generally does not happen with regular frequency in this county (natural/accidental hazards) and current intelligence does not indicate that it is an imminent threat (terrorism, etc.)
4	It is likely that this event will occur in this county based on historical precedents (natural/accidental) or current intelligence reporting (terrorism, etc.)
5	This event is expected to occur, without question, based on historical precedence in this county (natural/accidental hazards) or current intelligence reporting (terrorism, etc.). (Always)

Consequence Value

1	This event would cause virtually no impact on the people, responders, property and economy in this county.
2	The impact of this event would be minimal on the people, responders, property, and economy in this county; response could generally be done without mutual aid.
3	The impact of this event would be noticeable on the people, responders, property and economy in this county; mutual aid would likely be needed from other counties and/or the State.
4	The impact of this event would be very significant on the people, responders, property and economy in this county; significant mutual aid resources would be called in from surrounding counties, the State, and the Federal government.
5	This event would have a devastating (or potentially catastrophic) impact on the people, responders, property, and economy in this county; all mutual aid networks (local, State, and Federal) would be immediately utilized and government functions would severely or wholly be compromised.



via FEMA National Risk Index Overview Fact Sheet

State Hazard Mitigation Plan

MDEM also takes a quantitative, science-based approach when prioritizing hazards for the State Hazard Mitigation Plan (SHMP).[2] The SHMP serves as a roadmap for how Maryland prepares for and mitigates hazards and disruptions, and it is updated every five years in compliance with FEMA's State Mitigation Planning Policy Guide.[3] An approved SHMP is a condition of receiving certain FEMA Hazard Mitigation Assistance funding.

To inform the SHMP, MDEM utilizes the National Risk Index.[4] The National Risk Index is a dataset created by FEMA, which measures natural hazard and community risk factors for each U.S. county, territory, and Census tract. The National Risk Index's interactive map can be used to score risk indices, including community resilience, social vulnerability, and expected annual loss.[5] Risk Index scores are calculated using the equation below, and take into account composite scores for 18 hazard types, which were identified as the most prevalent hazards across state hazard mitigation plans.[6]

The 18 hazard types included in the National Risk Index are avalanche, coastal flooding, cold wave, drought, earthquake, hail, heat wave, hurricane, ice storm, landslide, lightning, riverine flooding, strong wind, tornado, tsunami, volcanic activity, wildfire, and winter weather.

Statewide Datasets

Finally, Maryland is a data-rich state with many datasets and predictive models that inform resilience planning. A few key examples are highlighted in the graphic to the right.

For a more exhaustive list of tools and datasets related to flooding in particular, please see **Appendix D: Flood Risk Assessment Tools.**

Maryland's Hazards & Climate Impacts

With information gleaned from the processes and datasets described above, MDEM's Risk Analysts, and other data sources, the Maryland Office of Resilience (MOR) identified several overarching hazards that affect all five sectors covered in this Strategy: Housing, Critical Infrastructure, Food Systems, Environment and Natural Systems, and Community and Local Government Capacity.

Several of these hazards would have consequences spanning across sectors, with both acute and statewide impacts.

As climate change causes extreme temperatures, stronger storms, and higher sea levels, disasters and climate change are increasingly linked.

The University of Maryland Center for Environmental Science (UMCES)

UMCES develops an updated report for Sea-Level Rise Projections for Maryland every five years.[7] The 2023 edition forecasted that the sea level will likely rise a foot between 2000 and 2050 along Maryland's shores. The report underscores that greenhouse gas emissions and our ability to reduce them will directly affect the pace and significance of sea level rise. These projections are utilized across a number of State programs.

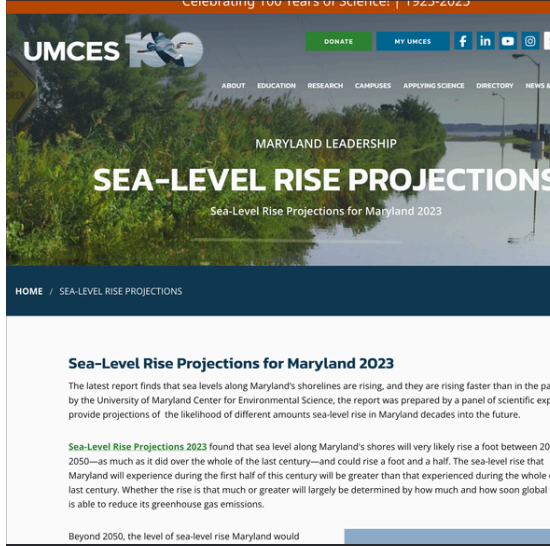
Maryland Department of the Environment (MDE)

