## RESILIENCY AND WATER RESOURCES MANAGEMENT

# WATER SUPPLY IN A CHANGING CLIMATE

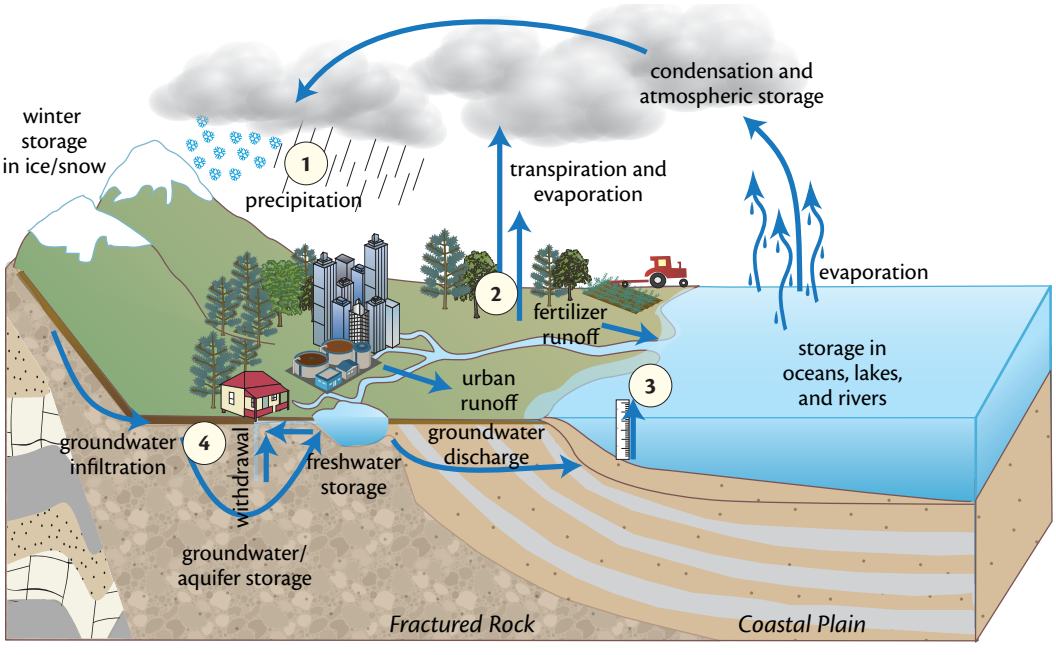
Maryland citizens are blessed with an abundant supply of water. However, many water systems are already stressed during droughts, and infrastructure damage and water contamination occurs during floods. Future population growth will combine with increasingly variable weather patterns to place more communities at risk of property damage, regulatory liabilities and uncertain access to drinking water. Maryland's Eastern Shore is particularly susceptible to salt water intrusion as water demand increases and sea levels rise. Aquifers in central and western Maryland are being stressed due to population growth; short-term storage capacities and contamination from road salt are two issues of significant concern.

## Why Adapt?

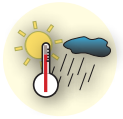
In Maryland, climate models predict more rain in the winter and spring and less in the summer, likely to result in both more flooding and more water shortages.[1] In the past 30 years, Maryland's climate has become wetter and hotter, resulting in more runoff and longer heat waves. August and September of 2011 were the wettest the state has seen in 117 years.[2] July of 2010, 2011 and 2012 were the hottest on record across much of Maryland and 2010 had the highest number of days over 90 degrees (59). In the fall of 2011, Hurricane Irene set new water level records at stream gages in some parts of Maryland. Below a major dam (Conowingo) in Maryland, flooding in 2011 was the highest it has been since the dam was built.[3] Tens of thousands of gallons of sewage spilled into Baltimore streams during these storms. Increasing temperatures associated with climate change will make these events more common as warmer air traps more moisture, leading to more intense rainfall events.

## Who Should Adapt?

A changing climate will mean we all have to plan for more uncertainty. Marylanders should consider the impacts of rising temperatures, more rain in the fall and winter and less in the summer, and more extreme events, on their livelihoods. Some of the changes will be positive, such as more growing days, while others negative, such as more flooding and associated impacts on infrastructure, buildings, and public health. ***Local governments*** should assess the performance of engineering designs, comprehensive plans, water and sewer plans, and hazard mitigation plans in light of climate change. ***Businesses*** should consider projected changes in climate on their product supply chain and operations, areas that could be affected by both local and global impacts of climate change. ***Individuals and community organizations*** should implement and advocate for improved sustainability measures and protection of their homes and ecosystems. Those communities that prepare now for expected changes will be better prepared to cope with the variable effects of climate change.




