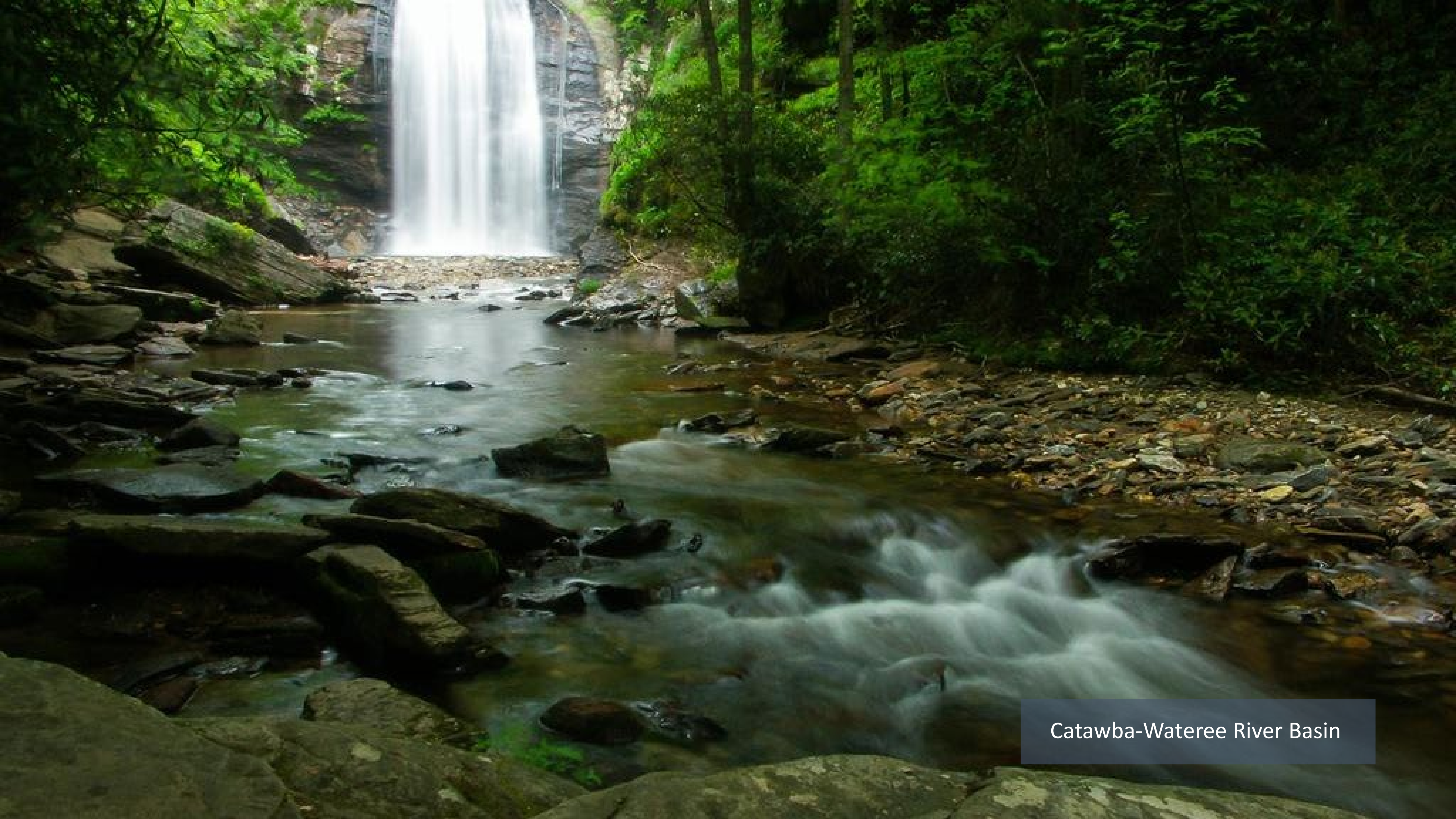
CATAWBA-WATEREE INITIATIVE

Clean Water Starts with a Healthy Forest

Understanding the Land / Water Connection

Where do you go to find naturally clean water?


Catawba-Wateree River Basin

Catawba-Wateree Initiative

CATAWBA-WATEREE INITIATIVE

Started in 2015 with:

FOOTHILLS CONSERVANCY OF NORTH CAROLINA

CATAWBA LANDS CONSERVANCY ESTD 1991

THE CONSERVATION FUND

Protecting Source Water in the Catawba-Wateree Watershed

In Partnership with

CATAWBA WATEREE
WATER MANAGEMENT GROUP

CATAWBA-WATEREE INITIATIVE

Collaborating with

Katawba Valley Land Trust
Nation's Ford Land Trust
Western Piedmont Council of Governments
Santee-Lynches Council of Governments
Centralina Council of Governments
Catawba Riverkeeper Foundation
SC Rural Water Association
Resource Conservation and Development Councils
Soil and Water Conservation Districts
US Forest Service
Local Governments
Forestry groups

Funded by: U.S. EPA Endowment for Forests and Water – Healthy Watersheds Consortium
Z. Smith Reynolds Foundation

Method and Strategy

One Water Approach – use a systems mindset
Recognize interdependence of land – water - energy

Invest in forests as an integral part of water infrastructure
Use Natural Infrastructure to complement Built Infrastructure

Collaborate to create integrated, inclusive, sustainable management strategies that:

- protect our source water
- maximize forest benefits
- mitigate adverse impacts from development and agriculture
- avoid costs

Make positive environmental, economic and social impacts

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What is Source Water Protection?

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The American Water Works Association says:

Source water protection is one of the first critical barriers against drinking water contamination and other risks to drinking water supplies.

A strong source water protection program can be one of the most cost-effective methods for maintaining, safeguarding, and improving source water—and drinking water—quality and quantity.

Effective Source Water Protection relies on protecting the lands over which the water flows

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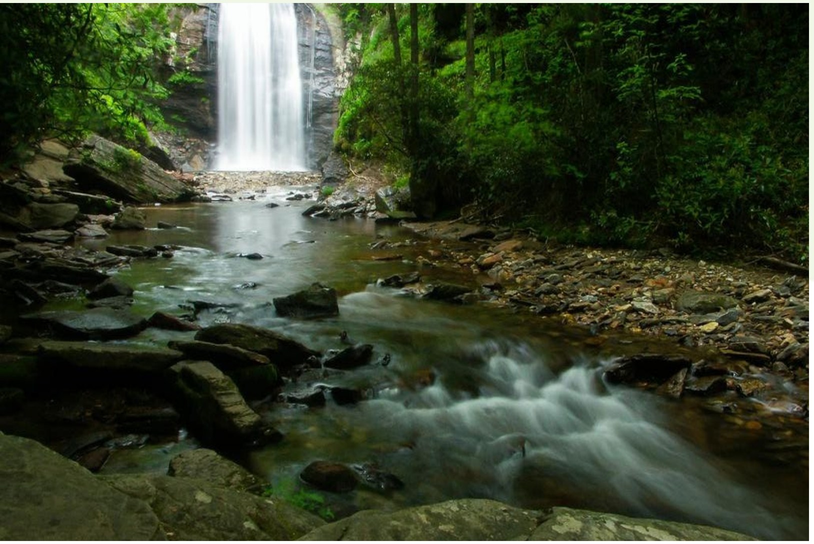
The Journey: Source Water to Drinking Water



Protect the water on its journey between the two.