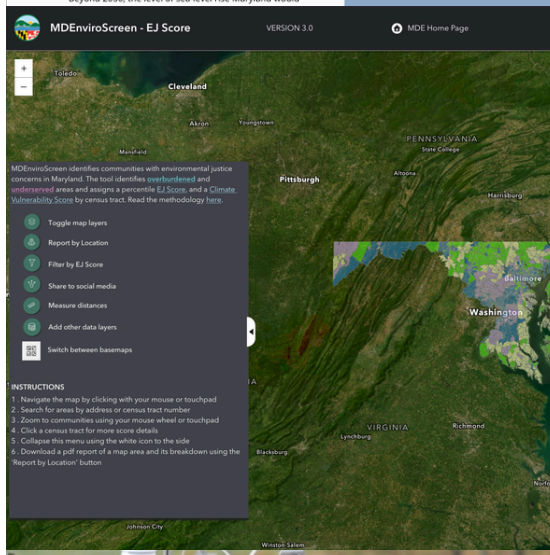
MDE's MDEnviroScreen tool provides data on pollution and population vulnerability to the effects of pollution.[8] Areas of Maryland receive an Environmental Justice (EJ) Score, an overall assessment of that region's environment and environmental justice indicators, such as pollution burden exposure, pollution burden environmental effects, and sensitive populations (including socioeconomic factors).

The tool also includes a "Climate Vulnerability Score" to help identify communities disproportionately affected by climate impacts in Maryland.

Maryland Mesonet

The University of Maryland and MDEM co-created Maryland Mesonet which utilizes a network of high-quality, closely spaced, rapid-sampling weather monitoring and data collection systems across the state to strengthen Maryland's emergency preparedness, accuracy of proximal weather forecasts, and expedite disaster assessment and recovery when needed.[9]





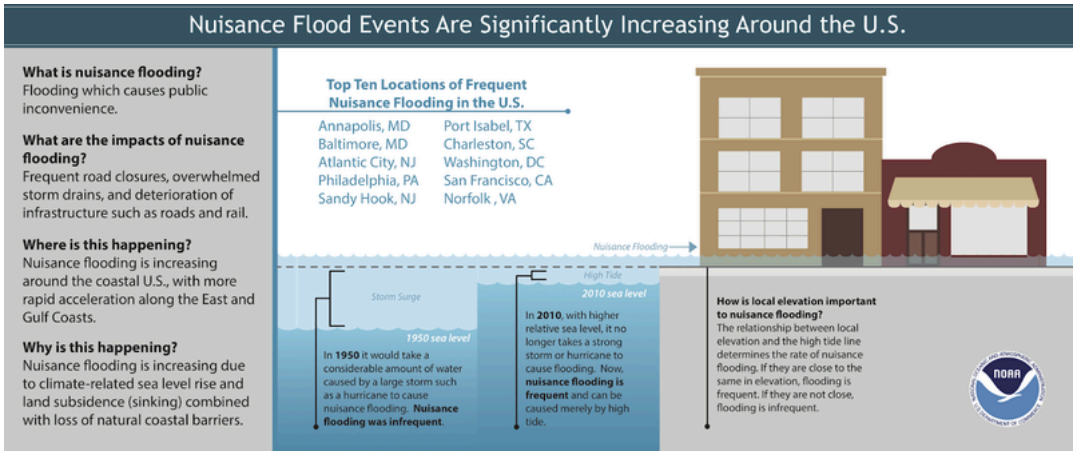
FLOODING

Flooding is Maryland's most widespread and persistent hazard, affecting the entire state from the mountainous western region all the way to the Atlantic coast. Floodwaters can disrupt transportation systems, damage agricultural and natural landscapes, degrade soil quality, and threaten homes, businesses, and public safety. In 2020, roughly 133,700 properties in Maryland faced a substantial risk of flooding.[10] Flooding affects approximately 15,000 lane miles of state-maintained roads.[11]

Maryland's flooding can take many forms: nuisance flooding that occurs in coastal areas during high tides, pluvial flooding that occurs when heavy rainfall overwhelms local stormwater systems, fluvial flooding along rivers and streams, and storm surge inundation caused by tropical systems.

