Storm Water Management & Regulation

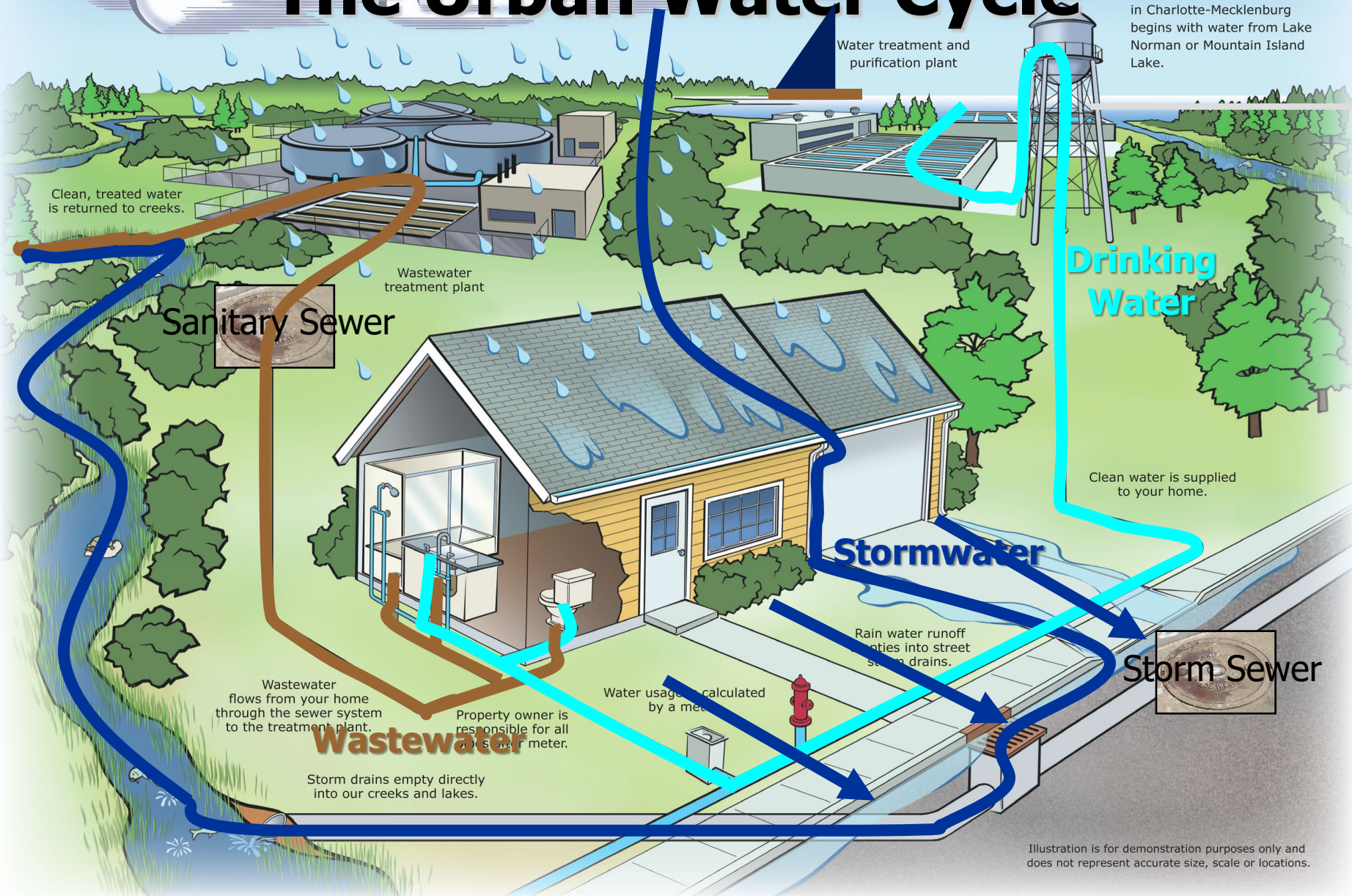
Impacts of Stormwater on Water Quality

Managing These Impacts

Challenges & Opportunities

McDowell Creek in Huntersville.

How Urbanization Causes Pollution – The Urban Water Cycle



Non-Point Source Pollution

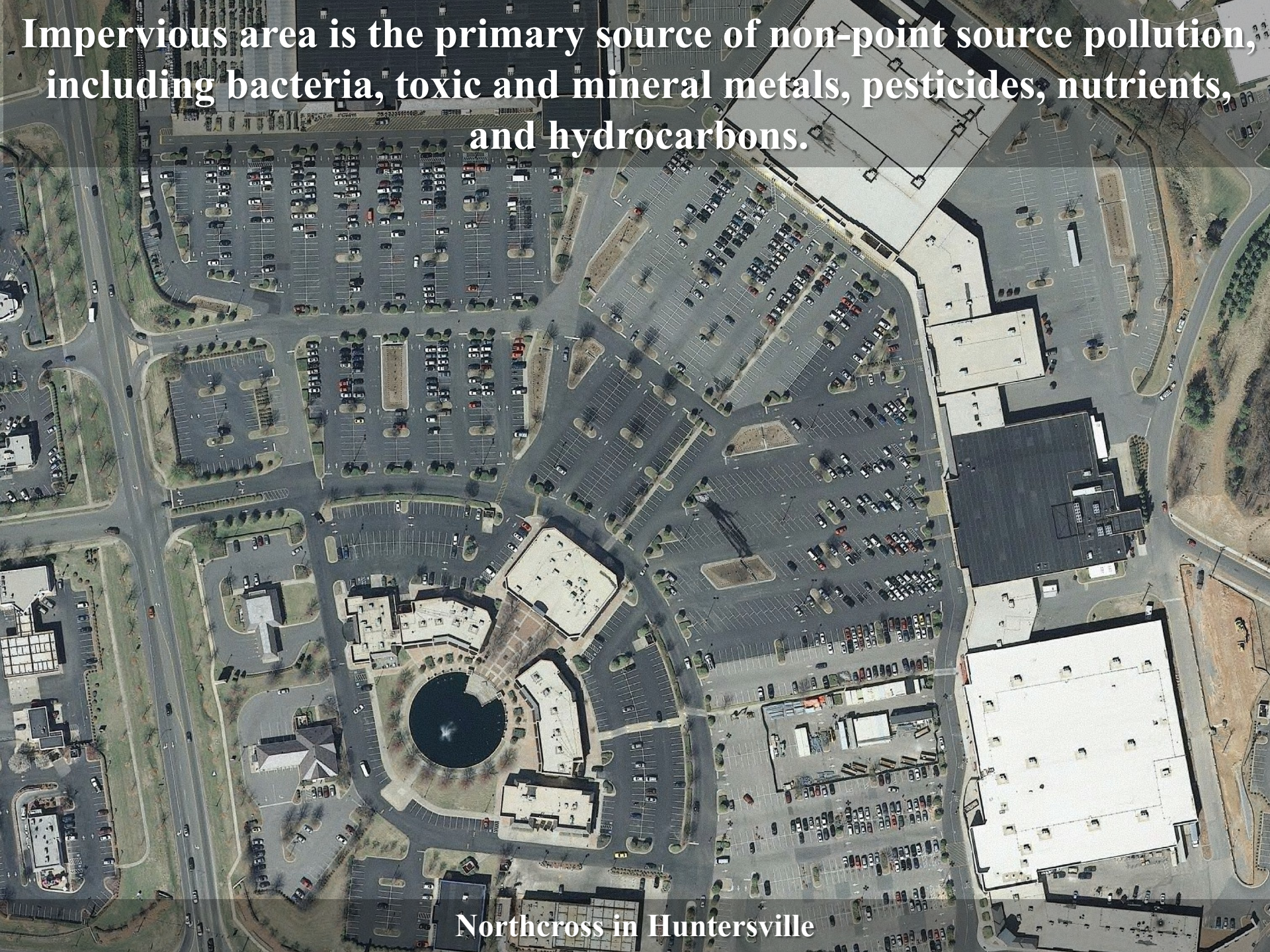
(pollution in stormwater runoff)

- **Bacteria**

Non-point source pollution is the primary cause of impaired streams in Mecklenburg County.