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Thousands of miles of streams and tributaries are the real source of our water.

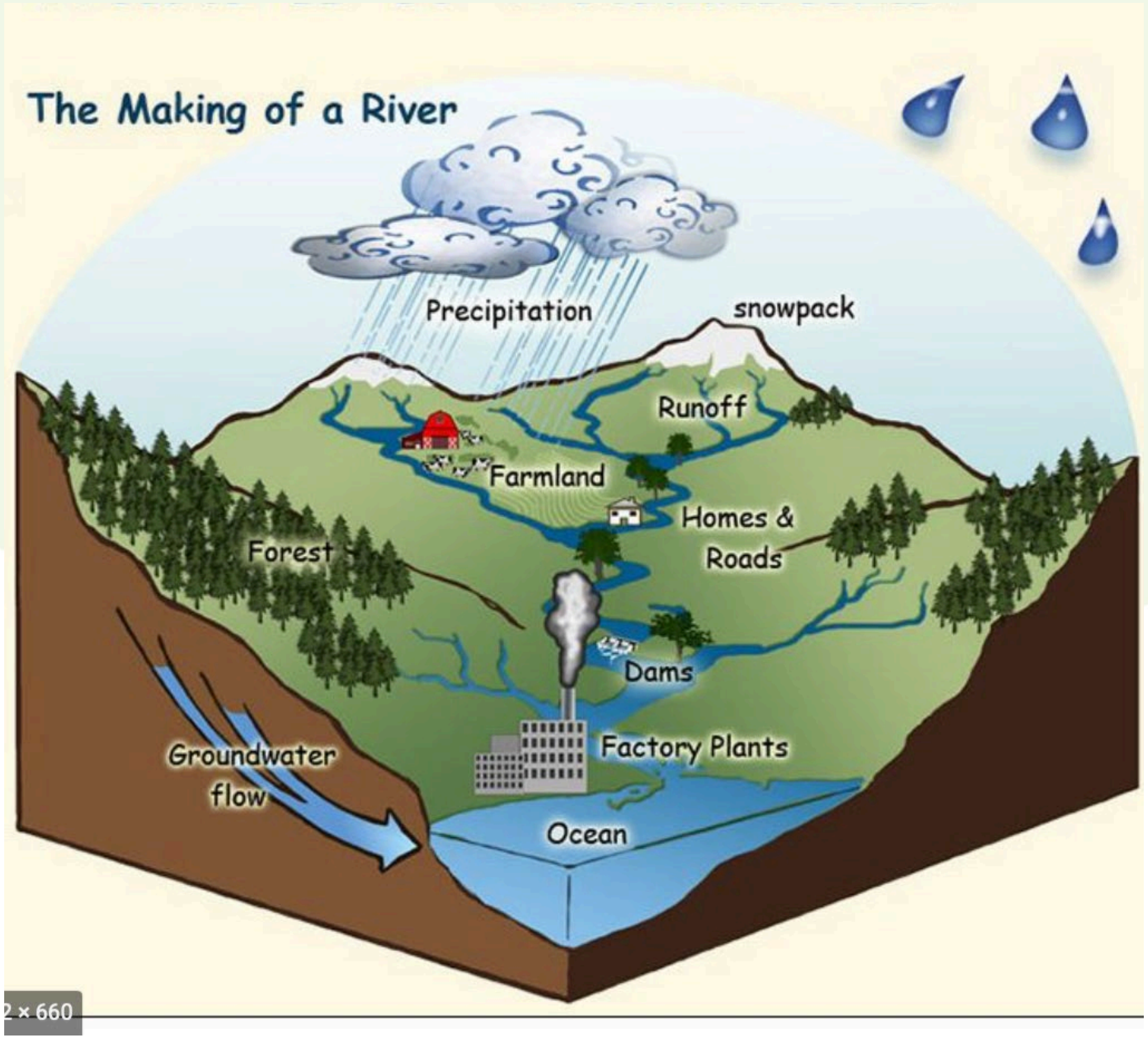
Every drop carries with it a legacy gained from the land over which it flows before it enters a raw water intake on its way to our faucets.

Rivers flow within Watersheds.

A Watershed is that area of land that drains all the streams and rainfall to a common outlet.

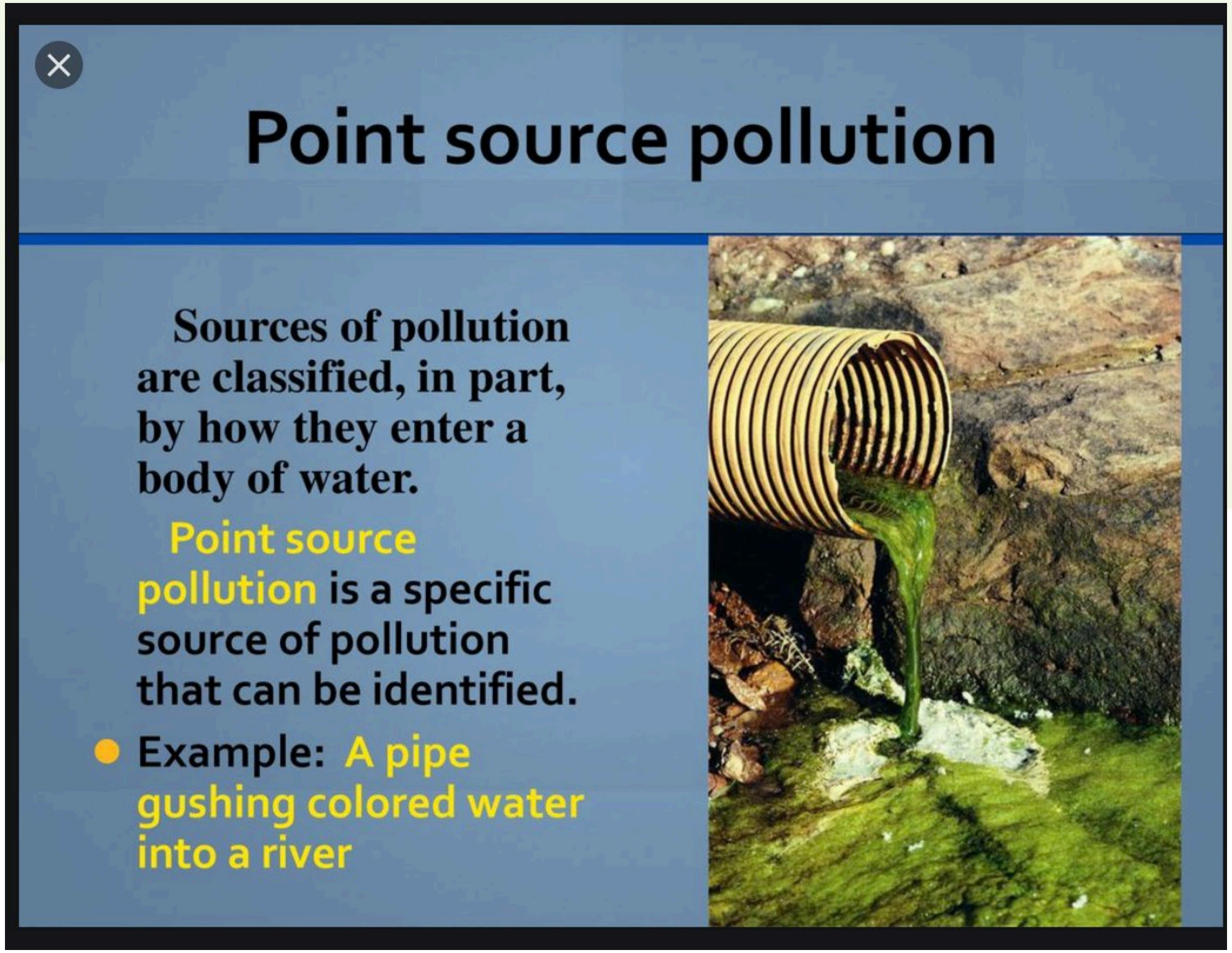
It lies between ridges that define the boundaries between watersheds.