Nearly 70% of Marylanders live in jurisdictions bordering the Chesapeake Bay and the Atlantic Coast, which are at increasing risk of nuisance flooding due to high tides, sea level rise, land subsidence, and storm surge.[12] As pictured in the graphic below, Annapolis and Baltimore are in the top ten locations of frequent nuisance flooding in the United States.[13]

But flooding does not just affect coastal communities. Maryland's creeks and streams are susceptible to flash flooding, and urban and suburban areas across the state can experience flooding when aging or insufficient stormwater systems - often just not built to withstand modern flash flooding severity - become overwhelmed. Ellicott City faced devastating flash floods in 2016 and 2018 with flood waters taking lives and wreaking havoc on homes and businesses. In May 2025, western Maryland experienced severe flooding with damages estimated at $33.7 million.[14]



via Florida Museum Thompson Earth Systems Institute

SEA LEVEL RISE

Sea levels are projected to rise between 1 and 1.5 feet from 2000 to 2050 in Maryland, causing coastal flooding to occur more frequently and extend further inland.[7] Maryland has 3,190 miles of shoreline, making sea level rise a significant hazard for residences, businesses, and critical infrastructure.[15] Sea level rise in Maryland is faster and more significant than the global average due to the compounding effects of subsidence, varying levels of sea surface height across the globe, and climate change.

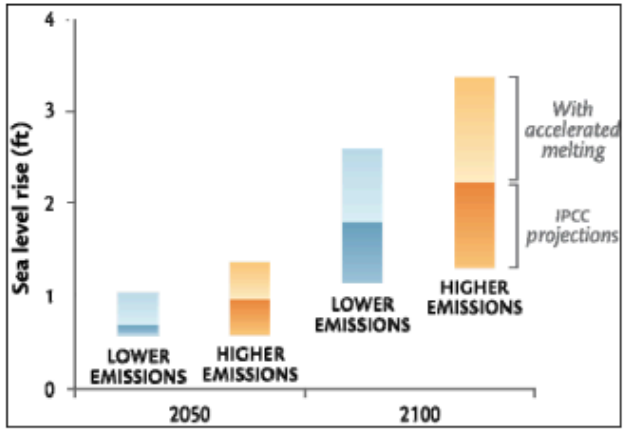


Figure 3: Sea level rise projections for the Chesapeake Bay based on greenhouse gas emission scenarios. By mid-century Maryland may experience up to 1.3 ft and, by the end of the century under accelerated melting relative sea-level may rise 2.7 ft under lower emission scenario to 3.4 ft under the higher emission scenario (MCCC, 2008).

via Maryland Department of Natural Resources Coastal Land Conservation in Maryland: Targeting Tools and Techniques for Sea Level Rise Adaptation and Response[16]

Figure 4: Rates of sea-level rise in Chesapeake and Delaware Bays region. Data are from tide gauges and the period of time they cover is in parentheses (MCCC, 2008).

As sea levels rise, saltwater intrusion threatens Maryland's farmland, much of which is clustered on the Eastern Shore. Maryland has lost more than 3,500 acres of farmland and 25,000 acres of forest to tidal marsh since 1984.[7] Certain species are particularly vulnerable to habitat loss from sea level rise, such as Loblolly Pines, which are turning into "ghost forests".[17] The loss of farmland and coastal forest on Maryland's Eastern Shore threatens the region's economy, communities, and ecological health.

Temperatures are steadily reaching new extremes, heightening concern for occupational and public safety, straining the power grid, and creating new challenges for natural and agricultural systems.[18] The Maryland Department of Health (MDH) has recorded a sharp increase in heat-related illness, hospitalizations, and deaths since 2020, with the greatest impact felt by vulnerable communities, including children and older adults.

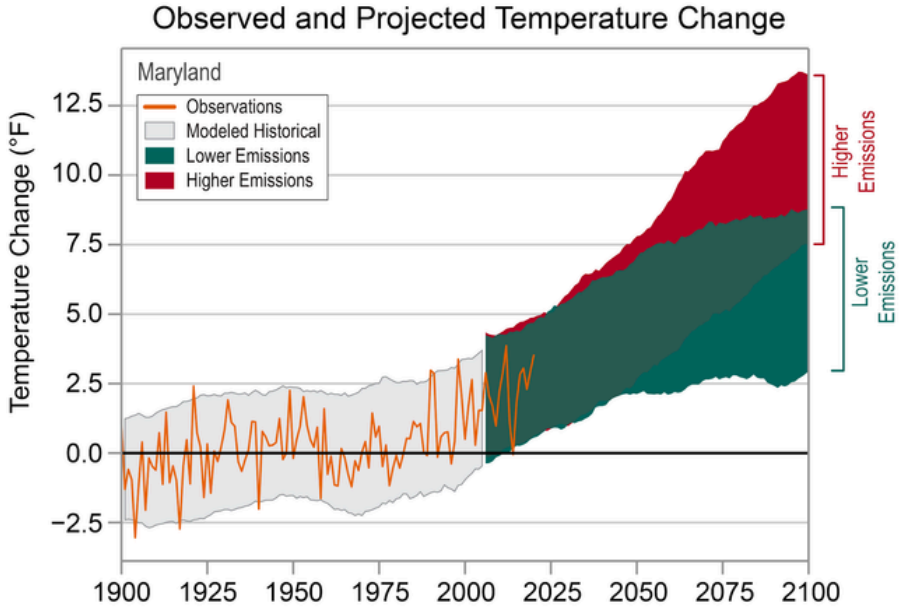
Historic Total Reported Heat-Related Deaths in Maryland (2020-2025)