### Climate change impacts



1. Increased frequency and variability of extreme rain may lead to flooding, surface runoff, and high energy flows, impacting water quality, stormwater infrastructure, and water and wastewater treatment infrastructure.
2. Increased likelihood of summer drought may affect stream ecosystems, lead to increased demand for irrigation, and result in water shortages.
3. Saline intrusion of freshwater resources may occur as a result of the combined effects of sea level rise and storm surge, and as a result of increased rates of groundwater withdrawal.
4. Increased withdrawal due to drought may reduce groundwater supplies.

# IMPENDING RISKS TO WATER SUPPLY

## Flooding

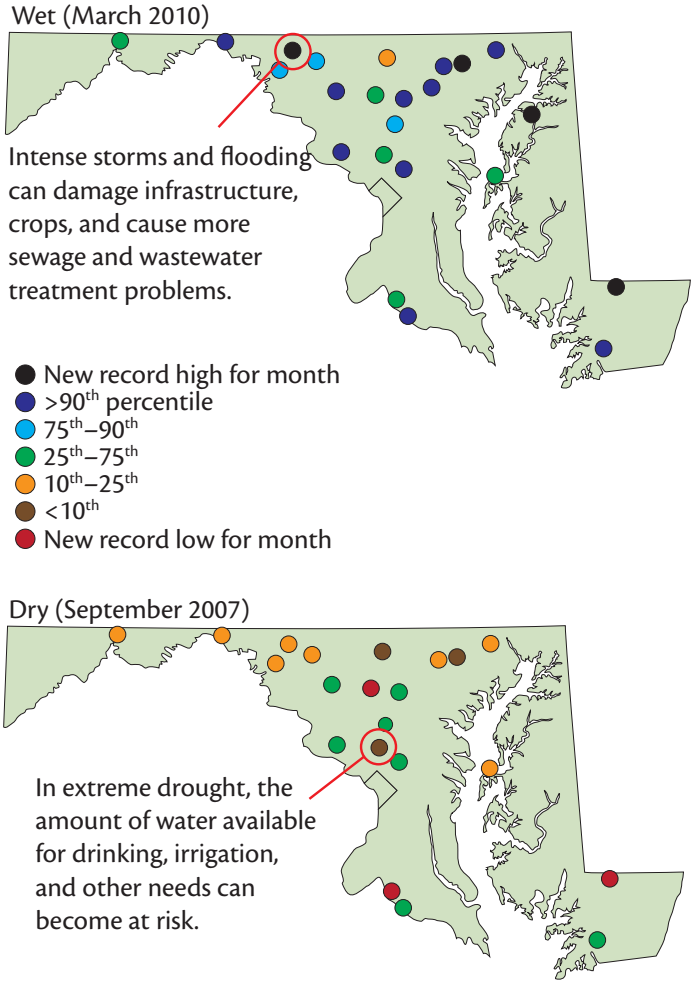
- Intense storms and high temperatures will be the norm and will require planning now. 100-year floods are expected to increase by as much as 10-20%, 10-year storms by 16-30%,[1] and annual streamflows by as much as 50%.[4]
- A likely increase in the frequency and intensity of flooding and stormwater flows will significantly impact Maryland's urban and rural areas, damaging roads, pipes, buildings, water and wastewater treatment facilities, crops, and ecosystems. Urban and developing areas will be particularly vulnerable.
- More intense storms and floods will place water and transportation infrastructure at risk, including dams, treatment plants, and culverts.

## Water quality

- Existing and future impervious surfaces will amplify the impacts of more intense storms. In communities with combined sewer and stormwater systems, more rain will allow pollutants such as salt, pathogens, petroleum and other chemical products to enter the water supply.
- Heavy rainfall was the primary cause of 3.3 billion gallons of sewage pouring into local streams and waterways in Maryland between 2005 and 2011.[5]
- More intense storms and higher precipitation, already seen during the past several years, will increase the likelihood of these overflows, threatening recreation, human health, drinking water supplies, fisheries, and regulatory compliance.
- Reducing risks to these events now will allow communities to be better prepared, save money on upgrades in the future, and ensure a better quality of life for citizens.
- Higher runoff from more intense storms may add more carbon, nutrients, and sediment to source waters, making treatment more costly and difficult, and placing private well owners at risk of contamination.