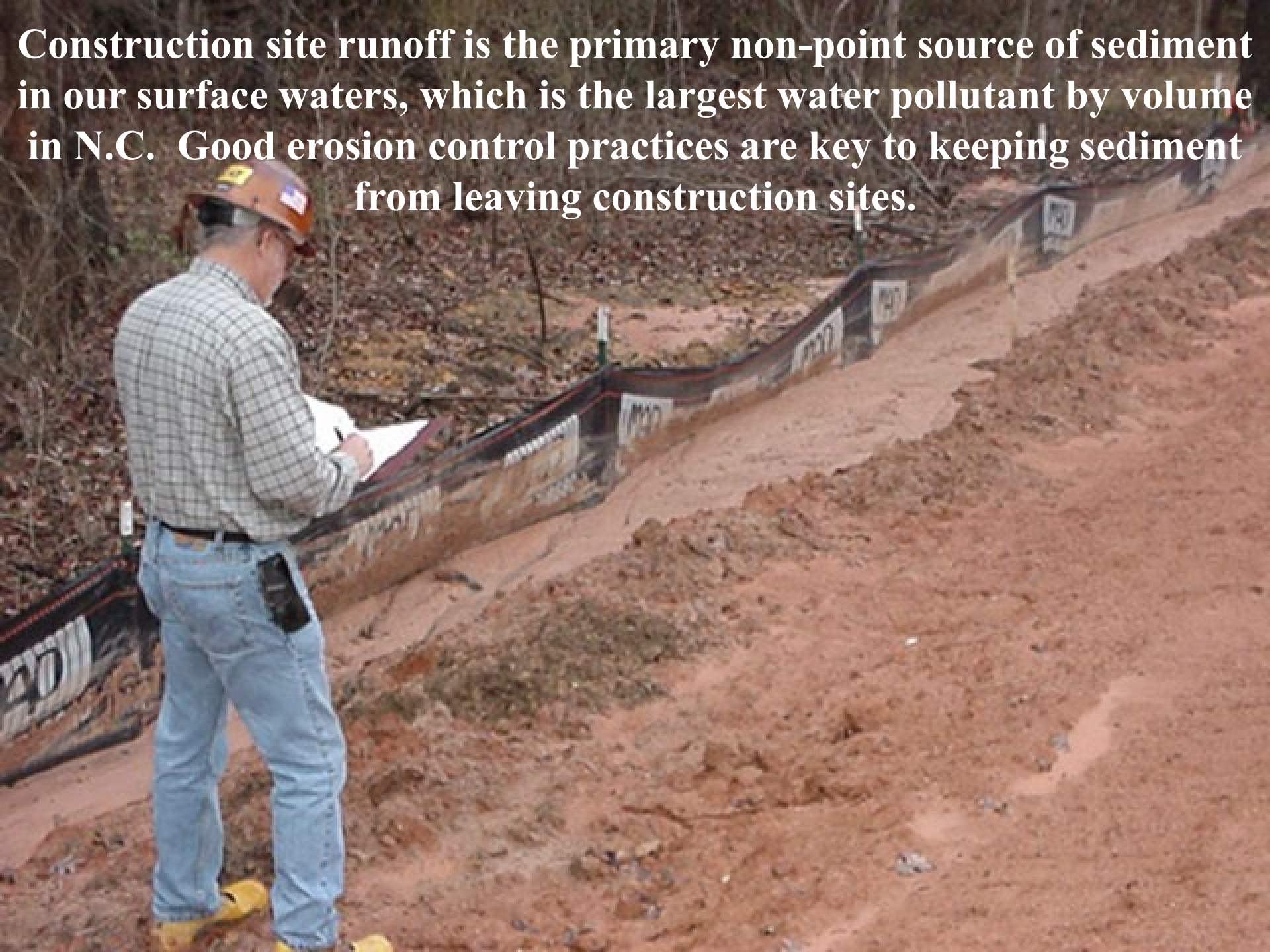
- **Pesticides**
- **Nutrients (fertilizers)**
- **Hydrocarbons (petroleum)**
- **Sediment**

Impervious area is the primary source of non-point source pollution, including bacteria, toxic and mineral metals, pesticides, nutrients, and hydrocarbons.



Northcross in Huntersville

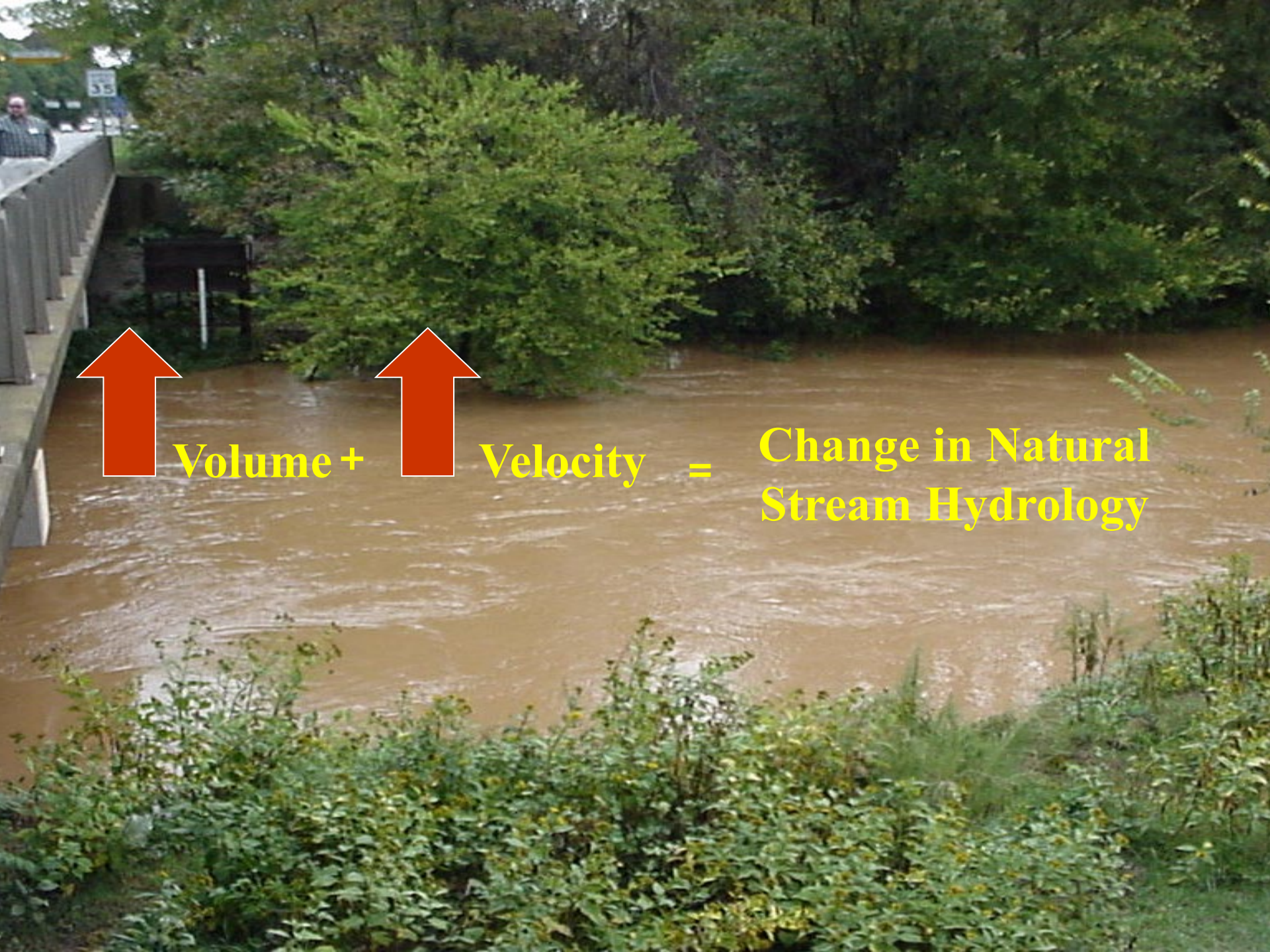
Urban landscape and yard maintenance can be a source of pesticides and nutrients (fertilizer) particularly if improperly applied within 48 hours of a rain event, within 50 feet of a stream or storm drain or during windy conditions.