2020 Deaths: 21 **2021 Deaths:** 18 **2022 Deaths:** 6 **2023 Deaths:** 9

2024 Deaths: 27 **2025 Deaths:** **34** *(as of last available data)*

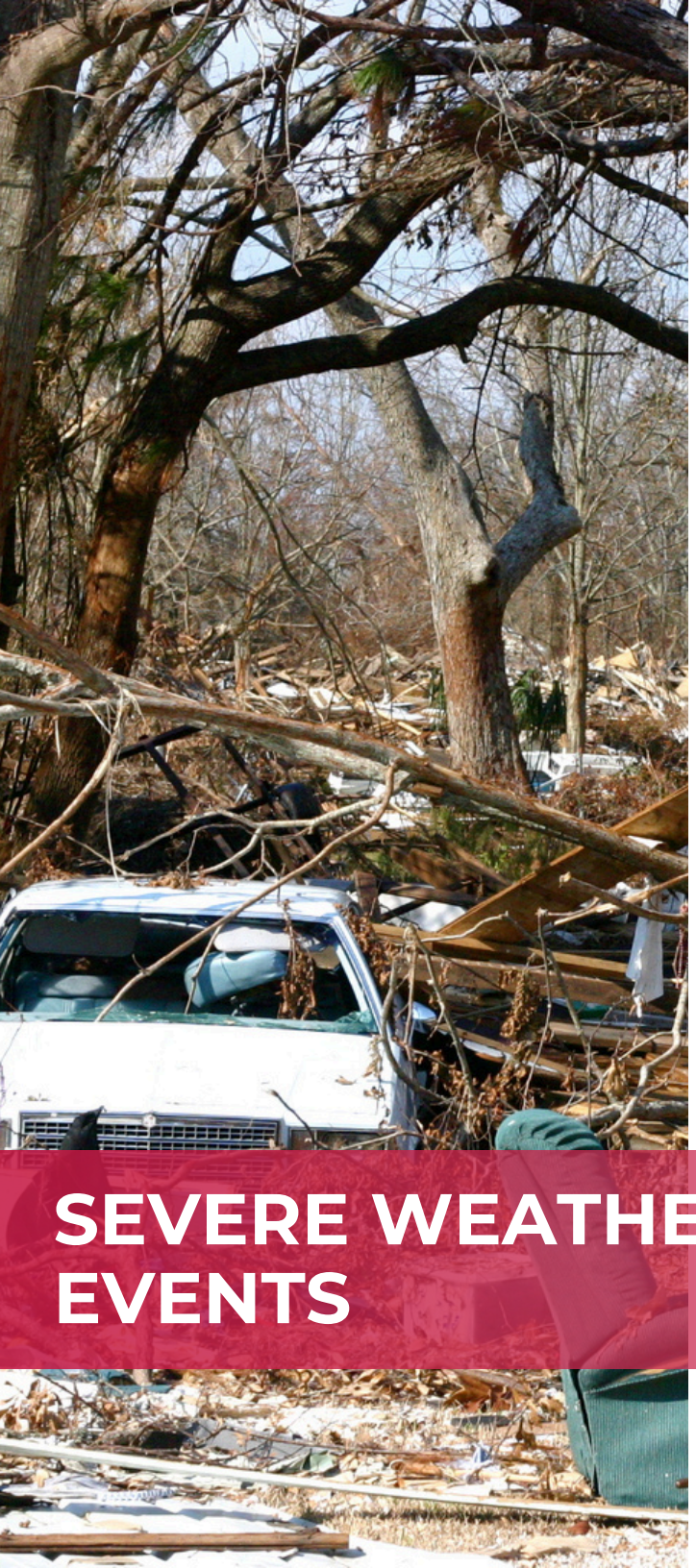
(Source: MDH Heat-Related Illness Surveillance Report)[19]

Rising temperatures have occurred in conjunction with increasing drought conditions in the state, and consequently, higher fire risk, diminished drinking water supplies, and reduced agricultural yields. Extreme cold and heat both impact ecological systems and natural aquatic and wildlife habitats in Maryland, especially around the Chesapeake Bay.