## Water supply

- Rainfall is unlikely to replace groundwater in sufficient quantities to compensate for the high demands of a hot, dry summer. Increased water demand for irrigation, especially in the agricultural sector, will become a fact of life as the population grows.
- Additional withdrawals may increase competition for water and the risk of saltwater intrusion in the Coastal Plain. The State can expect heightened emergency restrictions enacted regionally or at the county level if water supplies are not appropriately managed to address projected demand increases and climate impacts.




*Climate change will place drinking water supplies and water available for irrigation, industry, and energy supply at risk.*

USGS

Mary-Clare McNatt

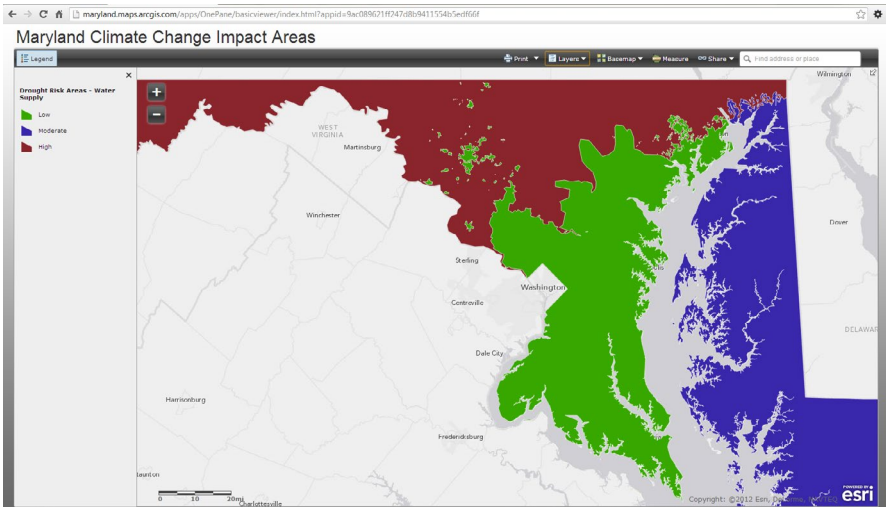
*A moderate to severe drought in Maryland in 2012 caused wetland and agriculture crop damage.*

# WE MUST TAKE ACTION NOW TO PREPARE FOR THE IMPACTS OF A CHANGING CLIMATE

## Adaptation Toolbox: Climate Change Impact Area Mapper

The Climate Change Impact Area Mapper is an online tool provided by the Maryland Department of Natural Resources for management decision-making, planning, and education purposes. The Climate Change Impact Area Mapper brings together multiple data layers from different sources to illustrate land areas in Maryland that are projected to be the most sensitive to anticipated changes in climate. The layers include areas vulnerable to sea level rise, storm surge, flooding, drought, and rising temperatures.

**http://bit.ly/UIX4Hw**




*The Climate Change Impact Mapper includes several different layers related to Water Supply. Drought hazard risk is divided into low, moderate, and high risk areas.*

## Adaptation strategies:

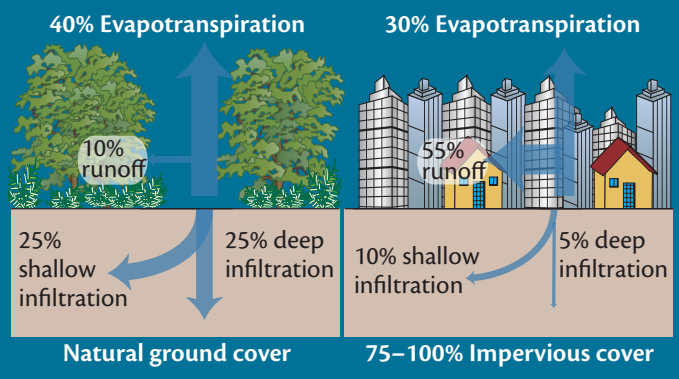
Human consumption, agricultural irrigation practices, and natural resources all impact the water supply in your area. For example, enhancing and protecting riparian buffers and groundwater recharge zones will sustain underground aquifers needed for drinking water consumption. Planting heat-, disease-, and drought-tolerant cultivars, and longer or earlier maturing cultivars will help farmers reduce the amount of water needed to irrigate their lands. Citizens should be aware of water restrictions in their area, especially during the summer when drought can occur. The Maryland Department of the Environment website posts current drought conditions and any water restrictions, when in effect. These types of adaptation strategies will save water, reduce flooding, and enhance natural environments.