Construction site runoff is the primary non-point source of sediment in our surface waters, which is the largest water pollutant by volume in N.C. Good erosion control practices are key to keeping sediment from leaving construction sites.

Increased Storm Water Volumes & Velocities Also Degrade Water Quality

One (1) inch of rainfall on one (1) acre of woods produces no runoff.

The same one (1) inch of rainfall on one (1) acre of asphalt will produce over 27,000 gallons of runoff.

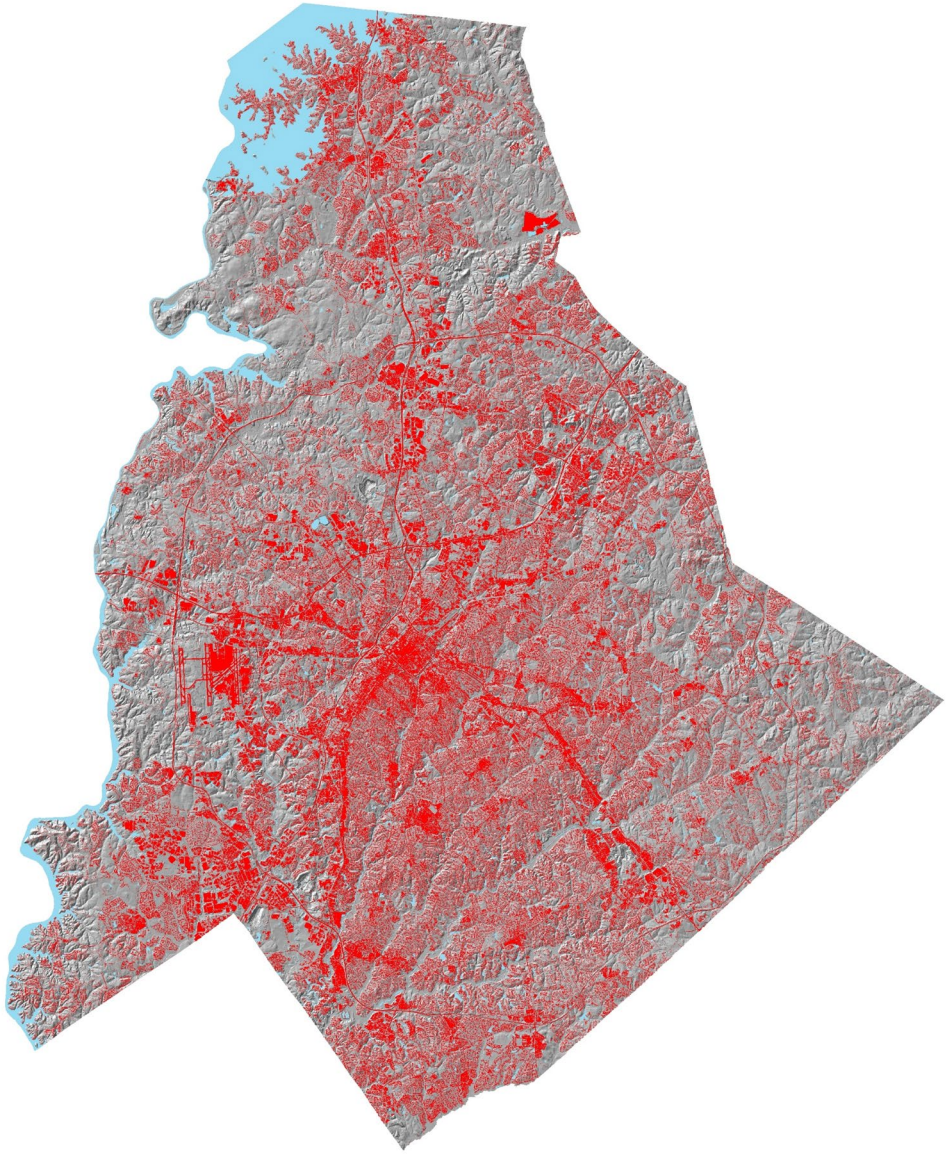

Volume +
Velocity
=
Change in Natural
Stream Hydrology

channels.

McDowell Creek in Huntersville

Sediment is deposited in the channel, the water becomes polluted, and aquatic life is destroyed.

Charlotte-Mecklenburg Impervious Cover Data from 2020



Impervious Areas Shown in Red

- Mecklenburg County has over 115 square miles of impervious area (almost 22% of the surface area of the County).
- This is an area larger than the City of Charleston, S.C.
- Impervious area has increased by 7% over the past 5 years.