Observed and projected changes in air temperature for Maryland (NOAA State Climate Summaries: Maryland and District of Columbia)[20]

EXTREME TEMPERATURES



SEVERE WEATHER EVENTS

With climate change, severe weather events – hurricanes, tropical systems, tornadoes, and winter storms – are becoming more frequent. As observed in recent years, severe storms can have devastating impacts nationwide, causing rapid and unprecedented levels of damage. But these events are unpredictable by nature, often evolving with little time for preparation.

Hurricanes, Tropical Systems, and Storm Surge

The severity and impact of hurricanes and tropical systems can be difficult to predict, despite forecasting and emergency preparedness efforts. Coastal storms are less frequent but far more costly than inland storms, as they are more likely to involve flooding from heavy rainfall, storm surge, and strong winds.[21] Recent catastrophic weather events, like Hurricanes Helene and Milton, serve as reminders that hurricane preparedness and resilience efforts are critical.

Maryland has experienced numerous severe storms, including the following:

- **Hurricane Isabel:** Though Hurricane Isabel in 2003 did not bring significant rainfall to Maryland, an 8-foot storm surge was recorded on the Chesapeake Bay at Hooper's Island. 6-foot waves destroyed over 2,500 wharves and piers, the bridge to Saint George Island, and 20 homes on the coastline of St. Mary's County.[22] Many bayfront buildings and structures were damaged or destroyed, including those along Baltimore County's shoreline and in Baltimore City's Inner Harbor and Fells Point, as well as the boardwalk in Havre de Grace.

- **Hurricane Irene:** During Hurricane Irene in 2011, fallen trees damaged nearly 1,000 homes (primarily across southern Maryland), and 850,000 power outages were reported in Maryland and the District of Columbia.[23]

- **Hurricane Isaias:** In July 2023, Hurricane Isaias caused significant flooding and damage throughout Anne Arundel, St. Mary's, Charles, Harford, Montgomery, and Baltimore Counties, as well as Baltimore City.[24] Reports of downed trees and damaged power lines, homes, and buildings were widespread, with an estimated cost of $13.9M.[12]

Tornadoes and Wind

Maryland has a moderate risk of tornadoes and generally experiences several per year, leading to thousands or, often, millions of dollars in property damage each year. In general, high winds and tornadoes pose risks to Maryland's critical infrastructure, including transportation and electrical systems, as well as to residences and public safety.[25]