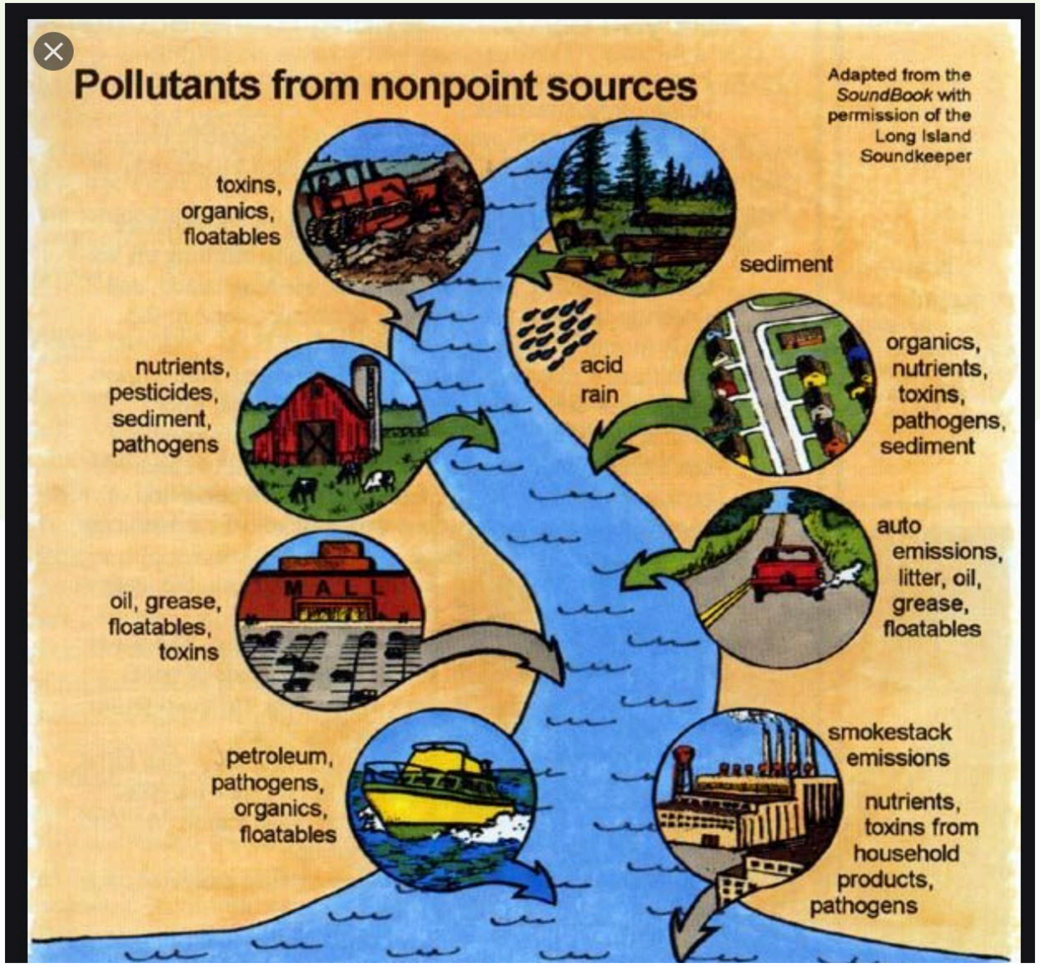
That’s why we call the area around a river a river “basin”



In a watershed there are two main types of pollution:

