



Maryland
Department of
the Environment

**Advancing Stormwater Resiliency in Maryland
(A-StoRM)
Maryland's Stormwater Management Climate
Change Action Plan**

FY 2021 Data

Prepared for:

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Background

Urban and riverine flooding is a growing issue in Maryland. The increasing number of extreme rainfall events that produce intense precipitation will continue to lead to more urban and riverine flooding events unless steps are taken to mitigate their impacts. The 2017 National Climate Assessment indicates that “heavy downpours are increasing nationally, especially over the last three to five decades. The largest increases are in the Midwest and Northeast. Increases in the frequency and intensity of extreme precipitation events are projected for all U.S. regions”¹. The University of Maryland’s Center for Disaster Resilience has characterized urban flooding as a “significant source of economic loss, social disruption, and housing inequality.”² The torrential downpours that Maryland recently experienced with Hurricane Ida overwhelmed drainage systems that flooded many roads, businesses, and homes, causing property damage and death. The even more severe impacts that were experienced in New York and New Jersey illustrate the growing public safety risk associated with extreme precipitation events.

Maryland worked to address these flooding issues in 2020 by updating Maryland’s stormwater management law, signed by Governor Hogan, that became effective on June 1, 2021. The state’s Stormwater Management Law, Environment Article 4-201.1, now requires the Maryland Department of the Environment (MDE) to report on the most recent precipitation data available, investigate flooding events since 2000, and update Maryland’s stormwater quantity management standards for flood control. A report on MDE’s plans to update stormwater quantity standards is due to the Maryland General Assembly by November 1, 2021, and thereafter, on updates to the stormwater management regulations and other regulations adopted pursuant to this statute.

The statute requires MDE to consult on the impact of any proposed regulations, at least six months prior to adoption, with the following stakeholders:

- The Commission on Environmental Justice; and
- Stakeholders with expertise on stormwater design standards and climate science, including stakeholders from:
 - An academic institution
 - The Chesapeake Bay Program
 - The Chesapeake Bay Commission
 - The Maryland Department of Emergency Management
 - The Maryland Association of Soil Conservation Districts
 - Local Government
 - A private sector entity with design and construction experience
 - An association that has expertise in stormwater restoration projects

¹ USGCRP, 2017: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp, doi: 10.7930/J0J964J6.

² University of Maryland, Center for Disaster Resilience, and Texas A&M University, Galveston Campus, Center for Texas Beaches and Shores. *The Growing Threat of Urban Flooding: A National Challenge*. 2018. College Park: A. James Clark School of Engineering.

Precipitation Data Available

MDE is to report on the most recent precipitation data available, defined in the statute as “historical data that describes the relationship between precipitation, intensity, duration, and return period (frequency).” Known as intensity-duration-frequency (IDF) curves, this data is used in various hydrologic models to predict runoff rates and quantities. This information is the basis for both stormwater quality and quantity management design standards. The following are the most recent statewide precipitation data available:

- 2006 National Oceanic and Atmospheric Administration (NOAA) Atlas 14, *Precipitation-Frequency Atlas of the United States, Volume 2*,³ includes record data through December 2000;
- In early 2021, Maryland Department of Transportation (MDOT), along with the states of Delaware, Virginia, and North Carolina agreed to fund an update to the 2006 NOAA Atlas 14 precipitation data. This work, which began in federal fiscal year 2022, is expected to be completed within three years and will include future rainfall predictions;
- In May 2021, a consortium of universities and the RAND Corporation published forecasted precipitation information using two air emissions scenarios (RCP 4.5 and RCP 8.5), and two time periods (i.e., 2020-2070 and 2050-2100). The forecasted precipitation data can be found at midatlantic-idf.rcc-acis.org/.

The 2006 Atlas 14 precipitation data and the RAND Corporation climate projections incorporate regional atmospheric and topographic variability. Both are available for a number of locations across the state. Table 1 provides, for one location in Maryland, an example of the comparison of precipitation information between the 2006 Atlas 14, and the RAND Corporation’s projections due to climate change.

Table 1: Atlas 14 and RAND forecasted precipitation information at United States Naval Academy (24 hour event)

United States Naval Academy Rainfall Station					
Probability of Occurrence in Any Given Year	Atlas 14 Precipitation (inches)	Projected precipitation using RCP 8.5			
		Planning Horizon 2020 to 2070		Planning Horizon 2050 to 2100	
		Projected (inches)	% change from Atlas 14	Projected (inches)	% change from Atlas 14
50%	3.23	3.49	8.0%	3.71	14.9%
10%	5.02	5.37	7.0%	5.72	13.9%
1%	8.66	9.61	11.0%	10.31	19.1%

³ NOAA Atlas 14, *Precipitation-Frequency Atlas of the United States, Volume 2*. Version 3.0. Geoffrey M. Bonin et.al, 2006.