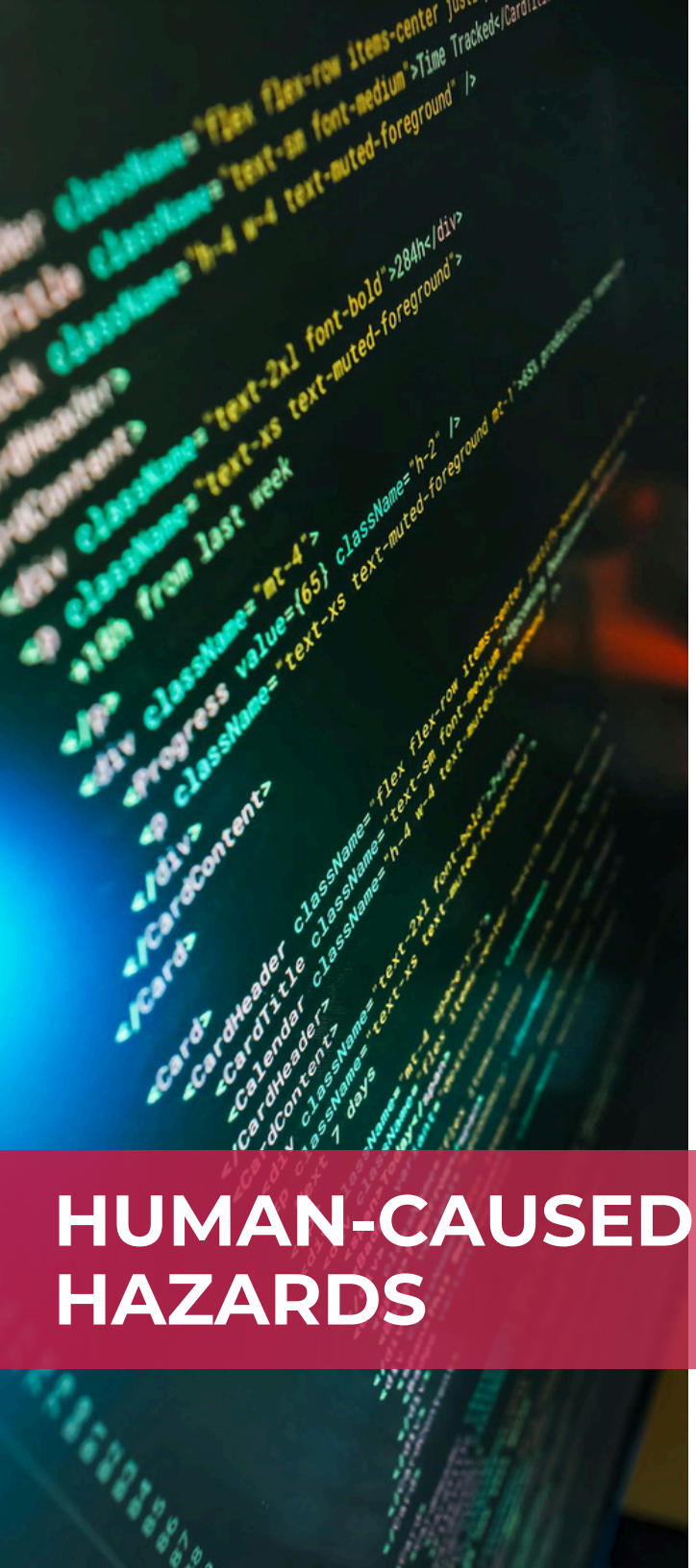
- On September 1, 2021, an EF2 tornado with wind speeds reaching 125 mph caused significant damage and destruction to homes and businesses in Anne Arundel County.[26,27]
- On June 5, 2024, thirteen tornadoes touched down in the Mid-Atlantic, nine of which occurred in Maryland. Marylanders grappled with significant tree damage, property damage, downed power lines, road closures, and personal injury as a result.[28]
- The Derecho that swept through Maryland on June 29, 2012 caused $19M in damages due to powerful winds and heavy rain, leading to a presidential major disaster declaration.[29] 9,200 power lines came down, leaving hundreds of thousands of Maryland residents and businesses without power across six jurisdictions.[30]
    - It took over eight days for power to be restored to all customers. Roadways were severely impacted by debris and intersections without power.[31] With temperatures in the upper 90s and low 100s during the days following the storm, health risks became especially pressing for Marylanders without access to electricity and air conditioning.

Winter Storms

Winter storms can also impact the State and cause disruptions. The 2016 Historic Nor'easter caused over 10,000 power outages, with snow accumulation exceeding two feet in the Baltimore metro area.[32,33] 2,398 flights at the three Washington, D.C. international airports were canceled during the height of the blizzard.

During this event, the Calvert Cliffs Clean Energy Center in Lusby, MD was forced to temporarily shut down some nuclear operations due to high winds and heavy snow accumulation.[34]

SEVERE WEATHER EVENTS



HUMAN-CAUSED HAZARDS

Human-caused hazards, whether resulting from human intent, negligence, or error, are a growing concern as new technologies emerge, supply chains become more complex, and political extremism permeates.

Cyber attacks are on the rise globally, and Maryland is no exception. As described throughout the strategy, Maryland has experienced cyber attacks on its local governments, healthcare system, and schools. These attacks can disrupt core constituent services and halt functions across key sectors. As one example, in August 2025, the Maryland Transit Authority (MTA) experienced a cybersecurity incident in which unauthorized users accessed MTA systems.[35]

Likewise, vulnerabilities in software programs like SharePoint have caused ripple effects across the public and private sectors.[36] Cyber attacks are evolving alongside new technologies, making cyber resilience essential. While Maryland is taking the initiative to shore up its cyber resilience and protect critical infrastructure, this remains a key area of concern.[37]

The supply chain and transportation systems are particularly vulnerable to human-caused hazards. In March 2024, a container ship struck and collapsed Baltimore City's Francis Scott Key Bridge, and killed six Marylanders. On January 29, 2025, a military helicopter collided with a passenger plane, American Airlines Flight 5342, 0.5 miles from Ronald Reagan Washington National Airport, killing two pilots, two flight attendants, sixty passengers, and three helicopter crew members. The FAA determined that the factors leading to this tragedy included understaffing of an air traffic control tower as well as multiple errors made by the helicopter's crew.[38]