Point Source and Non Point Source

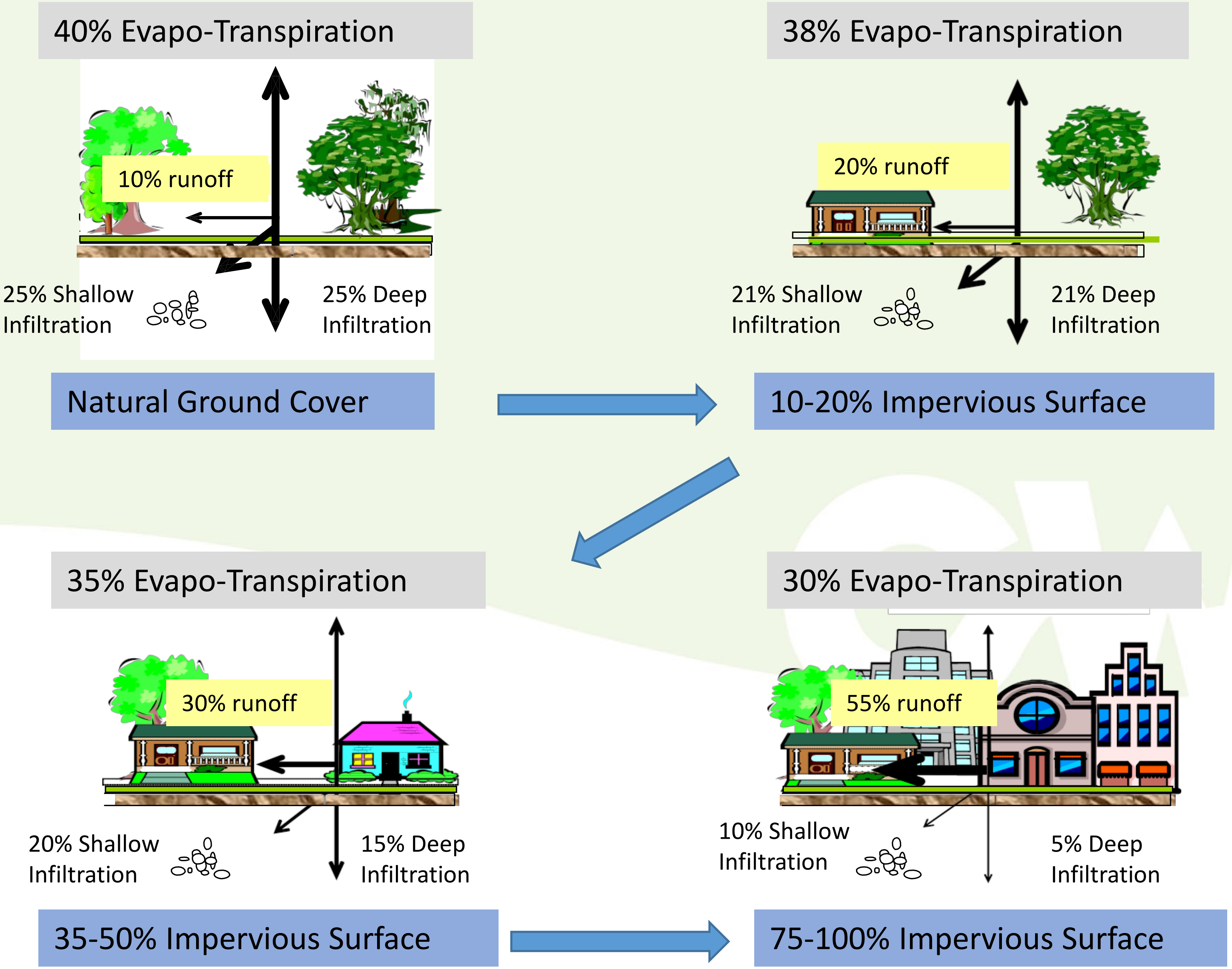




<u>Point source pollution:</u> Relatively easy to find and fix

<u>Non-point source pollution:</u> Multiple sources and harder to deal with

<u>Natural lands</u> around source water are the best protection from non-point sources. They act as <u>sponges and filters.</u>



http://www.coastal.ca.gov/nps/watercyclefacts.pdf

What changes when forest lands are developed?

2(a) Representative of hydrograph of a forested watershed

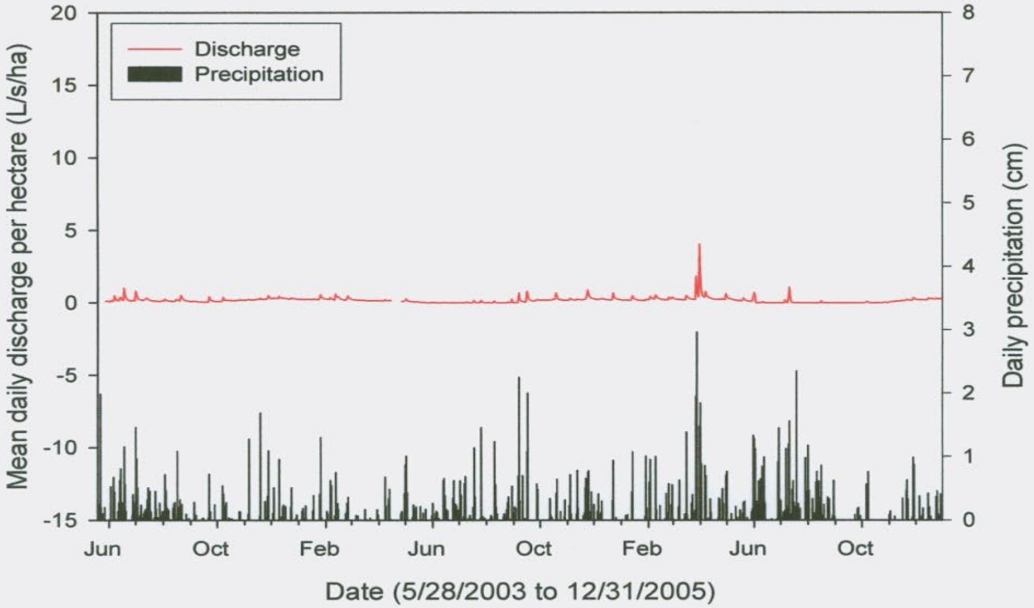


Figure 2 (a)

2(b) Representative of hydrograph of an urban watershed

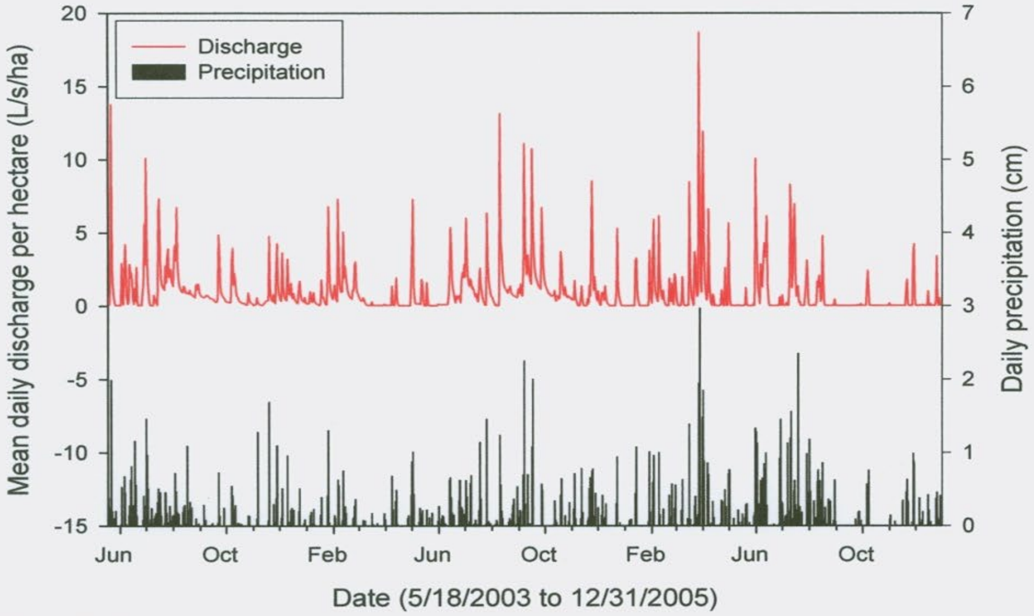


Figure 2 (b)

This has implications for
QUALITY
QUANTITY
RELIABILITY of our water supply

Flashiness

The runoff from one acre of paved parking generates the same amount of annual
runoff as: 36 acres of forest;
20 acres of grassland;
or a 10 acre subdivision (0.5 acre lots).

One inch of rainfall on one acre of forest produces no excess runoff.

The same one inch of rainfall on one acre of asphalt produces over 27,000 gallons of runoff.

Sedimentation

What do forests and natural lands do for us?