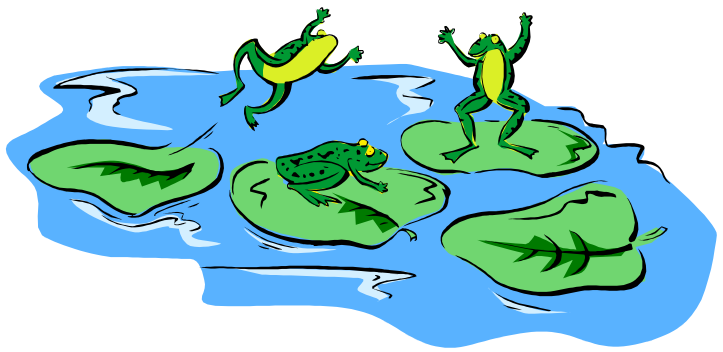




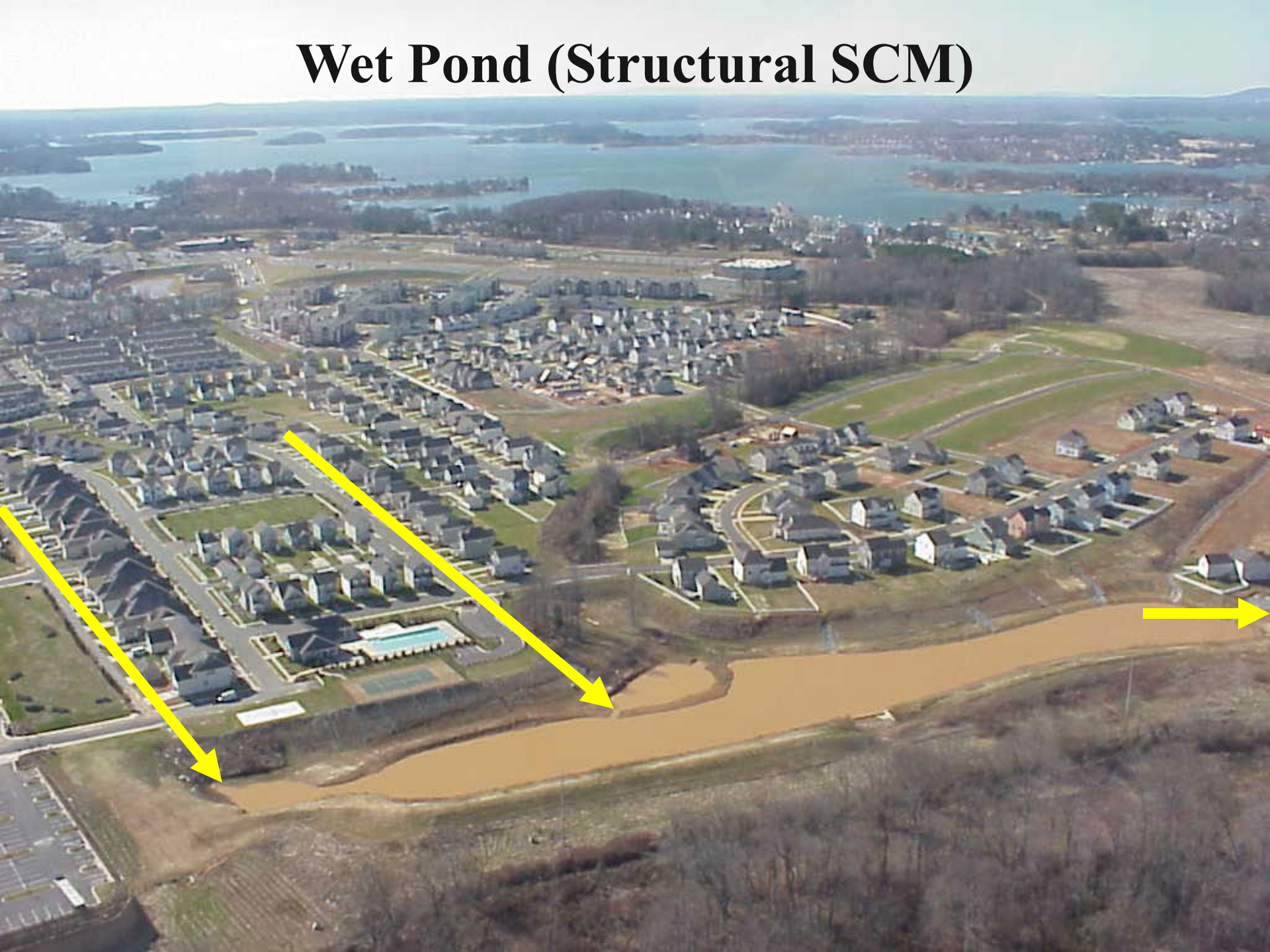

1 inch of rain will generate 2 billion gallons of runoff in Mecklenburg County, which is enough to fill Panthers Stadium 8 times. Our average annual rainfall is 44 inches that generates 88 billion gallons of runoff which would fill Panthers Stadium 340 times.

Controlling Non-Point Sources Stormwater Control Measures (SCMs)

Collect and treat surface run-off from developed areas prior to discharge into streams and/or lakes for the purpose of reducing non-point source pollutants and protecting water quality from increased runoff volumes and velocities. Includes both structural and non-structural stormwater control measures (SCMs).



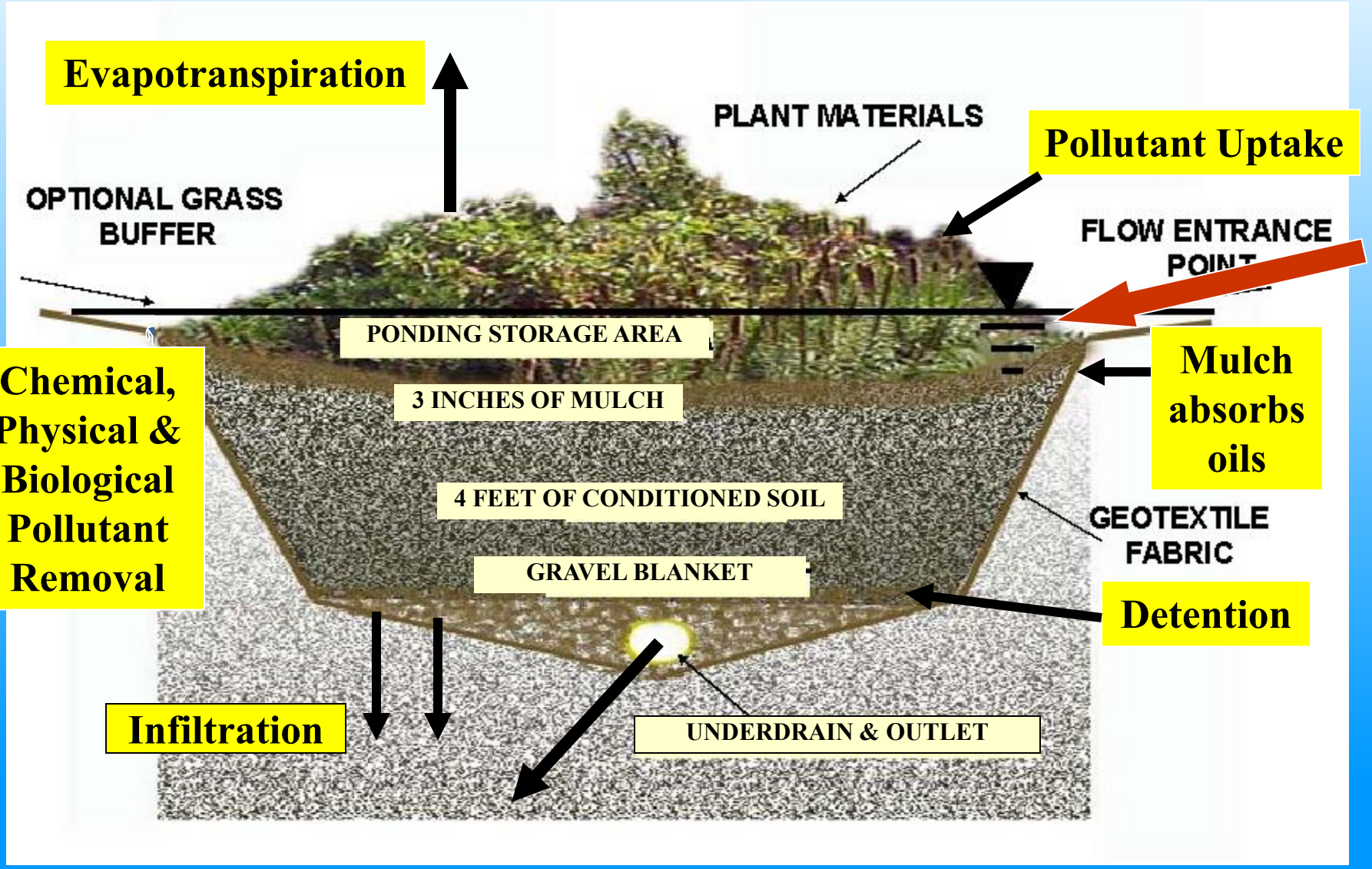
Wet Pond (Structural SCM)



rden (Structural SCM)

