

Temperature/ Thermal Load Mitigation Provided by Stormwater BMPs

*Stormwater
Engineering*

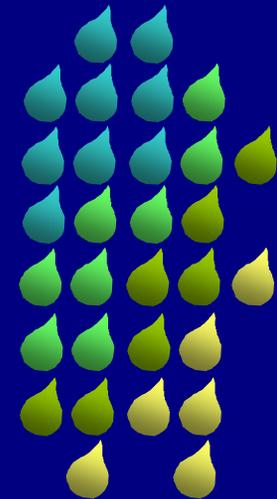


NC STATE UNIVERSITY

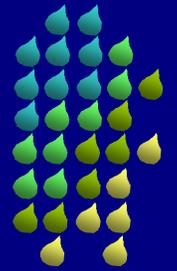


William F. Hunt, Ph.D., PE
Biological & Agricultural Engineering
NC State University

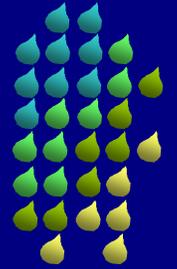
www.bae.ncsu.edu/stormwater



Cold Water? In North Carolina?

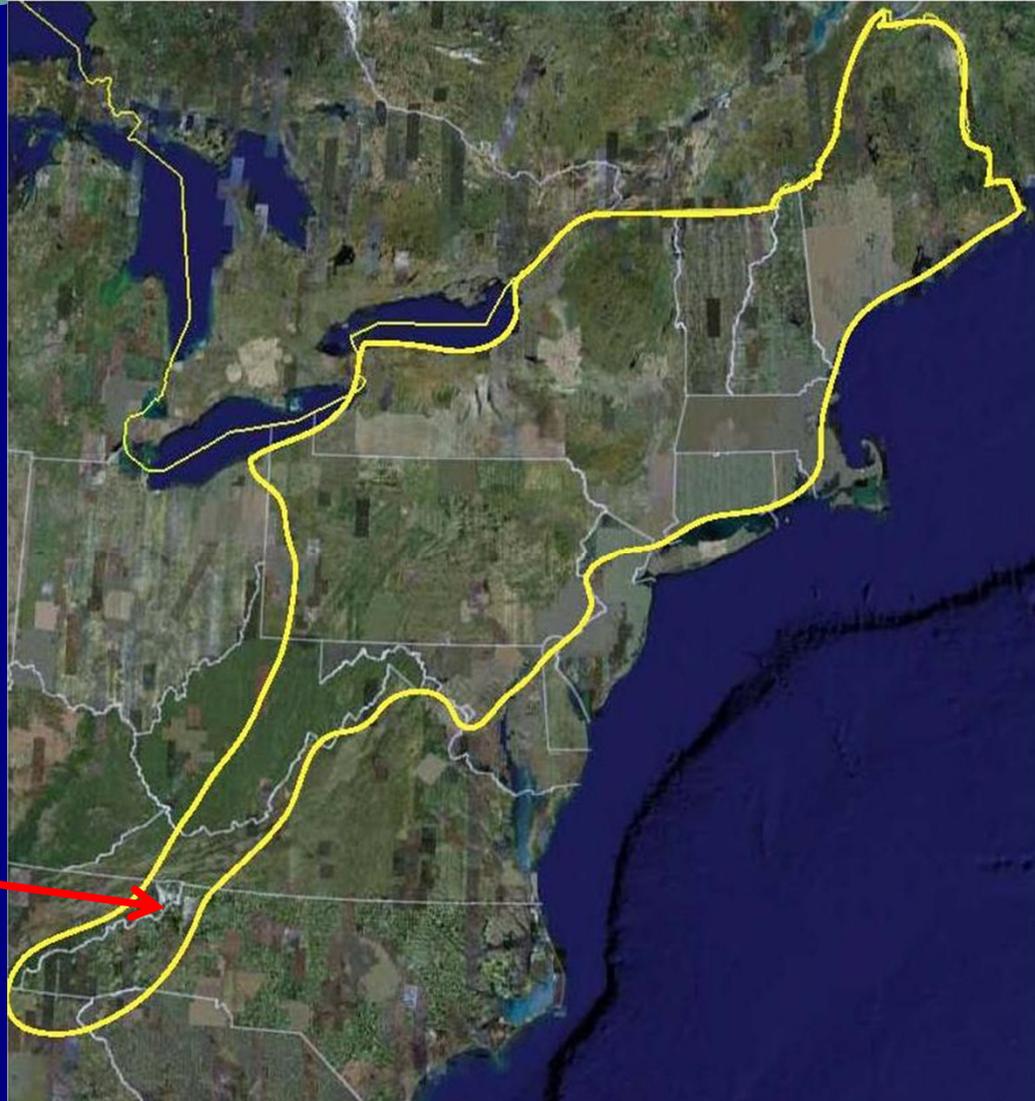


NC Lies along the Southern Extent of Native Trout Ranges



Thanks to our
Mountains

Extent of
Brook Trout
Range



Trout in North Carolina

- NC contains roughly 4,000 miles of streams capable of supporting trout
- Roughly 1.3 million people fish in NC, spending over \$1 billion
- Nationwide, anglers spend a combined 83 million days fishing for trout
- Most NC trout prefer water temperatures between 40-70°F

What Does Body Temperature Affect?