MDE’s Plans for Updating Stormwater Quantity Control Standards for Watersheds

Defining a flooding event

The first step in developing a plan to update stormwater quantity control standards for watersheds, where flooding events have occurred, is to define flooding event:

- The Federal Emergency Management Agency (FEMA) defines flooding as “...[a] general and temporary condition of partial or complete inundation of 2 or more areas of normally dry land area or of 2 or more properties.”
- COMAR 26.17.02.02 defines “Extreme flood volume” as the storage volume required to control those infrequent, but large storm events in which overbank flows reach or exceed the boundaries of the 100-year floodplain.
- Prince George’s County defines urban flooding as “...the inundation of property in a built environment, particularly in more densely populated areas, caused by rain falling on increased amounts of impervious surfaces and overwhelming the capacity of drainage systems.”⁴

MDE plans to work with local jurisdictions to more consistently define flooding events as used in the statute.

Identifying watersheds where flooding events occurred on or after January 1, 2000

MDE will work with local jurisdictions, the Maryland Departments of Emergency Management, Planning (MDP), Natural Resources (DNR), and MDOT along with other state agencies, to gather existing flood event data.

MDE has applied for a grant from the U.S. Environmental Protection Agency to identify and map all known flood events that have occurred since January 2000. Additionally, MDE will use this funding to collect information to help characterize local stormwater quantity management requirements for flooding; on stormwater infrastructure best management practices and conveyance systems such as size, capacity, age, and location; and existing watershed studies. Future federal grants will be sought after by MDE for the development of a web-based information management system to be integrated with the Maryland Resiliency Partnership (md-resiliency-partnership-maryland.hub.arcgis.com).

Updating stormwater quantity management standards for flood control

MDE recognizes that communities are safer when built to withstand larger and more intense amounts of precipitation. Therefore, MDE may consider regulatory changes to include the use of the most recent Atlas 14 precipitation estimates in the Stormwater Design Manual.

⁴ Drainage and Flooding in Prince George’s County. Presentation by Prince George’s County DPIE, DPW and DER. (2021)

Extrapolating the RAND Corporation projections to the 1-year rainfall event, MDE has estimated about an 11% increase in Maryland's 1-year storm, from 2.7 to 3 inches of rainfall. Using this estimate, MDE may propose an increase in the implementation of "green infrastructure," known as environmental site design (ESD) to the maximum extent practicable (MEP), for the 1-year rainfall event.

MDE may update the stormwater regulations to explicitly require peak flow management for the 2-year and 10-year storms in watersheds where flooding events have occurred since 2000. For addressing climate change, MDE intends to investigate the best methods for implementing additional stormwater quantity management based on estimated future precipitation trends. For example, MDE is considering updating the regulations to require peak flow management for the 25-year storm in watersheds where flooding events have occurred.

MDE will investigate proposing regulatory standards that would require the safe conveyance of the 100-year storm in watersheds where flooding events have occurred since 2000. This supports the statutory language requiring the department to "...[i]mplement quantity control strategies to prevent increases in the frequency and magnitude of out-of-bank flooding from large, less frequent storm events," and also expands the focus of the 100-year storm beyond the currently regulated interjurisdictional watersheds.

Finally, MDE could update stormwater regulations to require that local jurisdictions and state and federal agencies develop watershed studies, pursuant to COMAR 26.17.02..05.E, for areas with flooding events since 2000. The updated regulations will require local jurisdictions, state, and federal agencies to use these watershed studies to implement watershed-specific flood management plans that shall include:

- Stormwater quantity management requirements for new development;
- Accounting for the cumulative watershed impacts of past and future land development; and
- Upgrading existing stormwater practices and conveyance systems.

MDE's Plans for Updating other Regulations Adopted under this Statute

MDE recognizes that preventing and mitigating the impact of flood events requires more than just managing stormwater peak discharge rates. MDE may use its authority pursuant to the Flood Hazard Management Act of 1976 (Environment Article, Title 5, Section 8; or Act) to require comprehensive watershed management studies and flood control plans. The Act required MDE to designate a priority list of watersheds by 1982 for watershed studies that were to:

- Define the existing magnitude and frequency of flood events, including at least the 100-year flood event;
- Define the magnitude and frequency of flood events based on planned development; and
- Identify alternative management techniques according to their effectiveness in controlling floods and minimizing flood damage.

The Act required that by 1990, each jurisdiction shall prepare flood management plans based upon these watershed studies that may include:

- Flood control dams;
- Levees and dikes;
- Stormwater detention or retention structures;
- Public acquisition;
- Flood proofing;
- Storm drain and stream maintenance;
- Tax adjustment policies;
- Subdivision, zoning, and related ordinances;
- Other practical methods; and
- Management techniques shall include flood warning systems.

