RISING WATER TEMPERATURES: Watershed Findings and Management Recommendations from the STAC Workshop

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Link to the Final Report

Watershed Acknowledgements

- **APP. D- Synthesis Element #1 (Water Temperature Effects on Fisheries and Stream Health in Nontidal Waters):** Stephen Faulkner, Rosemary Fanelli, Matthew Cashman, Than Hitt and Benjamin Letcher, USGS; Frank Borsuk and Greg Pond, EPA; Kevin Krause, MN DNR
- **APP. E- Synthesis Element #1 Addendum (Temperature Criteria in CBP Jurisdictions' Water Quality Standards and Information on Warmwater Species):** Rebecca Hanmer, EPA-retired; Jonathan Leiman, Maryland Department of the Environment; Daniel Goetz, Maryland Department of Natural Resources; Robert Breeding, Virginia Department of Environmental Quality; and Matthew Robinson, DC Department of Energy and Environment
- **APP. H- Synthesis Element #4 (Watershed Characteristics and Landscape Factors Influencing Vulnerability and Resilience to Rising Stream Temperatures)**: Nora Jackson, CRC/CBP; Judy Okay, J&J Consulting; Nancy Roth, Tetra Tech; Sally Claggett, USFS; Renee Thompson, USGS
- **APP. I- Synthesis Element #5 (Trends)**: Rich Batiuk, CoastWise Partners; Nora Jackson, CRC/CBP; John Clune, USGS; Kyle Hinson, VIMS; Renee Karrh, Maryland Department of Natural Resources; Mike Lane, Old Dominion University; Rebecca Murphy, University of Maryland Center for Environmental Science/CBP; and Roger Stewart, Virginia Department of Environmental Quality
- **APP. J- Synthesis Element #6 (Model Projections)**: Rich Batiuk, CoastWise Partners; Gopal Bhatt, Pennsylvania State University/CBP; Lewis Linker, U.S. EPA CBP; Gary Shenk, USGS/CBP; Richard Tian, University of Maryland Center for Environmental Sciences/CBP; and Guido Yactayo, Maryland Department of the Environment
- **APP. K- Synthesis Element #7/8 Paper (Impacts of BMPs and Habitat Restoration on Water Temperatures):** Katie Brownson and Sally Claggett, USFS; Tom Schueler, CSN; Anne Hairston-Strang and Iris Allen, Maryland Department of Natural Resources-Forestry; Frank Borsuk and Lucinda Power, EPA; Mark Dubin, UMD; Matt Ehrhart, Stroud; Stephen Faulkner, USGS; Jeremy Hanson, VT; Katie Ombalski, Woods & Waters Consulting
- **Synthesis Element #10 Paper (Monitoring)**: Peter Tango, Breck Sullivan, John Clune, USGG; and August Goldfischer, CRC