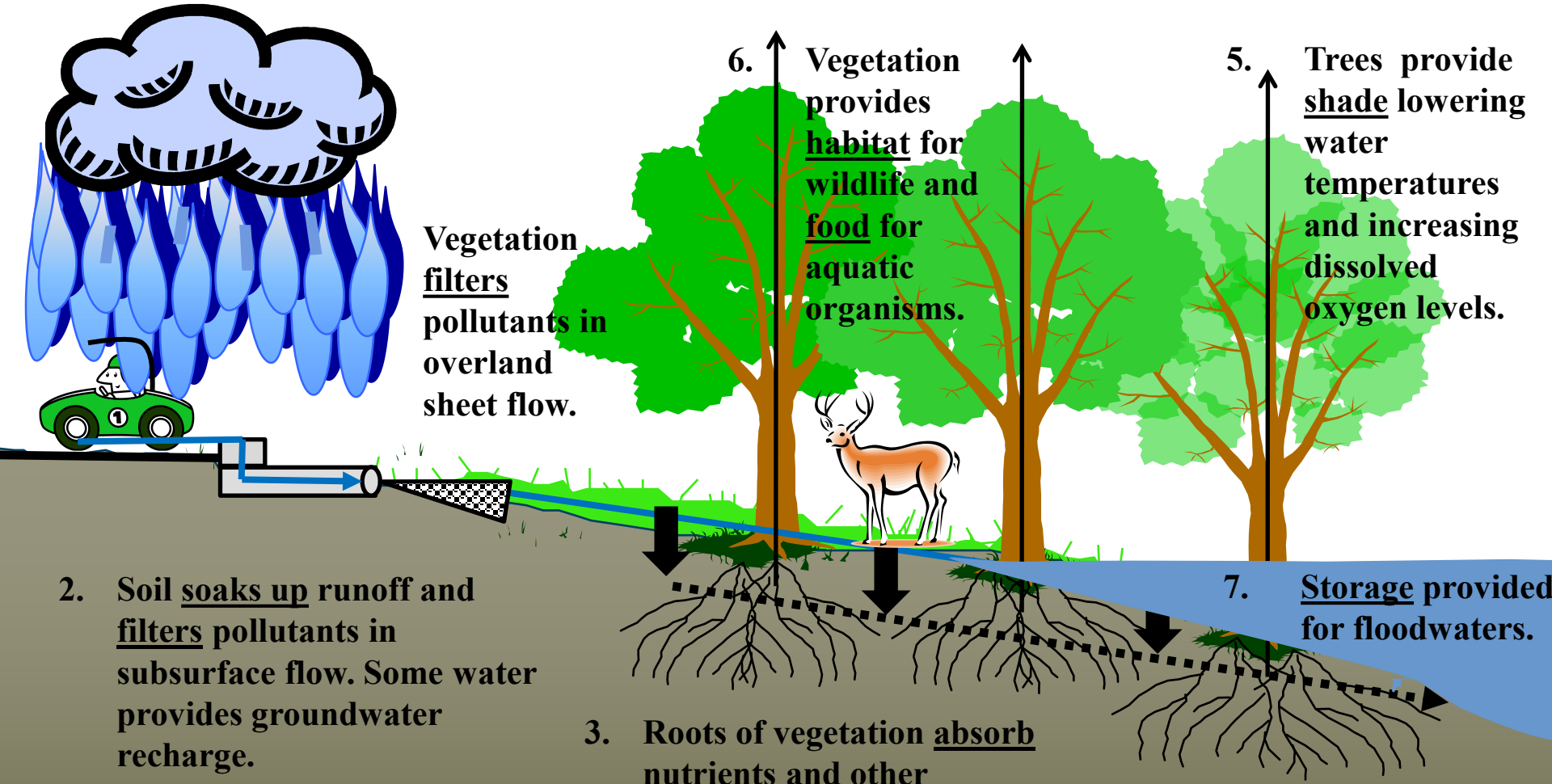
Northcross in Huntersville

How A Rain Garden Works



Buffers (Non-Structural SCM)

Buffers Are The Best!



Vegetation filters pollutants in overland sheet flow.

6. Vegetation provides habitat for wildlife and food for aquatic organisms.

5. Trees provide shade lowering water temperatures and increasing dissolved oxygen levels.

2. Soil soaks up runoff and filters pollutants in subsurface flow. Some water provides groundwater recharge.

3. Roots of vegetation absorb nutrients and other pollutants and release moisture into atmosphere through evapotranspiration.

7. Storage provided for floodwaters.

4. Roots of vegetation stabilize banks preventing erosion and allowing the formation of natural meanders.

Buffer = Filter + Sponge + Much More

Open Space (Non-Structural SCM)

Filter pollutants and reduce impervious area.

Other Measures for Controlling Non-Point Sources

1. **Post-Construction Runoff Controls** – Stormwater Control Measures (SCMs)
2. **Construction Site Runoff Controls** – Reduce pollutants from construction sites (erosion control programs).
3. **Public** [illegible] stormwater runoff a[illegible]
4. **Public Involvement & Participation** – Involve community in activities to improve water quality.
5. **Illicit Discharge Detection/Elimination** – Identify and eliminate sources of pollution.
6. **Pollution Prevention/Good Housekeeping** – Properly operate and maintain municipal facilities and infrastructure.
7. **TMDL Compliance** – Implement measures to improve water quality where stormwater runoff has been identified as a source of impairment.

Stormwater Permit

Challenges & Opportunities

Challenge: Typical SCMs only remove ±85% total suspended solids (state minimum).

Opportunity: Require SCMs with nutrient removal capabilities to better protect our lakes.

Challenge: Most jurisdictions only require SCMs at >24% impervious area (state minimum).

Opportunity: Require SCMs at >10% impervious area which is when most negative water quality impacts begin to occur.

Challenge: Buffers are usually 30 to 50 feet in width (state minimum).

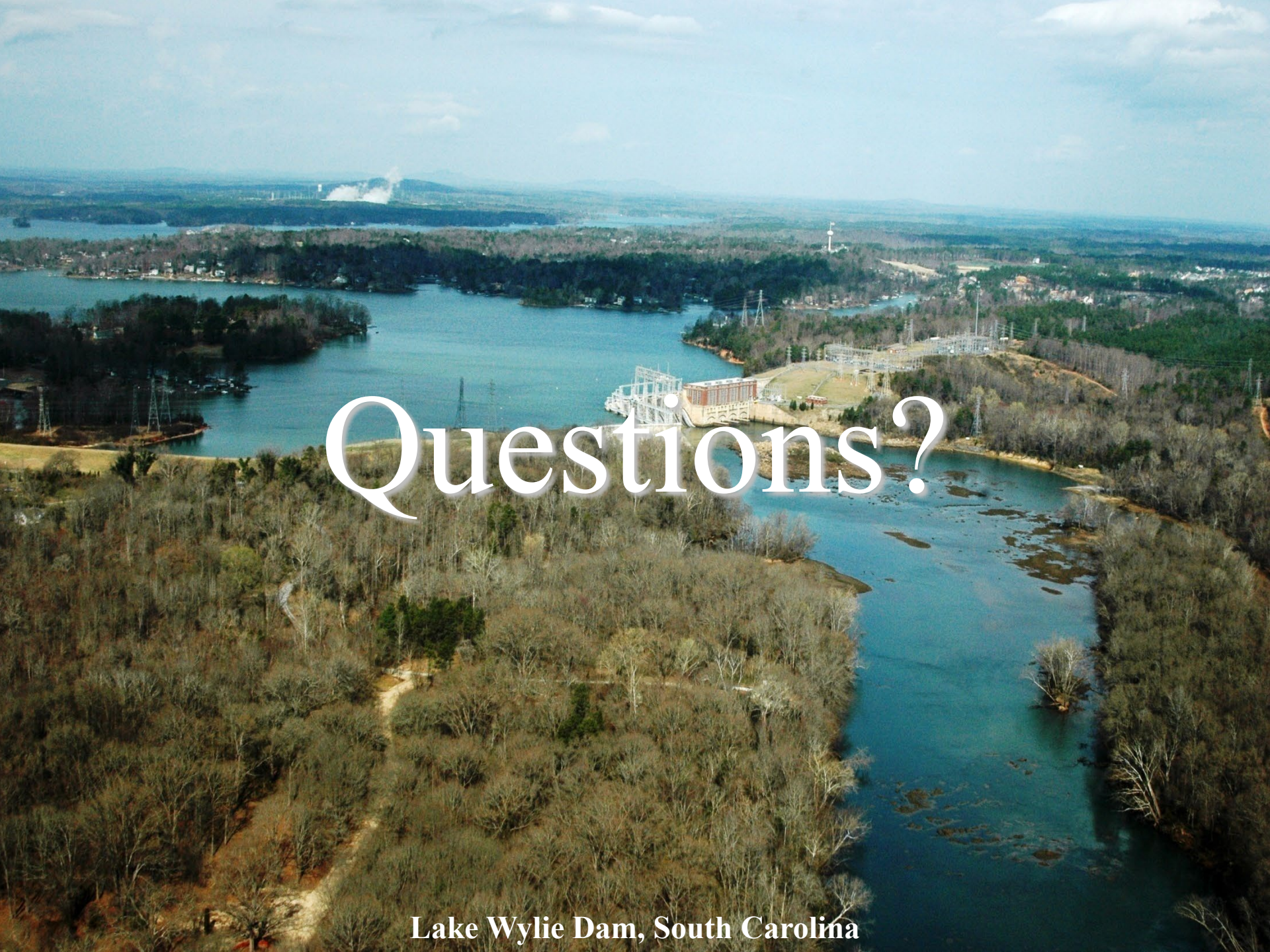
Opportunity: Require 100-foot buffers to better filter pollutants and increase open space.