Reduce volatility of flows
Reduce sedimentation & pollution
Help preserve storage capacity in reservoirs
Reduce water treatment costs
Keep water cool
Provide multiple other public benefits:
    Jobs, recreation, wildlife, clean air

In short, they provide reliability and resilience for our water supply and quality of life

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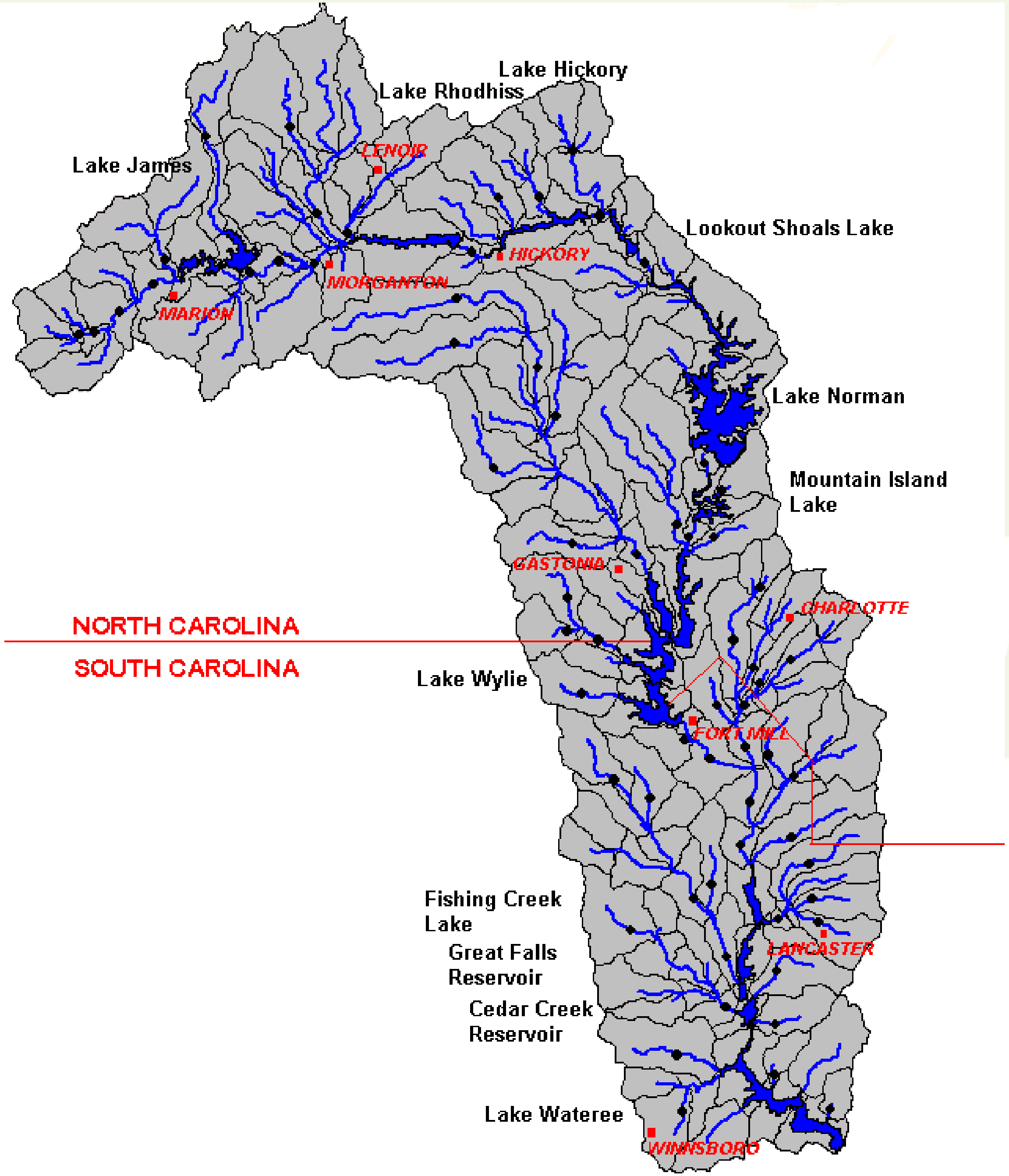
Catawba Wateree River Basin



About 50-60% forested.

How can we protect natural lands in a rapidly growing region?

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• Find out which lands are most critical to enable that growth by protecting our water supply.

• Use the RTI International Study and Modeling Tool – What’s that?

• Incorporate local knowledge and update zoning and land use plans and ordinances as we grow and develop.

• Seek funding sources for conservation and protection.

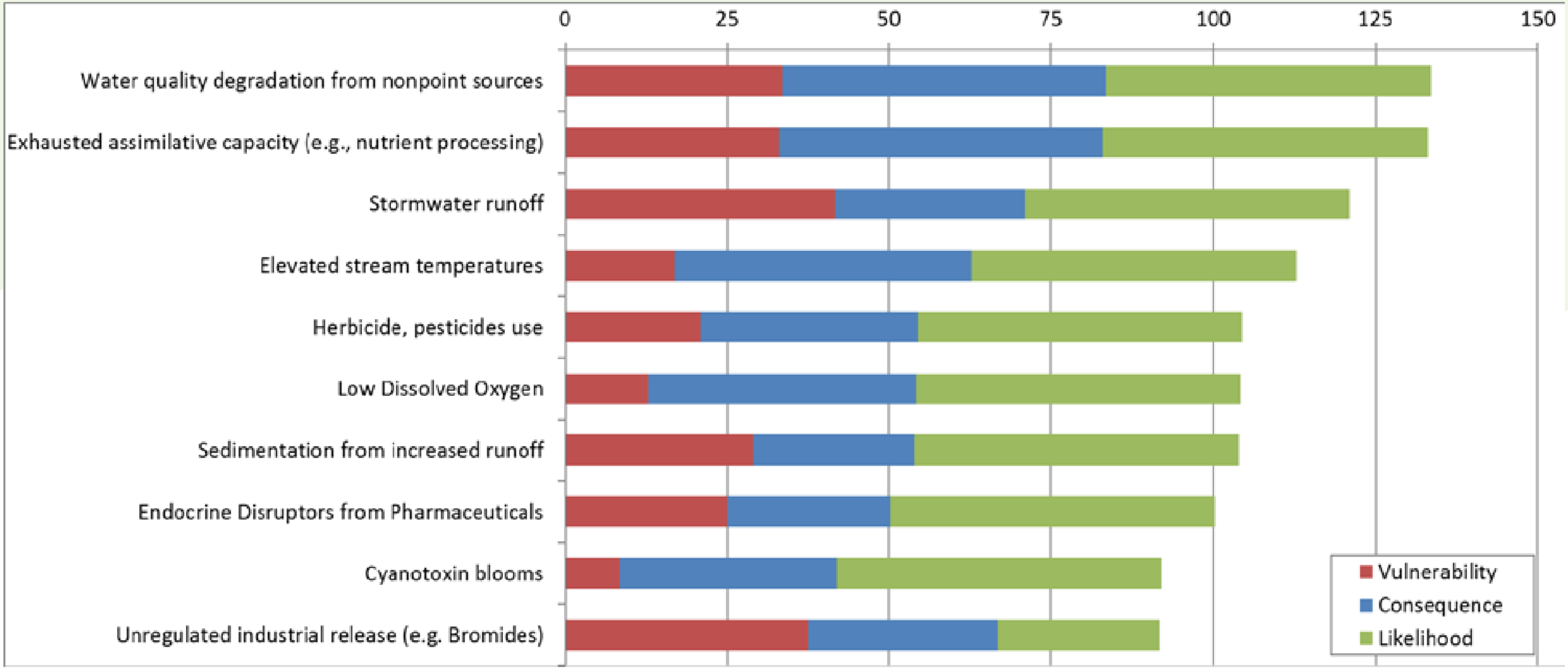
Key Finding from the RTI Study

Not so surprising

Land use change (from natural to developed) was the biggest driver of water flow and sediment delivery changes.