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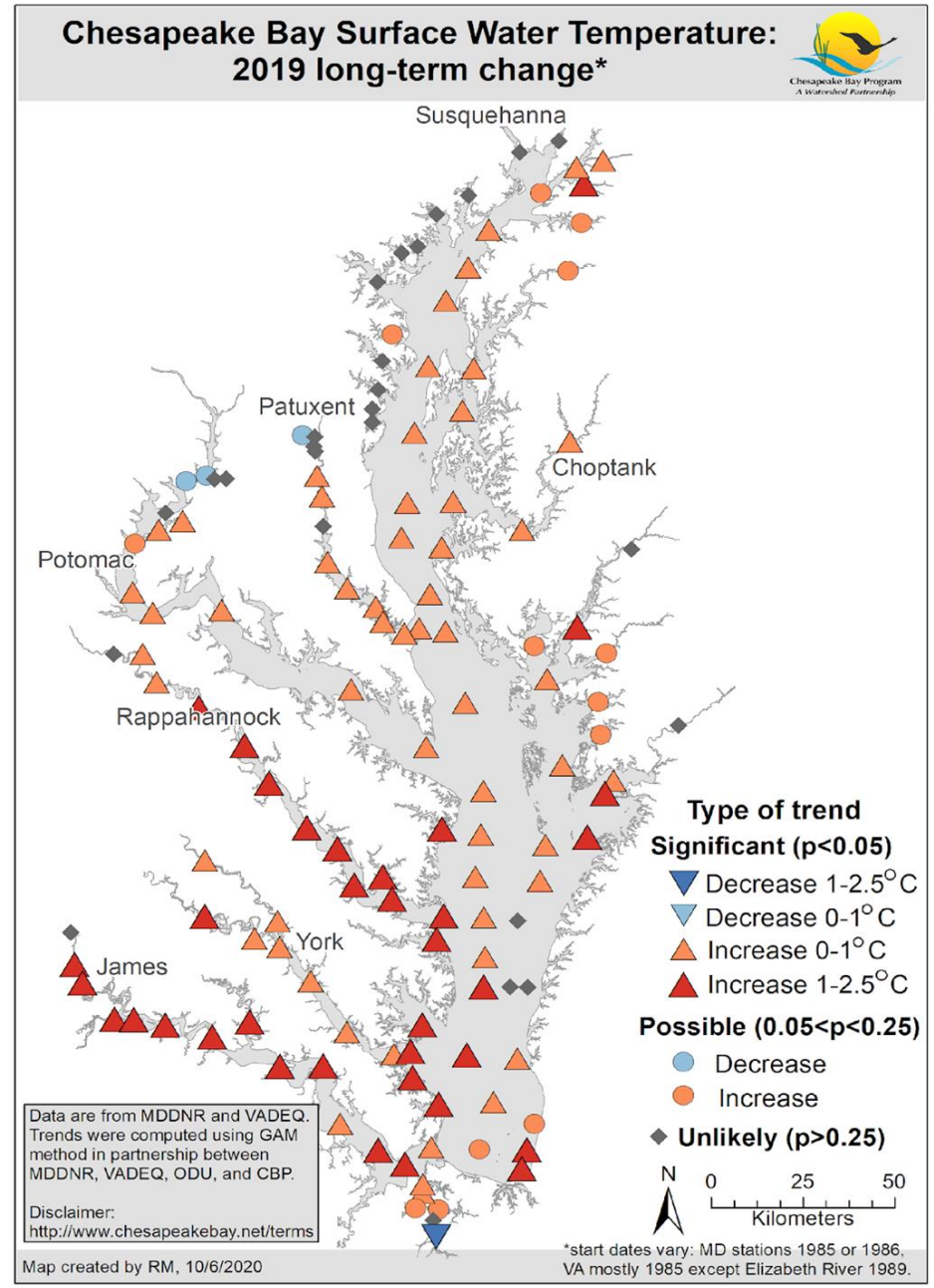