Challenge: SCMs are not required for redevelopment (Session Law 2018-145 (aka Senate Bill 469)).

Opportunity: Join with Mecklenburg County to get the law changed to control stormwater from existing impervious area when redeveloped which is the primary source of water quality impairment in urban areas.

Much cheaper and easier to address water quality with new development and redevelopment than to retrofit fixes later.

Northcross Retrofit in Huntersville



Lake Wylie Dam, South Carolina

Duke Energy's Environmental Monitoring in the Catawba Basin

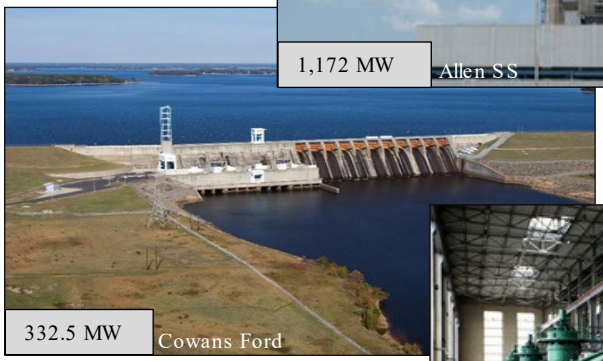
Maverick Raber
Manager, Surface Water Science & Environmental Instrumentation

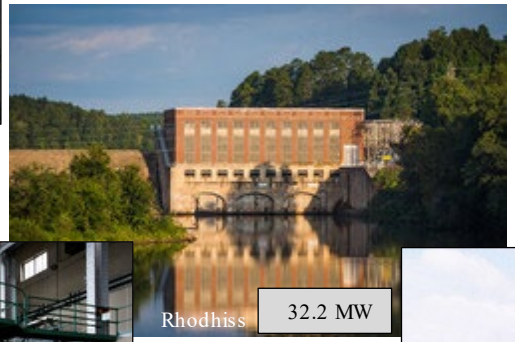
DUKE ENERGY®

Duke's Environmental Monitoring Programs

Many programs began in 1960's-1970's in the respective (pre-merger) companies (Duke Power, Progress Energy, Carolina Power & Light, Nantahala Power and Light, Cinergy) and continue today

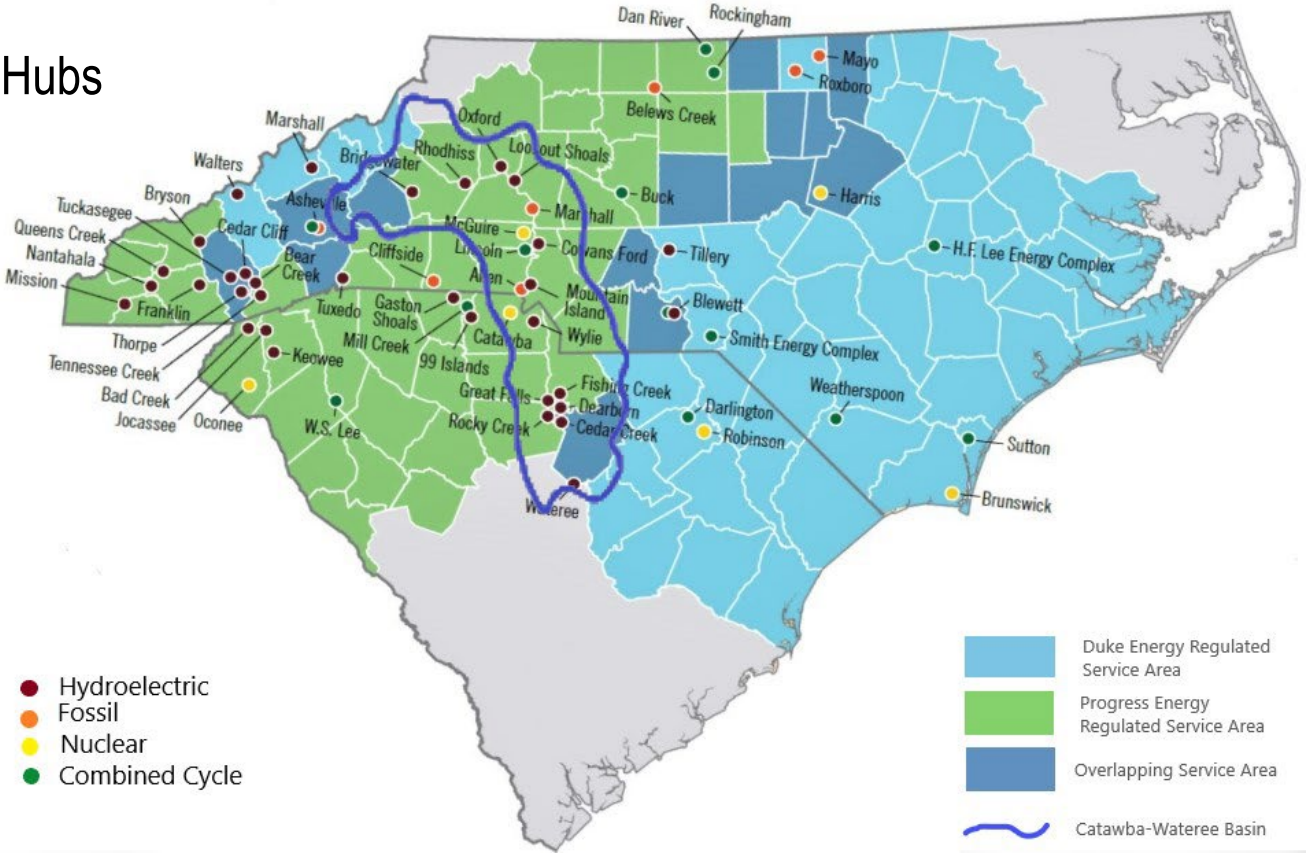
- Meet Local, State, and Federal Regulations
- Provide Operational Support for Power Plants (Hydro, Fossil, Nuclear)
- Ensure Duke is Protective of the Environment and Local Communities
  - Maintain long-term datasets for trending and tracking of waterbody changes and health





4 Regional Support Hubs

- Carolina West
- Carolina East
- Midwest
- Florida



In-house, fleet wide field monitoring, lab and environmental programs

Director of Environmental Sciences – Zach Hall

70+ Scientists and Specialists

Surface Water Science & Environmental Instrumentation
Manager - Maverick Raber
Supports – Carolina West