Land use is also the biggest factor we CAN control

Threats identified in Water Supply Master Plan



6 of the 10 threats, including the top 5 are directly related to land use

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Economic Benefits

- $1 for source water protection saves $27 on water treatment (Winecki 2012)
- 10% increase in forest cover reduces treatment and chemical costs 20% (AWWA 2004)
- NYC filtration avoidance waiver - $2B in watershed protection vs projected $8B - $10B in treatment costs
- Many other examples in U.S.
- We are generating our own numbers with the RTI model

Does that mean we have to buy thousands of acres? Stop new development?

NO.

It means we should find ways to protect critical lands. It doesn’t take them out of use. Instead it keeps them in use performing valuable ecosystem services.

Development always depends on a region’s water source being clean and reliable. Land protection is key for that to continue.

We are working to find the right balance of land acquisition for permanent protection, easements, best management practices, zoning and land use decisions. This takes collaborations between land trusts, agriculture, government, and all of us.

What Actions are we Taking?

Toured the utilities' treatment plants to understand operations, build relationships and gain additional points of view on watershed protection.

Held 4 regional workshops for planners and elected officials to learn how the RTI Model works, how to use it, and why to use it.

Collaborated with the CWWMG to fund an update to the RTI model with more current land use data.

Launched an online too so anyone can use the RTI modeling tool to see quantified benefits of protecting natural lands.

Working with HDR Engineering as the Integrated Water Resources Plan is developed which will now include Source Water Protection and land conservation planning.

Progress

The CWWMG now includes land conservation for source water protection in its strategic planning.

A process and criteria have been developed to guide strategic land protection and investment.

CWWMG contributed toward the acquisition of 3 critical land areas.

A Source Water Protection Plan is drafted.

Oak Hill Community Park and Forest Burke County NC

A project of Foothills Conservancy of North Carolina
We ran the RTI model and saw these projections for the 652 acres of land if conserved:

Sediment Avoided: **290 tons/year**
Economic Benefit of avoided sediment: **$ 247,185**
Economic Benefit of protected canopy: **$ 3,188,693**
Total Economic Benefit: **$3,435,879**
Total Economic Benefit per acre: **$5,082**

Raised **$3.1 million** to purchase this land.

Plans:

Restore impaired stream that drains directly into the Catawba River

Open for public recreation and connect two mountain greenways and trails

Farmland portion will support community agriculture
Forest restoration and forestry education

Forney Creek Lincoln County NC

A project of Catawba Lands Conservancy

Drains into Dutchman's Creek, a tributary of Lake Wylie

This project helped close a gap in the 470 acre Forney Creek Conservation Area

Provides access for critical stream restoration on Forney Creek

Will provide access for future leg of the Carolina Thread Trail

Paddy Creek Burke County NC

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Paddy Creek flows directly into Lake James

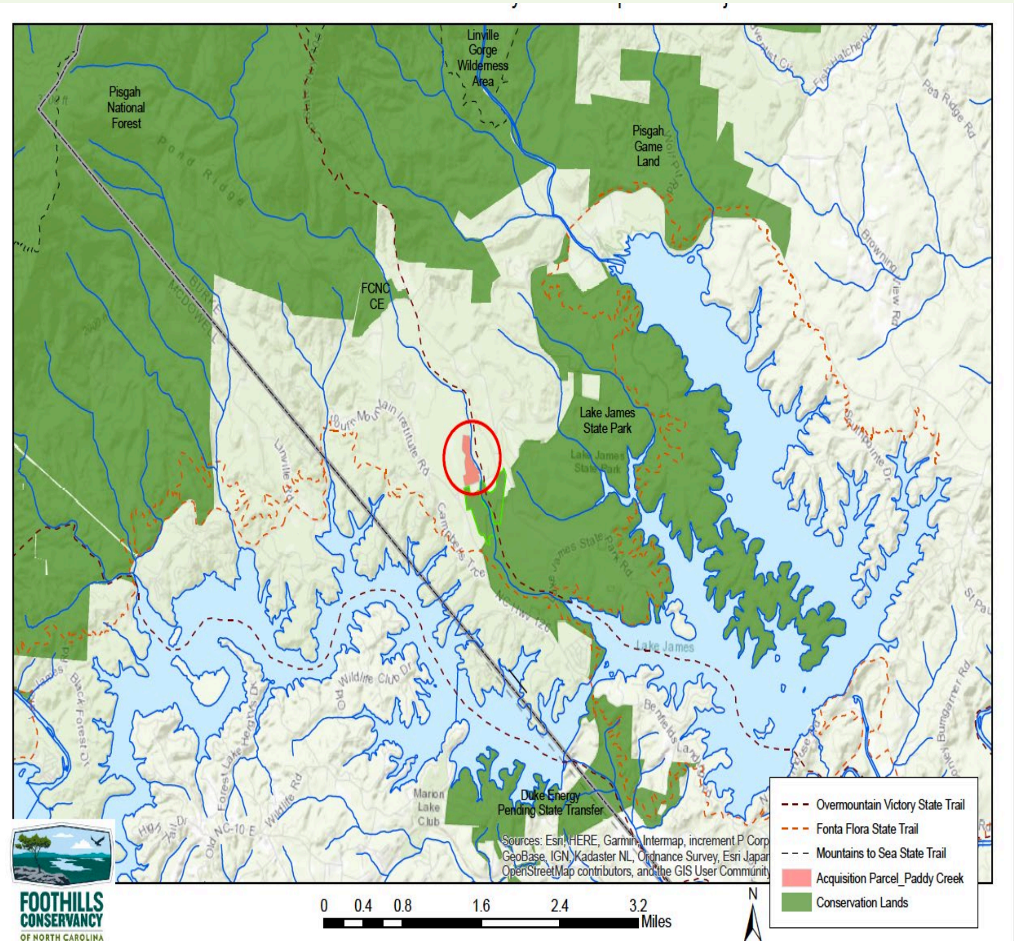
Currently threatened due to cattle grazing within the buffer

Cattle will be moved and managed elsewhere

Buffer will be restored

Provides critical link to ultimately connect conserved land to Lake James State Park

Will provide access to Overmountain Victory National & State Trail



What's Next?

Include Source Water Protection in the Integrated Water Resources Plan

Work more closely with water quality committee

Include management of invasive species that affect our source water

Continue to identify critical lands for protection using the RTI modeling tool and local knowledge

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What can we all do?