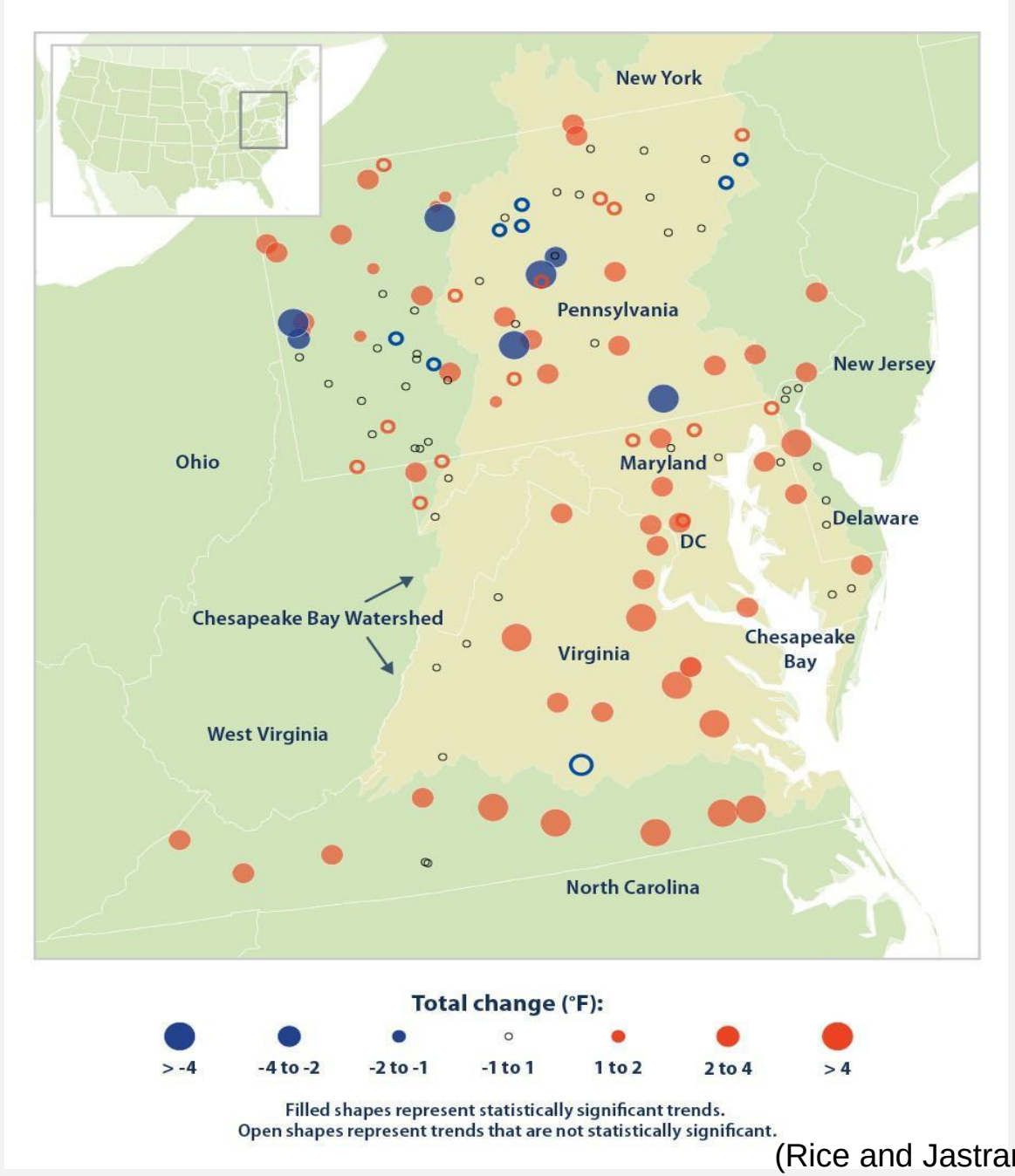
Chesapeake Bay tidal and non-tidal water temperatures have been increasing.