Analytical Laboratory
Manager – Penny Franklin
Supports – Carolinas East & West

Water Resources
Manager – Linda Hickock
Supports – Carolina East

Groundwater Science
Manager – Brian Moeller
Supports – Carolinas East & West

Natural Resources
Manager - Scott Fletcher
Supports – Carolina West (Fisheries); all (Wildlife)

Environmental Siting, Licensing & Permitting
Manager – Anne Pifer
Supports - All

Federal Clean Water Act

- 316(a) – thermal variance, balanced and indigenous communities
- 316(b) – impingement and entrainment
- 401 – water quality certification

National Pollutant Discharge Elimination System (NPDES) Permits

- Wastewater
- Stormwater

Nuclear Regulatory Commission (NRC)

Federal Energy Regulatory Commission (FERC)

- Hydro Licensing

Endangered Species Act (ESA)

Migratory Bird Act

Bald and Golden Eagle Protection Act

Coal Combustion Residuals (CCR) Rule

Coal Ash Management Act (CAMA)

Duke Energy Environmental Monitoring Programs

Surface Water Quality, Aquatic Toxicology

Sediment Characterization

Fisheries

Freshwater Mussels, Benthic Macroinvertebrates

Planktonic Communities

Aquatic Vegetation

Hydrology and Geomorphology

Groundwater Monitoring

Terrestrial Surveys

Avian Surveys

Water Quality Monitoring

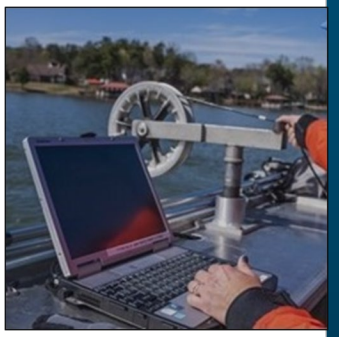
CWA – 316(a) Thermal Variance, 401 Certifications, NPDES Permits

- Weekly, monthly, quarterly, annual monitoring events
- Samples are collected across seasons and at various depths from Lake Norman & Lake Wylie (historically also Mountain Island Lake)
- Field measurements (dissolved oxygen, pH, conductivity, temperature)
- Turbidity & secchi depth - *generally *not* suspended sediment
- Nutrients & chlorophyll *α*
- Metals (several!) & major ions (chloride, sulfate, etc.)
- Aquatic toxicology

FERC – Hydro License Support

- Bridgewater temperature monitoring – trout & freshwater mussel habitat suitability
- Wateree DO monitoring – sturgeon habitat suitability
- Swim beach planning & operation - bacterial sampling (SCDHEC & NCDEQ)

Water Quality Monitoring



Operational Support

- Lake Norman temperature & DO – summertime cool water availability & fish behavior
- Hydro DO warranty – aerating runners
- Emerging contaminants – case-by-case specialized studies
- Sediment chemistry & characterization – case-by-case specialized studies

- SW snapshot of the Catawba-Wateree Basin, by the numbers:
  - Varies up to >45,000 water quality field measurements & laboratory results (>1,000 samples) each year
  - Since 1959, >2 million water quality results in our database

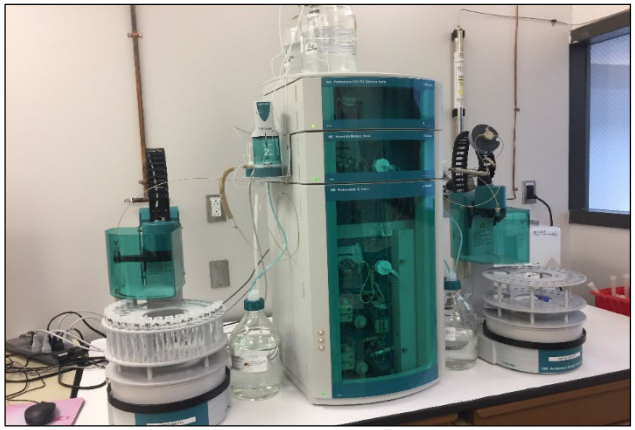
Groundwater Monitoring

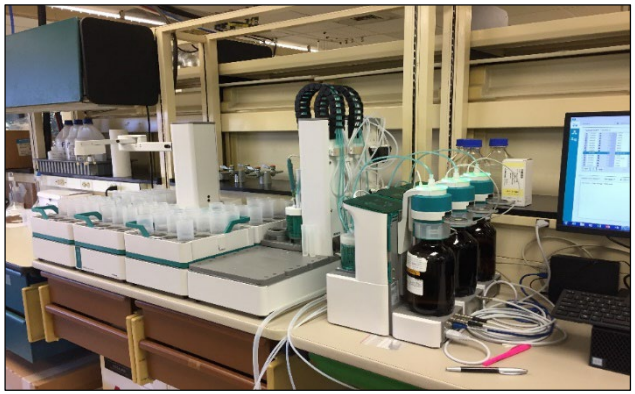
NPDES Permits, NCDEQ CAMA, Court Orders, CCR, Solid Waste Permits

- Assessment, compliance, leachate, routine detection
- Class D landfills at all Duke facilities
- Ash basins

State Certified Laboratory in NC and SC.

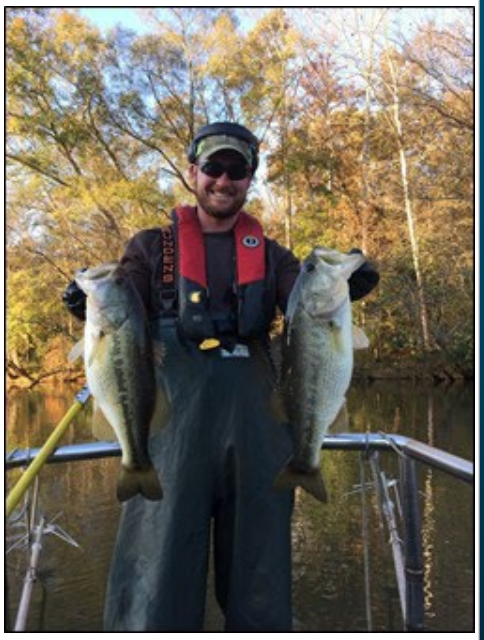
- Environmental Laboratory (groundwater, surface water, wastewater)
  - Wet chemistry
  - Trace metals determinations
  - Leachability studies
  - Material guide testing
- Dissolved Gas Analysis, Oil Characteristics, Radiochemistry
- 2020 Statistics:
  - Over 139,000 individual tests performed on 33,000 samples
  - $5,800,000 performed in-house, $5,900,000 performed by qualified vendor labs





CWA – 316(a) Thermal Variance & 316(b) Impingement & Entrainment

- Spring & fall lake fish community assessments
- Lake Norman and Lake Wylie (historically included Mountain Island Lake)
  - Fish health metrics – relative weight, rel. abundance, & length frequency (age class)
- 56 species from 12 families across the 3 reservoirs
  - Multiple trophic levels (prey and predators) and feeding guilds (insectivores, etc.)
  - Dominated by desirable species: Bluegill and black bass (Largemouth and Alabama)
  - Consistently low proportion of pollution tolerant species



NPDES Permits

- Fish Tissue (muscle) - Trace Elements and RADfish
  - Annual sampling and analysis
  - Species of different trophic levels, in Lake Norman and Lake Wylie
  - Arsenic, selenium and mercury

Fisheries Monitoring

FERC – Hydro License Support

- Diadromous Fish Surveys – American Shad, Blueback Herring, American eels
- T&E Species – Collaborative Partnerships
  - Conservation Plans (sturgeon, and others)

Operational Support

- Lake Norman Hybrid Striped Bass - Fish Behavior

CWA – 316(a) Thermal Variance, 401 Certifications

- Zooplankton & Phytoplankton Community Assessments
- Benthic Macroinvertebrate Community Assessments