Our government and social systems too are at risk. On November 1, 2025, funding for SNAP benefits nationwide lapsed due to the federal government shutdown, combined with the presidential decision not to fully fund the program using contingency funds. In response, Governor Moore, like many other state leaders, declared a State of Emergency and directed $72 million from state emergency funds to support emergency food assistance organizations and to partially backfill the SNAP program.[39,40] 680,000 Maryland SNAP participants were forced to grapple with new threats of food insecurity, and it took until November 18, 2025 for benefits to be fully restored after the shutdown ended.[41]

References - Executive Summary

1. *National Risk and Capability Assessment.* (2023, June 12). FEMA. https://www.fema.gov/emergency-managers/national-preparedness/goal/risk-capability-assessment

2. *Maryland State Hazard Mitigation Plan.* (2021). Maryland Department of Emergency Management. https://maryland-state-hazard-mitigation-plan-maryland.hub.arcgis.com/

3. *State Mitigation Planning Policy Guide.* (2025, May 19). FEMA. https://www.fema.gov/sites/default/files/documents/fema_hmd_state-mitigation-planning-policy-guide_05292025.pdf

4. *National Risk Index.* (n.d.). FEMA. https://hazards.fema.gov/nri/

5. *The National Risk Index Map.* (2025). [Map]. FEMA. https://hazards.fema.gov/nri/map

6. *National Risk Index Technical Documentation.* (2025, March). U.S. Department of Homeland Security FEMA. https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf

7. *Sea-Level Rise Projections.* (2023). University of Maryland Center for Environmental Science. https://www.umces.edu/sea-level-rise-projections

8. *MDEnviroScreen.* (2025, October). Maryland Department of the Environment. https://mde.maryland.gov/Environmental_Justice/Pages/MDEnviroScreen.aspx

9. *Maryland Mesonet.* (n.d.). University of Maryland - Maryland Mesonet. https://mesonet.umd.edu/

10. *The First National Flood Risk Assessment: Defining America's Growing Risk.* (2020). First Street Foundation. https://assets.firststreet.org/uploads/2020/06/first_street_foundation__first_national_flood_risk_assessment.pdf

11. Fuchs, M. (2021, May 25). New Study Reveals Impact of Flooding on Maryland's Transportation Infrastructure. *Pew.* https://www.pew.org/en/research-and-analysis/articles/2021/05/25/new-study-reveals-impact-of-flooding-on-marylands-transportation-infrastructure

12. *State of Maryland Nuisance Flood Plan Development Guidance 2024 Update.* (2024). DNR. https://dnr.maryland.gov/ccs/Documents/Final_Nuisance_Flood_Plan_Guidance_2024.pdf

13. Bauer, J. (2019, May 28). *Sea Level Rise Increases Frequency of High Tide Flooding*. Thompson Earth Systems Institute. https://www.floridamuseum.ufl.edu/earth-systems/blog/sea-level-rise-increases-frequency-of-high-tide-flooding/

14. Governor Moore Appeals Western Maryland Disaster Declaration Denial. (2025, August 19). *MDEM*. https://news.maryland.gov/mdem/2025/08/19/governor-moore-appeals-western-maryland-disaster-declaration-denial/

15. Boesch, D. F., Baecher, G. B., Boicourt, W. C., Cullather, R. I., Dangendorf, S., Henderson, G. R., Kilbourne, H.H., Kirwan, M. L., Kopp, R. E., Land, S., Li, M., McClure., K., Nardin, W., & Sweet, W. V. (2023). *Sea-Level Rise Projections for Maryland 2023*. UMCES. https://www.umces.edu/sites/default/files/Maryland%20Sea-Level%20Rise%20Projections%202023%20report_0.pdf

16. Papiez, C. (2012). *Coastal Land Conservation in Maryland: Targeting Tools and Techniques for Sea Level Rise Adaptation and Response*. https://dnr.maryland.gov/ccs/documents/coastalland_conserv_md.pdf

17. *Ghost Forests Haunt Atlantic Coast*. (2022, October 31). [USDA Forest Service: Inside the FS.] https://www.fs.usda.gov/inside-fs/delivering-mission/sustain/ghost-forests-haunt-atlantic-coast

18. *Heat Stress - MOSH*. (2024). Maryland Department of Labor. https://labor.maryland.gov/labor/mosh/moshheatstress.shtml

19. *Reports: Heat*. (n.d.). MDH. https://health.maryland.gov/preparedness/Pages/Reports_Heat.aspx

20. *Maryland and District of Columbia*. (2022). NCICS. https://statesummaries.ncics.org/chapter/md/

21. *Expected Costs of Damage From Hurricane Winds and Storm-Related Flooding*. (2019, April). Congressional Budget Office. https://www.cbo.gov/system/files/2019-04/55019-ExpectedCostsFromWindStorm.pdf