(Rice and Jastram, 2015)

Watershed Findings: What Data Indicate

- In many areas, water temperatures increased more than air temperatures
- Land use has a significant impact on both stream and runoff temperatures
- Trees matter: by shading, evapotranspiration and facilitating rainwater infiltration
- Cool groundwater input helps

Watershed Findings

- Some CBP BMPs are "coolers" - e.g. forest buffers and tree canopy
- Urban and Ag BMPs for stormwater infiltration should help [study needed]
- More "heater" than "cooler" BMPs have been installed
- Need finer geographic scale for modeling

Ecological Impacts - Species

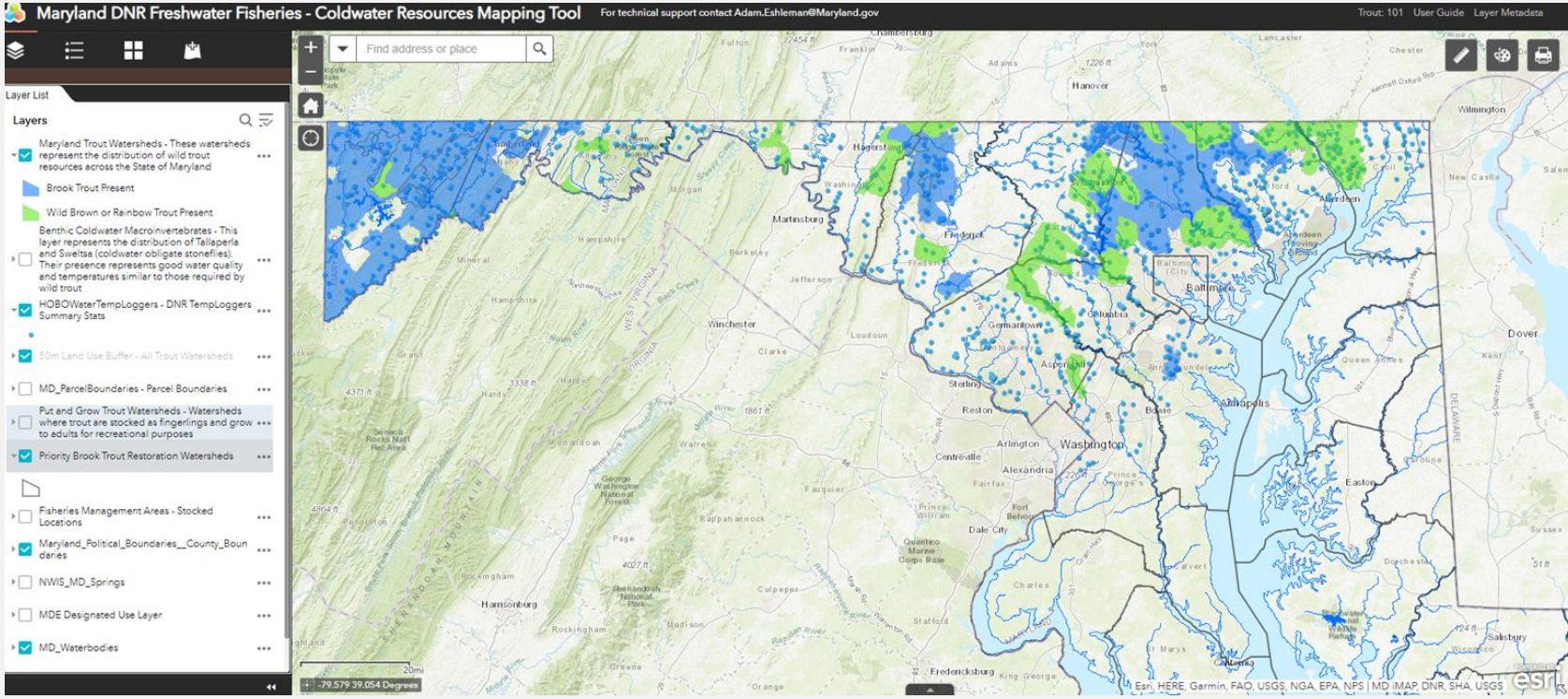
- **Strongest negative impacts** on coldwater species (e.g., trout, sculpin) and their habitats (esp. where streams aren't driven by groundwater)

- Watershed-wide, warmwater aquatic species are most common. Although more tolerant to temperature increases, they are **sensitive to extreme temperatures** including rapid changes and to indirect effects (e.g., invasives, pathogens) from higher temps.

- **More study needed** of temperature effects on lower foodweb
  - Algae, biofilms, zooplankton
  - Macroinvertebrates
  - Freshwater mussels & host species

Coldwater Fisheries and Habitat Recommendation

- Chesapeake Bay Program partners need to **accelerate conservation** to protect the coldwater streams now supporting healthy aquatic life, especially native brook trout, which are extremely sensitive to rising water temperatures, and **continue resiliency analyses and mapping to focus coldwater habitat restoration efforts.**



Implementing Coldwater Actions

- Good Brook Trout mapping and expertise, but high quality habitat diminishing
- Connecting science to decision-makers needed
- Each state needs a federal-state-local-private partnership strategy
- Increase continuing, high-frequency surface temperature monitoring + sediment/benthic temp monitoring and groundwater mapping (ID resiliency)

Rural Waters and Habitats Recommendation

- In rural areas, CBP partners should work to **strategically conserve and restore forests and aquatic habitats** while promoting **good agricultural stewardship practices** that can reduce the amount of heated runoff being generated by farms

Implementing Rural Actions

- Map streams where RFB can have greatest cooling impact
- Prioritize conservation of healthy cool-water habitat
- Focus habitat restoration to improve connectivity and thermal refugia
- Farms: climate-smart whole farm planning, agroforestry, soil health/infiltration
- Target research in small ag watersheds to measure temp impacts of ag land/water management, including infiltration

Urban Waters and Habitats Recommendation

- In urban areas, the CBP partners should i**ncrease tree canopy, vegetation and practices favoring infiltration** to reduce the amount of heated runoff entering waterways, p**aying attention to underserved urban areas** which historically suffer the worst heating and human health outcomes.