FERC – Hydro License Support

- Catawba-Wateree basin-wide freshwater mussel population surveys – community and T&E
- Freshwater mussel habitat assessments – temperature suitability

Operational Support

- Invasive & Nuisance Species - Chinese Mystery Snail, Asiatic Clams (*Corbicula*)

Hydrology and Geomorphology

FERC - Hydro License Support

- Ecological flows – Bridgewater trout & mussel habitat

Operational Support – Hydro, Nuclear, Fossil

- Bathymetric surveys – maintenance, planning, O&M improvements
- Receiving stream flows – engineering & permitting

CWA 316(a) Thermal Variance

- Habitat formers in Lake Norman & Lake Wylie

FERC – Hydro License Support

- Catawba-Wateree reservoir plant population surveys

Operational Support

- Invasive & Nuisance Species - power plant intakes

Bald and Golden Eagle Protection Act

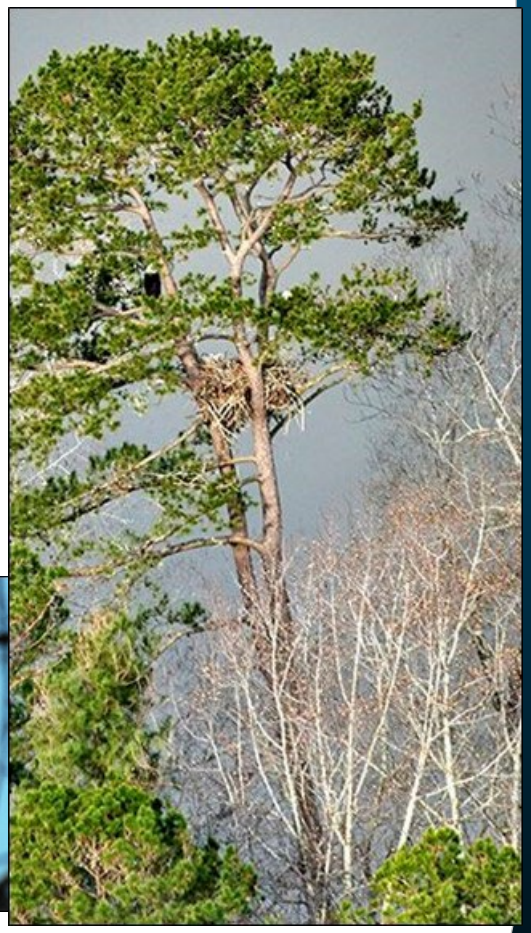
- Catawba-Wateree bald eagle rookery surveys
- Sighting and reporting injuries and fatalities

Migratory Bird Act

- Migratory Bird Hotline – relocations, reporting injuries and fatalities

FERC – Hydro License Support

- Catawba-Wateree colonial wading bird rookery surveys

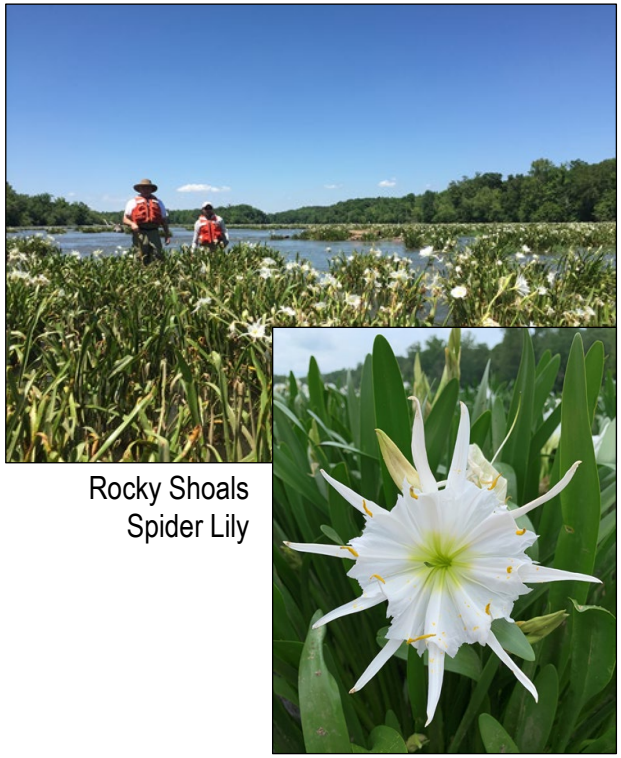


Endangered Species Act

- Catawba-Wateree terrestrial community assessments
- T&E species – flora & fauna

Bats – 14 species detected

Schweinitz's sunflower



Rocky Shoals
Spider Lily

Collaborative Partnerships / Advancing the Science!

Water Quality Monitoring & Analysis

- Drones!
- Laboratory analytical methods - detection limits
- Isotopic analyses
- Bromide treatment (UGA)
- Reservoir limnology (1960's through 1980's, and beyond)

Fisheries Monitoring

- XRF - Trace element analytical method development
- Selenium bioassay (late 1970's)
- Hybrid striped bass telemetry
- Sensitive Species Conservation Plans

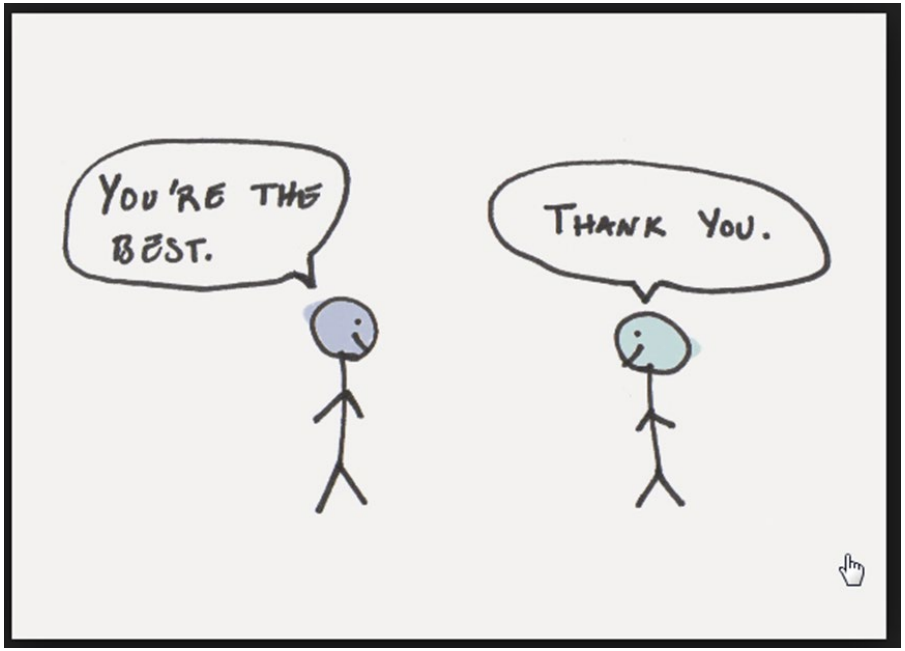
Aquatic Vegetation Monitoring

- Lyngbia research (USC)

Avian Monitoring

- Top of the World testing site for IdentiFlight camera technology

Citizen's Water Academy
February 15, 2022



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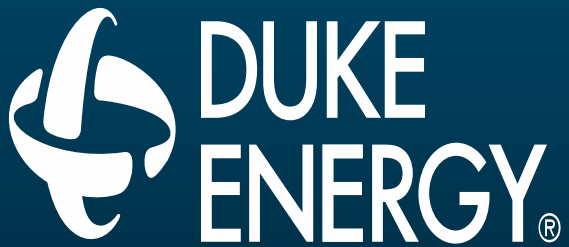
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