22. *Flooding in Maryland*. (n.d.). National Weather Service. https://www.weather.gov/safety/flood-states-md

23. *Hurricane Irene*. (n.d.). National Weather Service. https://www.weather.gov/lwx/events_20110827_irene

24. *Tropical Storm Isaias Impacts: August 4th, 2020*. (n.d.). National Weather Service https://www.weather.gov/lwx/TropicalStormIsaias

25.*Tornadoes* (n.d.). MDReady. https://mdready.maryland.gov/know-the-threats/Pages/tornadoes.aspx

26. *Tornadoes* (n.d.). Annapolis Maryland https://annapolis.gov/325/Tornadoes

27. Some Annapolis Businesses Damaged or Destroyed by Tornado Last Year Aren't Coming Back (2022, September 1). *WBALTV*. https://www.wbaltv.com/article/annapolis-tornado-2021-businesses-arent-coming-back/41054352

28. *Public Information Statement - June 05 2024 Tornado Outbreak*. (n.d.). National Weather Service. https://www.weather.gov/lwx/June052024Tornado

29. Brown, M. H. (2012, August 2). Obama Declares Major Disaster in Md. for Derecho. *The Baltimore Sun*. https://www.baltimoresun.com/2012/08/02/obama-declares-major-disaster-in-md-for-derecho/

30. *A Look Back On the 9 Year Anniversary of Maryland's Derecho Storm* (2021, June 29). CBS Baltimore. https://www.cbsnews.com/baltimore/news/a-look-back-on-the-9-year-anniversary-of-marylands-derecho-storm/

31. *Governor O'Malley Seeks Federal Disaster Aid in Wake of Derecho Storms of June 29-30* (2012, July 30). Maryland Department of Emergency Management. https://news.maryland.gov/mdem/2012/07/30/governor-omalley-seeks-federal-disaster-aid-in-wake-of-derecho-storms-of-june-29-30/

32. *The Historic Nor'easter of January 2016.* (2016). NOAA. https://www.weather.gov/media/publications/assessments/16Northeast_Blizzard.pdf

33. Ng, G. (2023, January 23). Archives: Remembering the Blizzard of 2016 in Maryland. *WBALTV*. https://www.wbaltv.com/article/blizzard-of-2016-baltimore-maryland-weather-snow-archive-video/42568718

34. *Calvert Cliffs Clean Energy Center.* (n.d.). Constellation. https://www.constellationenergy.com/our-company/locations/location-sites/calvert-cliffs-clean-energy-center.html

35. *Impacts From Cybersecurity Incident.* (2025, December 3) Maryland Department of Transportation - Maryland Transit Administration. https://www.mta.maryland.gov/cybersecurity-incident

36. *Update: Microsoft Releases Guidance on Exploitation of SharePoint Vulnerabilities.* (2025, August 6). CISA. https://www.cisa.gov/news-events/alerts/2025/07/20/update-microsoft-releases-guidance-exploitation-sharepoint-vulnerabilities

37. Department of the Environment - Community Water and Sewerage Systems - Cybersecurity Planning and Assessments, No. SB0871 (2025). https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/SB0871?ys=2025RS

38. Kelly, K., & Walker, M. (2025, December 1). Missteps, Equipment Problems and a Common but Risky Practice Led to a Fatal Crash. New York Times. https://www.nytimes.com/2025/04/27/business/dc-plane-crash-reagan-airport.html#:~:text=The%20New%20York%20Times%20examined,the%20helicopter%20was%20turned%20off

39. Moore, W. (2025). *Executive Order 01.01.2025.20 Declaration of a State of Emergency.* The State of Maryland Executive Department. https://governor.maryland.gov/Lists/ExecutiveOrders/Attachments/92/EO%2001.01.2025.20%20Declaration%20of%20a%20State%20of%20Emergency_Accessible.pdf

40. *Governor Moore Declares State of Emergency to Address Economic Impacts of Federal Government Shutdown and Distribute $10 Million in Emergency Funding to Fight Food Insecurity.* (2025, October 31). The Office of Governor Wes Moore. https://governor.maryland.gov/news/press/pages/ICYMI-Governor-Moore-Declares-State-of-Emergency-to-Address-Economic-Impacts-of-Federal-Government-Shutdown-and-Distribute-.aspx

41. Price, L. (2025, November 18). *Customers Will Still Receive Help Before Regular Benefits Resume Thanks to Governor Moore's Emergency Order.* Maryland Department of Human Services. https://news.dhs.maryland.gov/reports/that/maryland-snap-benefits-resume-100-november-18/

** End of Chapter References **