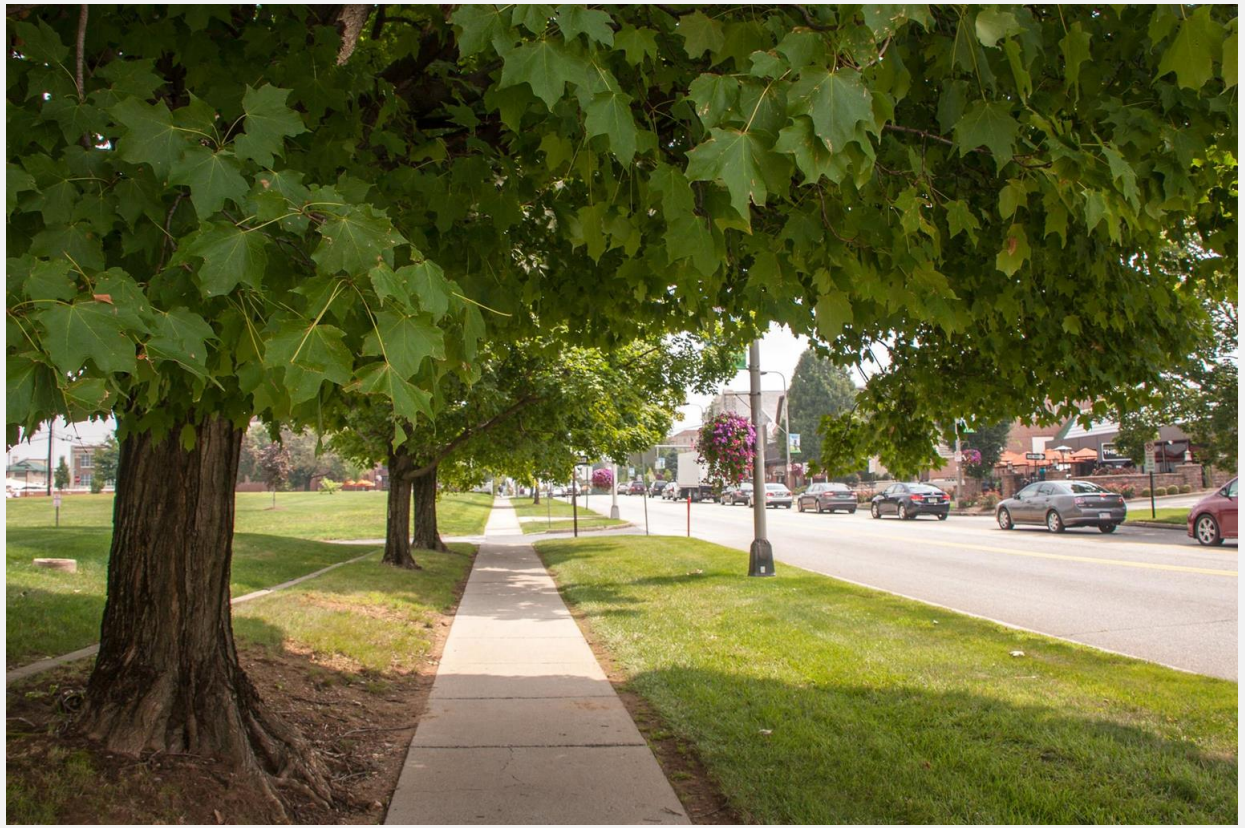


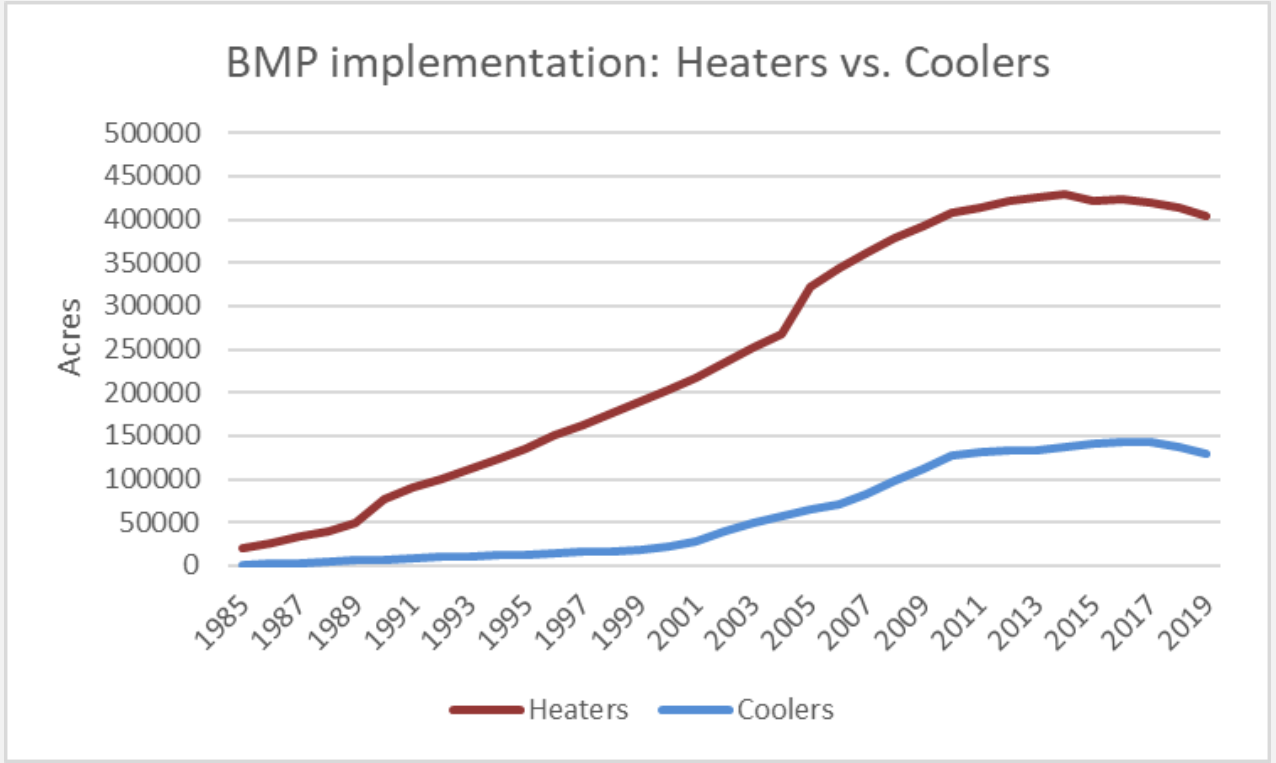
Photo Credit: Leslie Robertson, NASF

Implementing Urban Actions

- Build CBP promotion of lawn conversion, urban tree canopy, stormwater infiltration and less impervious cover
- Emphasize multiple benefits of urban trees (e.g. public health, urban livability)
- Stream restoration BMPs: consider temperature, thermal refugia
- Focus research/monitoring on rising water temperatures vs public health (e.g. heated runoff and pollution)

Best Management Practices (BMPs) Recommendation

- The CBP partners should work to **minimize the extent to which water quality BMPs are further heating waterways and strategically use cooling BMPs** to counteract the warming effects of climate change and land use where possible
- Need better understanding of temperature and biological response to BMPs



State Temperature Water Quality Standards Recommendation

- **States and EPA** should **review and modernize current WQS systems** to **address climate-related rising water temperatures and drive area protection and restoration strategies**
- Rethink WQS monitoring - from points to landscape + timing
- Are temperature criteria protective?
- Can anti-degradation policies do more to protect healthy brook trout streams?
- Watch for Maryland's temperature TMDL

Common Themes Across the Workshop: Implementation

- Comprehensive Jurisdictional and Land Use Plans
  - E.g., ensure that land-use planning decisions and county comprehensive plans incorporate science and evidence-based practices in regard to water temperature.
- Targeting
  - E.g., incorporate water temperature considerations when planning, siting, and implementing restoration and conservation efforts.
- Nature-Based Features
  - E.g., restore nature-based and natural features on land and in the water to help moderate or build resilience to rising water temperatures.
  - Support efforts to implement living shorelines, cooling BMPs, and natural infrastructure where appropriate and feasible (e.g., on public land or develop incentive programs for private land).
- Communication
  - E.g., ensure open communication with stakeholders (e.g., communities, decision makers, scientists, practitioners) to ensure that rising water temperatures are taken into consideration.

(Marcy Damon, Chesapeake Bay Foundation)

Common Themes Across the Workshop: Science & Research

- Modeling tool improvements
  - E.g., finer-scale modeling, incorporating temperature change, improving connections between modeling and monitoring living resources.
- Expanded Monitoring
  - E.g., expanding monitoring networks to collect data necessary to track water temperature and ecological change; improve the ability to pair air temperature trends with water temperature trends.
- Thresholds
  - E.g., understanding environmental condition and habitat thresholds and communicating the implications of rising water temperatures for living resources.