MDE has chronicled 27 local flood management plans, with the most recent plan completed in 1995. MDE is recommending that these plans be updated to include current and future land use and precipitation data. New watersheds, including those with flooding events since 2000, should be identified and prioritized by MDE for watershed studies. These studies and plans can provide proactive solutions for significantly reducing the risk of a changing climate in vulnerable communities.

Financial resources, including grants, will likely be needed for local jurisdictions and state and federal agencies to update and generate new studies and plans. The Comprehensive Flood Management Grant Program (CFMGP), established under the Act, is a potential funding source for these studies and plans, and the MDE proposes to require that a portion of the CFMGP go toward watershed studies. Once these studies and plans are approved by MDE, the CFMGP may award need-based funds to local jurisdictions for capital improvement projects, including infrastructure repairs, watershed restoration and emergency protection measures.

These watershed studies and flood management plans can be used to leverage over \$1 billion through FEMA's Building Resilient Infrastructure and Communities program, which provides financial support to states and local communities as they undertake hazard mitigation projects that reduce the risks they face from disasters and natural hazards, including flooding.

Financial Considerations

This report proposes a comprehensive planning approach to preventing flooding before it occurs and minimizing its impacts where it cannot be prevented. There will be impacts to state, local government, and small business finances. However, dollars spent on comprehensive planning, development of management plans, and requirements for additional quantity management will result in overall savings from the reduction of flooding impacts. As noted by the National Institute of Building Sciences, federal grants and public-sector investment in flood mitigation since 1995 by FEMA, the U.S. Economic Development Administration, and the U.S. Department of Housing and Urban Development cost the country \$27 billion, but will ultimately save \$160 billion, meaning \$6 saved from disaster relief per \$1 invested in planning. Certain Maryland localities could expect to see a similar cost-benefit result.

Stormwater management designs that manage larger flows and more storage volume in general cost more. The increased cost is usually from an opportunity cost with the use of additional land required to manage stormwater runoff onsite, the cost of more materials and time to build more robust structures, and the cost associated with a more comprehensive (upstream and downstream) engineering analysis.

The Fiscal and Policy Note for SB 227 identified that additional resources will be necessary to complete the requirements under this bill. Grant funding is being pursued for some of the work.

Proposed Actions and Schedule

1. Phase 1: Immediately (now through June 2022)

- a. Work with local jurisdictions to more consistently define a flooding event as used in statute.
- b. Consider regulatory changes to include the use of the most recent NOAA Atlas 14 precipitation estimates in Maryland's Stormwater Design Manual.
- c. Develop draft updates to Maryland's stormwater design standards for ESD to MEP to capture increased stormwater runoff volume (e.g., 3.0 inches for the 1-year rainfall event) for new development and redevelopment based upon future climate projections.
- d. Continue working with local governments and other state agencies to identify and document, in a publicly accessible format, frequently flooded areas post-2000 and locally required stormwater quantity management.
- e. Develop draft stormwater regulations that require local jurisdictions and state and federal agencies to generate comprehensive watershed studies (if funding exists) for all known flood event watersheds. The draft regulations will require local jurisdictions and state and federal agencies to use the watershed studies to develop watershed-specific flood management plans.
- f. Update CFMGP to set aside a portion of existing funding to support comprehensive watershed studies and related model development.
- g. Create a stakeholder advisory group for consultation on the proposed regulations that includes a representative from each of the following advisory groups:
 - Chesapeake Bay Program Office
 - Chesapeake Bay Commission
 - Maryland Department of Emergency Management
 - Maryland Association of Soil Conservation Districts
 - Maryland Association of Counties
 - Maryland Municipal League
 - Maryland Building Industry Association
 - Maryland Climate Change Commission

- Commission on Environmental Justice
- Private sector entity with design and construction experience
- Association that has expertise in stormwater restoration projects

2. Phase 2: Near-Term (before November 2022)

- a. Work with the stakeholder advisory groups to provide expert advice on the development and implementation of revised stormwater quantity management regulations that factor in climate change, including more frequent and intense storms, future precipitation projections, and also consider comprehensive watershed management studies.
- b. Collaborate with MDP and DNR to update Maryland's Water Resources Element guidance to incorporate the results of the comprehensive watershed studies when planning for growth and development.

3. Phase 3: Longer-Term (early 2023)

- a. Formally adopt new regulations for stormwater management.
- b. Integrate comprehensive watershed studies and model development into local growth and development planning process.
- c. Continue to work with local governments, stakeholders, and the public to identify, document, and implement comprehensive solutions to flood prone areas.