WikiCommons

*Planting rain gardens helps water percolate into the ground, rather than running into local streams. Credit: Wikimedia Commons.*

**Controlling stormwater will protect water supplies**

Stormwater is defined as the water that runs off impervious surfaces, such as parking lots and buildings, when it rains or when snow melts. Stormwater is a problem because it carries pollution to local waterways, but also because it affects the intensity of flooding and the delivery of water from the land to local waters. As the diagram below depicts, the more impervious surface there is, the more water is transported into local waters. A better strategy is to plant natural ground cover, such as gardens and trees, which will help the water infiltrate into the ground or evaporate back into the atmosphere. This is a much more balanced water system, when there is more natural ground cover.




*Removing a small percentage of paved surfaces can have a drastic impacts on stormwater runoff. Source: U.S. EPA.*

## PLANNING GUIDELINES

A changing climate will affect the water supply across the state and requires specific strategies to guard against impacts from extreme weather, rising temperatures, and disease. Local, state, and private citizens should consider the implementation of the following management practices to reduce risk and build resilience.

| Management practices | Coastal and riverine flooding | Water quality | Water supply |
|---|---|---|---|
| Expand water monitoring networks and aquifer studies to detect changes in temperature, precipitation, and streamflows and assess current and future water availability. | ✓ | ✓ | ✓ |
| Prevent inundation and overflow of on-site disposal systems (OSDS). | ✓ | ✓ | |
| Increase public communication and understanding of altered flood probabilities and hazards. | ✓ | | |
| Develop technical, incentive, and replacement solutions for failing septic systems in areas vulnerable to sea level rise. | | ✓ | |
| Encourage removal of vulnerable or high-hazard water supply and treatment infrastructure. | ✓ | ✓ | ✓ |
| Incorporate climate change impact considerations into local comprehensive plans and Water Resource Elements. | ✓ | ✓ | ✓ |
| Increase the level of protection for aquifer recharge areas and source water protection areas. | ✓ | ✓ | ✓ |
| Employ water utility rate structures based on water usage to encourage conservation. | | | ✓ |
| Assess the vulnerability of water systems (e.g., pipes, culverts, treatment plants) to extreme events and more intense precipitation. | ✓ | ✓ | ✓ |
| Identify avenues for the provision of alternative water supplies in emergency response plans. | ✓ | ✓ | ✓ |
| Target restoration efforts within watersheds that are close to their impervious surface thresholds. | | ✓ | |
| Store runoff on your property by planting native and drought tolerant vegetation, rain gardens, and installing rain barrels and cisterns. | | ✓ | |
| Install water efficiency products throughout your property (e.g., EPA WaterSense). | | | ✓ |

## FOR ADDITIONAL INFORMATION

Department of Natural Resources' Climate Change Website: www.dnr.maryland.gov/climatechange
Department of the Environment: www.mde.maryland.gov


*Citations*

1. http://www.umces.edu/sites/default/files/pdfs/global_warming_free_state_report.pdf
2. http://www.ncdc.noaa.gov/sotc/national/
3. http://water.usgs.gov/osw/floods/2011_TSLee/index.html
4. Johnson TE, JB Butcher, M ASCE, A Parker, CP Weaver. 2011. Investigating the Sensitivity of U.S. Streamflow and Water Quality to Climate Change: U.S. EPA Global Change Research Program's 20 Watersheds Project. *Journal of Water Resources Planning and Management* 138:453-464.
5. http://www.mde.state.md.us/programs/Water/OverFlow/Pages/ReportedSewerOverflow.aspx
6. Roy SB, L Chen, E Girvetz, EP Maurer, WB Mills, TM Grieb. 2010. Evaluating Sustainability of Projected Water Demands Under Future Climate Change Scenarios. TetraTech, Inc. 27 pp.



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Scientific content:
Scientific and Technical and Adaptation and Response Working Groups of the Maryland Commission on Climate Change

Funding provided in part by:
Town Creek Foundation


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