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CLIMATE RESILIENCY

Principles for Phase III Watershed Implementation Plans

Restoring resiliency to protect people and infrastructure

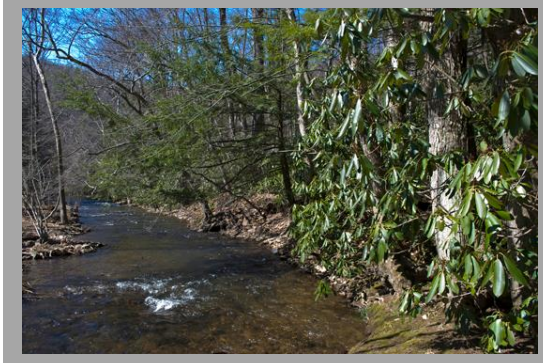
The Chesapeake Bay Watershed has experienced changes in climate over the last century. On the whole, the Watershed is experiencing stronger storms, an increase in heavy precipitation events, increasing air and water temperatures and a rise in sea level. These trends, which vary both spatially and temporally throughout the Watershed, are altering the watershed, its ecosystems and the human communities of the Chesapeake Bay and will require changes in programs and projects to successfully achieve restoration and protection goals.

Sustainable Investments: Considering impacts associated with climate change and extreme weather during the planning, siting, design and implementation of a water quality related Best Management Practice (BMP) can reduce the vulnerability of a project to structural failure over its intended design life.

Hazard Risk Management: In addition to water quality benefits, several suites of BMPs, including forest buffers, urban tree canopy, stream restoration, shore erosion control and wetland restoration, may aid with hazard (riverine and coastal flood, heat and drought) risk reduction. Addressing these risks in conjunction with ongoing restoration efforts will prepare communities for greater variability and may result in cost savings and reduced risks.

Success Stories

Living shoreline project at Ferry Point, MD (Source: MD DNR)



Forest buffer shading/cooling Brook Trout habitat (Source: CBP)

Best Management Practices with *Resiliency* in Mind

Incorporating resilient design considerations into your project design will not require a wholesale change in implementation in most cases. Evaluating your project for its risk vulnerabilities and developing a range of strategies at the initial planning stage will increase effectiveness, decrease maintenance costs, and help to ensure you are meeting the U.S. Environmental Protection Agency's Total Maximum Daily Load requirements into the future. Many BMPs already address these risks (see chart below) and will protect communities from increased flooding and ecosystems from rising temperatures and altered streamflows.

	Outcome Benefits					
Best Management Practice	Nutrient Benefit	Temperature Reduction	Storm Protection	Increased Drought Tolerance	Sea Level Rise Mitigation	Wildlife Corridor
Wastewater Treatment Plant	✓			✓		
Stream Restoration	✓					✓
Forest Buffer	✓	✓	✓			✓
Wetlands	✓		✓	✓	✓	✓
Infiltration	✓		✓	✓		
Shoreline Erosion Control	✓		✓		✓	
Vegetated Open Channel	✓		✓			

* highest scoring BMPs are in bold; BMPs providing greatest flood prevention co-benefit are in blue

Guiding Principles for Phase III Watershed Implementation Plan

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WIP Development

1. *Capitalize on "Co-Benefits"*: maximize BMP selection to increase climate or coastal resiliency, soil health, flood attenuation, habitat restoration, carbon sequestration, or socio-economic and quality of life benefits.
2. *Account for and integrate planning and consideration of existing stressors* – consider existing stressors such as future increase in the area of paved or impervious surface, future population growth, and land-use change in establishing reduction targets or selection/prioritizing BMPs.
3. *Align with existing climate resiliency plans and strategies* – align with implementation of existing greenhouse gas reduction strategies; coastal/climate adaptation strategies; hazard mitigation plans; floodplain management programs; fisheries/habitat restoration programs, etc.
4. *Manage for risk and plan for uncertainty* – employ iterative risk management and develop robust and flexible implementation plans to achieve and maintain the established water quality standards in changing, often difficult-to-predict conditions.
5. *Engage Local Agencies and Leaders* – work cooperatively with agencies, elected officials, and staff at the local level to provide the best available data on local impacts from climate change and facilitate the modification of existing WIPs to account for these impacts.

WIP Implementation

1. *Reduce vulnerability* - use "Climate-Smart" principles to site and design BMP's to reduce future impact of sea level rise, coastal storms, increased temperature, and extreme events on BMP performance over time. Vulnerability should be evaluated based on the factor of risk (i.e. consequence x probability) in combination with determined levels of risk tolerance, over the intended design-life of the proposed practice.
2. *Build in flexibility and adaptability* - allow for adjustments in BMP implementation in order to consider a wider range of potential uncertainties and a richer set of response options (load allocations, BMP selections, BMP redesign). Use existing WIP development, implementation and reporting procedures, as well as monitoring results and local feedback on performance, to guide this process.
3. *Adaptively manage* - Allow for changes in BMP selection or WIP implementation, over-time, as new climate and ecosystem science, research, or data becomes available and the understanding of the impact of how changing seasonal, inter-annual climatic and weather conditions may affect the performance of watershed restoration practices. Consider new science on climate change impacts in future BMP Expert Panels, following the CBP partnership's BMP Expert Panel Protocols.

Tools and Resources

- National Climate Assessment *U.S. Global Change Research Program*
  An interactive, online report reviewing the impact of climate change on the United States, with detailed regional information.
- Coastal Flood Exposure Mapper *NOAA Office for Coastal Management*
  A collection of visualization tools and maps that can be shared with stakeholders to communicate coastal flood hazards.
- Stormwater Management in Response to Climate Change Impacts: Lessons from the Chesapeake Bay and Great Lakes Regions *Environmental Protection Agency* - A report on strategies and tools to incorporate climate resiliency into community planning.
- Building Resilience through Habitat Restoration *MD DNR Chesapeake and Coastal Service*
  Recommendations on how to incorporate climate change consideration into the restoration decision-making process in Maryland.
- Implementation of BMP Strategies for Adaption to Climate Change and Land Use in a Pasture-Dominated Watershed *Chiang et al.*
  Paper predicts the impact of climate change on 171 pastural BMP combinations and recommends those that are the most resilient.
- Estimation of BMP Impact on Chesapeake Bay Program Management Strategies *Tetra Tech*
  The report scores BMPs based on their ability to positively impact flood control and climate adaptation goals of the Chesapeake Bay Program.
- Creating Resilient Water Utilities (CRWU) - Tools to help make drinking water, wastewater, and stormwater utilities more resilient.
- National Stormwater Calculator - The calculator uses a selection of low impact development controls to estimate local area annual rainwater and runoff frequency.
- Tools for Water Related Climate Change Adaptation *EPA Climate Change Adaption Resource Center*
  A database of climate change adaption tools for communities on water utilities, water quality, and ecosystem protection.

Contacts for More Information

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