- Support natural lands, parks and open space
- Support your local land trusts
- Learn about zoning and storm water protection
- Learn about your Soil and Water Conservation District
- Get involved in land use decisions
- Learn about best management practices
- Enjoy being part of a healthy ecosystem!

Impacts of Land Use on Water Quality – A Framework for Identifying Conservation Priorities

Catawba-Wateree Watershed Case Study

February 17, 2022

Michele Eddy

George Van Houtven, Benjamin Lord, and Katie van Werkhoven,

RTI Center for Water Resources

Sponsored by The Water Research Foundation

(WRF Project #: 4702)

The Duke Energy Water Resources Fund

The Catawba Wateree Initiative

What we are Trying to Find….

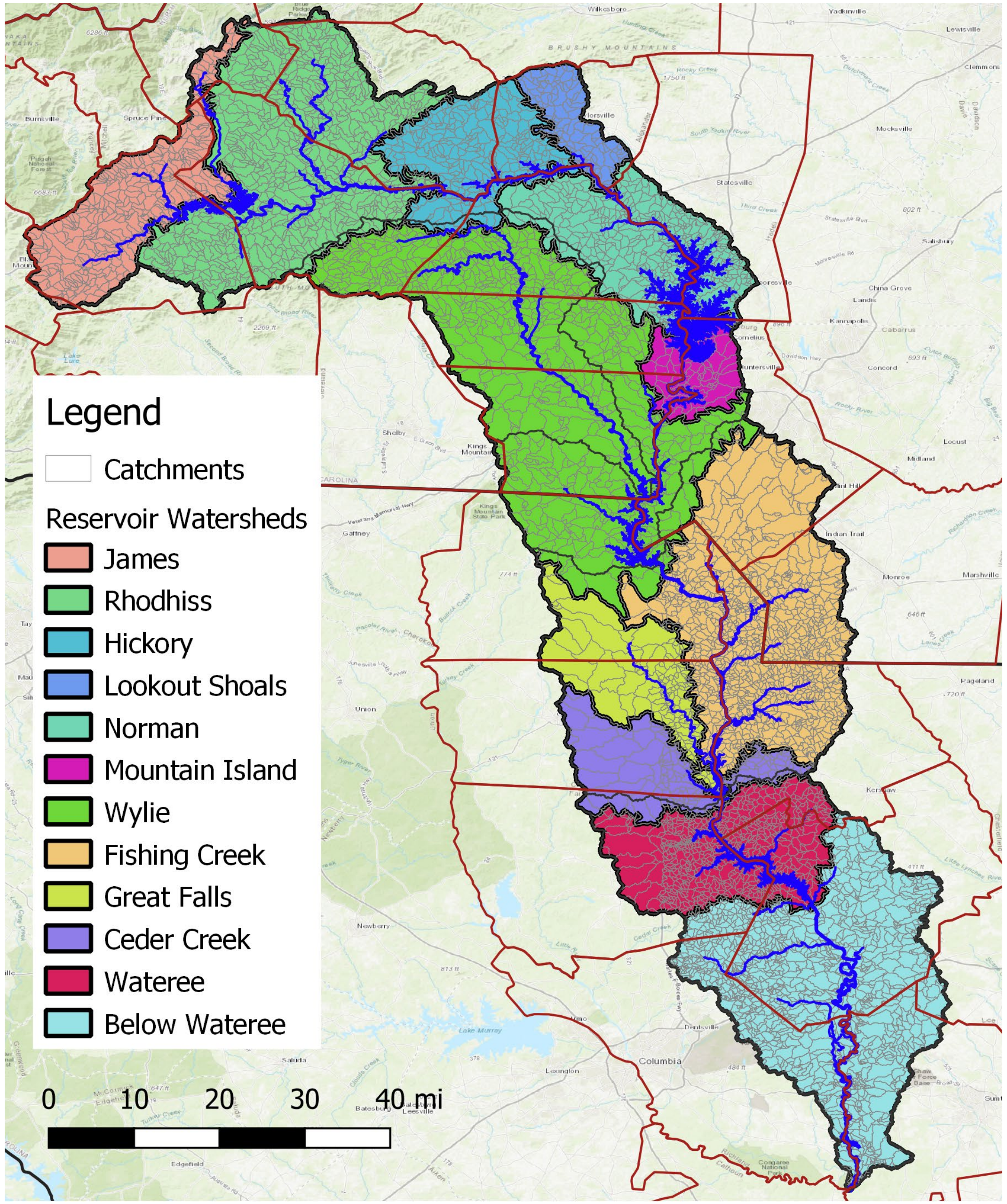
- **Hot Spot: a drainage area within the watershed in which**
  - (1) future projected changes in land use, climate, or water use have been determined to cause concerning levels of hydrologic or water quality change and
  - (2) there is an opportunity for conservation action to mitigate the projected changes.

Provide the numbers ($$ included) and corresponding geographic locations to support all the efforts Vicki just described

Framework Process

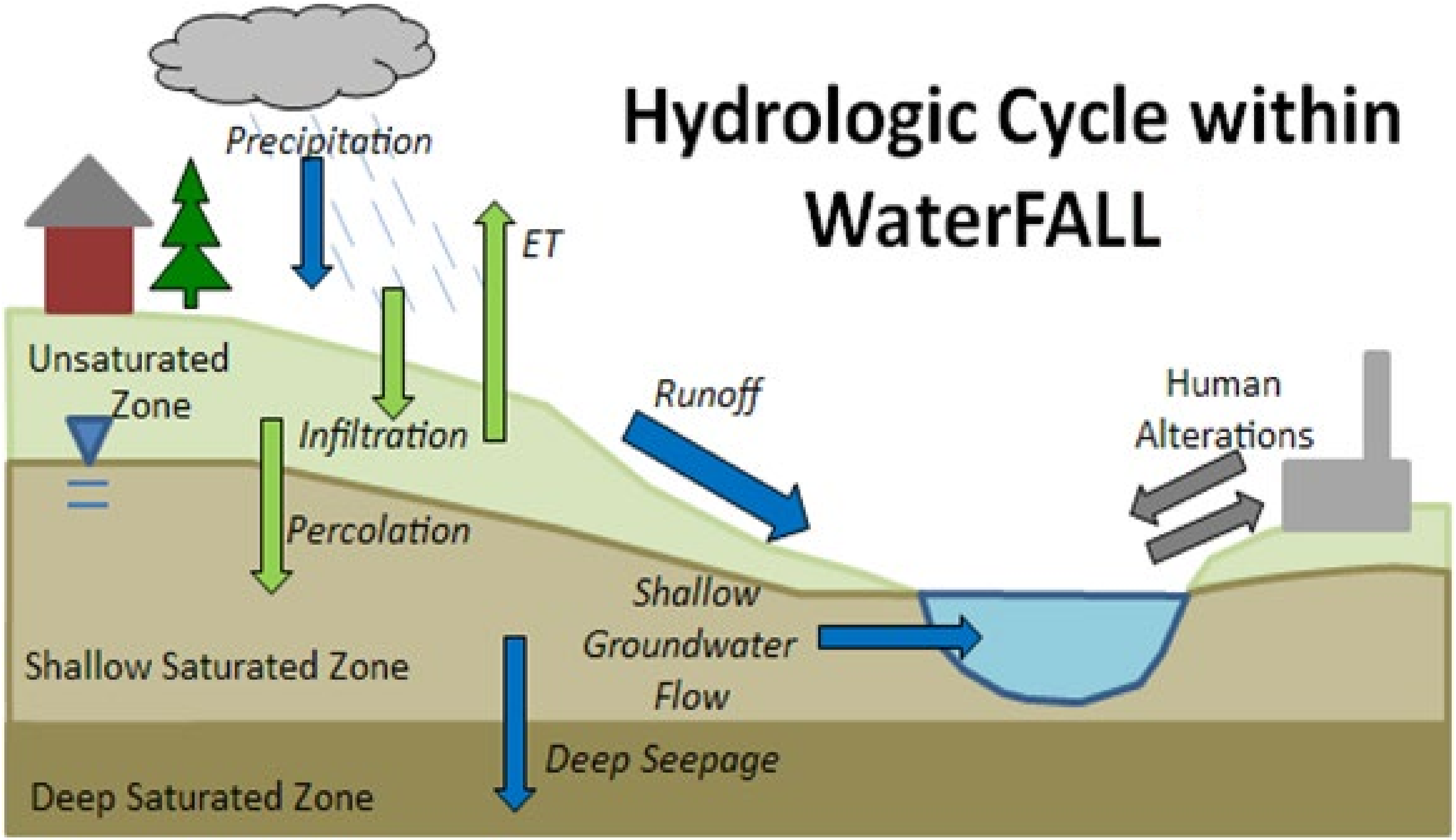
1. Estimate potential changes in flow and sediment delivery in the watershed as a result of future change in climate, land use, and water use
2. Find areas in the watershed where the impact relative to other areas is disproportionately large (“hot spots”)
3. Determine if and to what extent land conservation of “hot spot” could mitigate some portion of the total downstream impact to water supply
4. Estimate the net economic benefits of the mitigation and combine with “hot spots” for watershed prioritization
5. Guide stakeholders in using the maps, values, and summaries in planning, application, and education activities.