- Metabolism
 - Increased metabolic rate
 - Consume more energy
 - Increased oxygen demand
 - Can lead to cellular damage
- Enzymes
 - Effect on production and performance



What Does Body Temperature Affect?

- Reproduction
 - Organisms don't engage in reproduction
 - Eggs can't survive high temperatures
- Growth and Development
 - Smaller juveniles
 - Juveniles can't survive high temperatures



What Does Body Temperature Affect?

- Vulnerability to Disease
 - Parasites and diseases can thrive in warm water
 - Stress from heat reduces disease tolerance

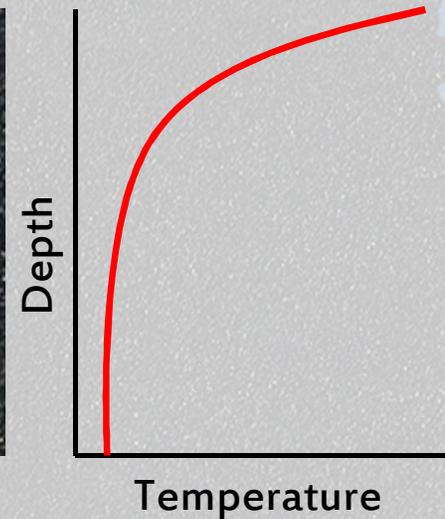
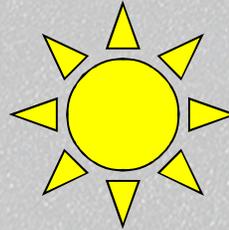


Effects of Urbanization

- Loss of vegetation
 - Less Shading
 - Less Evapotranspiration
- Loss of infiltration
 - Less groundwater recharge
- Increased surface temperature
 - Man-made surfaces warmer than natural

What Causes Thermally Polluted Runoff?

- Solar Radiation Captured by Pavement
 - High absorbance
 - Low conductivity
- High runoff flows transfer energy to receiving waters



What Causes Thermally Polluted Runoff?

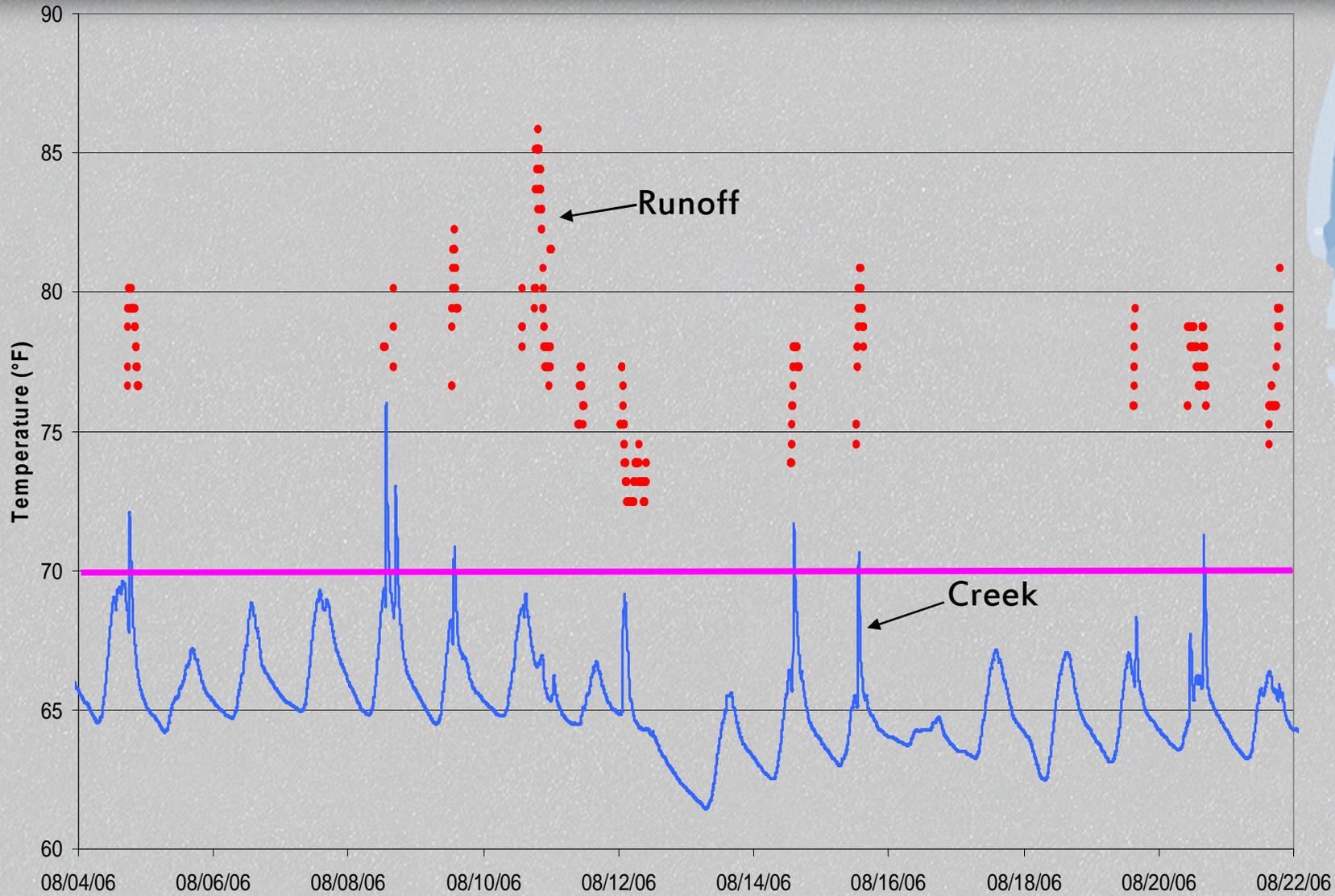
- Factors affecting stormwater temperature
 - Radiation intensity
 - Darkness of paved surface
 - Area of contact
 - Rainfall intensity
 - Rainfall duration
 - Size of receiving water

Stormwater
Engineering
Group

Brevard, North Carolina



Thermal Impacts



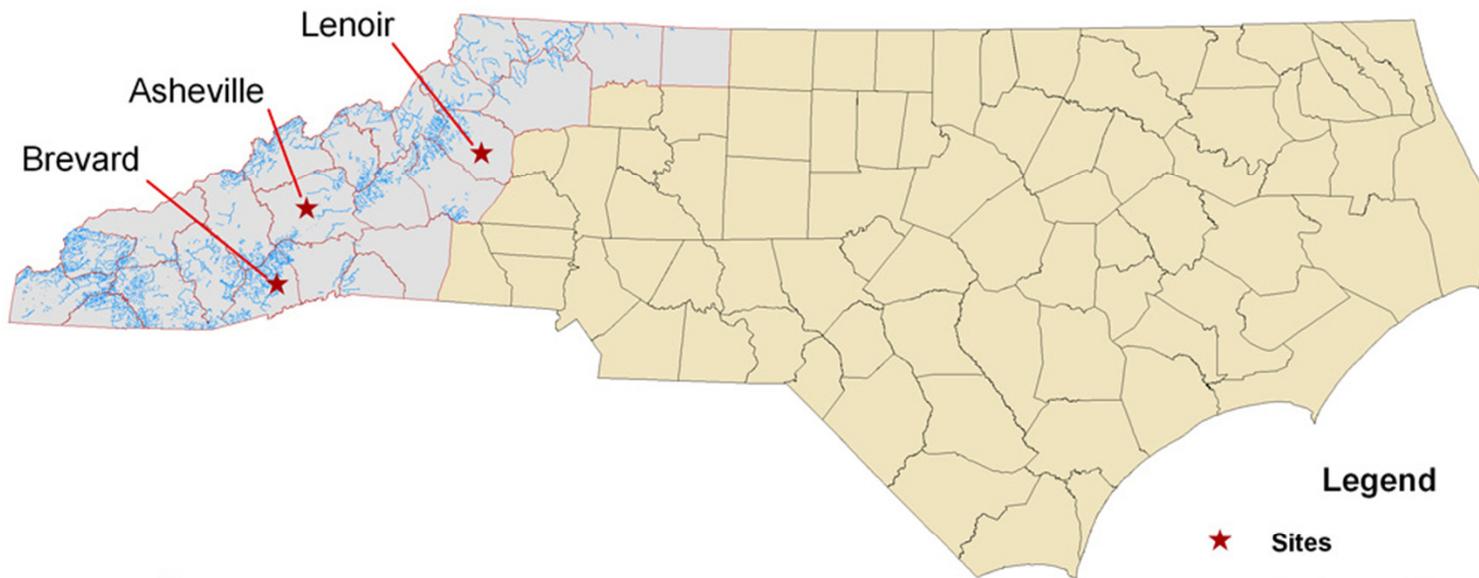
Monitoring Strategy

- Monitored 6 BMPs in Western North Carolina
 - 4 Bioretention Areas
 - 1 Stormwater Wetland
 - 1 Wet Pond
- Monitoring Data Collected:
 - Temperature and flow at all BMP inlets and outlets
 - Ambient air temperature and rainfall for each pair
 - Temperature at specific depths for some sites



Site Locations

North Carolina



Asheville Wetland

Asheville Bioretention