High Resolution Representation of the Drainage Basin



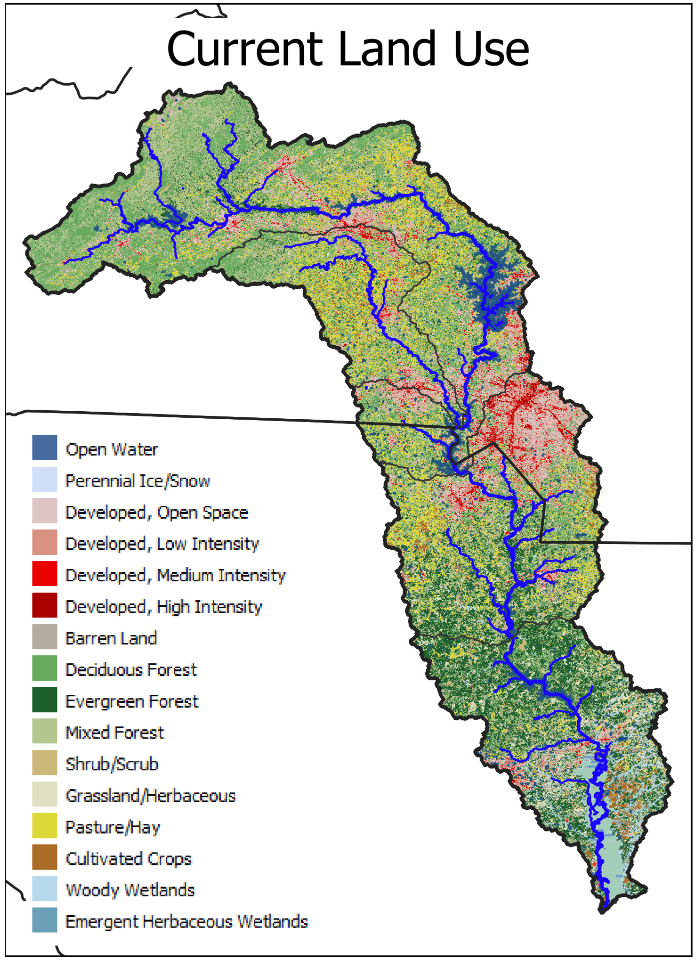
Watershed	# NHDPlus Catchments
Lake James	447
Lake Rhodhiss	871
Lake Hickory	293
Lookout Shoals	132
Lake Norman	462
Mountain Island Lake	66
Lake Wylie	853
Fishing Creek	1,393
Great Falls Reservoir	206
Cedar Creek Reservoir	340
Lake Wateree	825
Below Lake Wateree	1,571
Grand Total	7,459

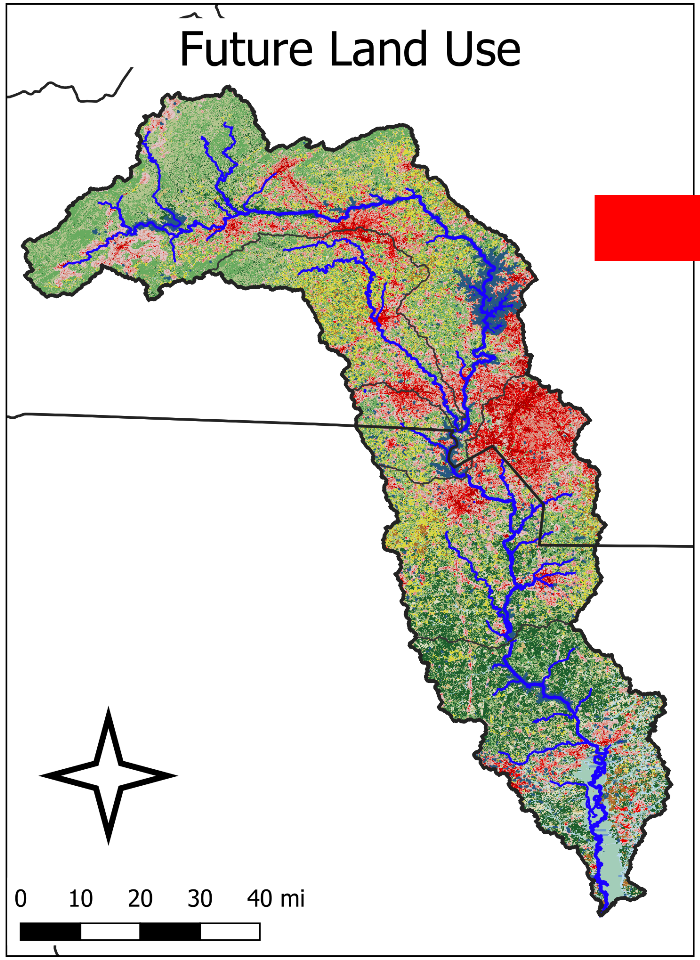
WaterFALL®: A High-Resolution Watershed Model

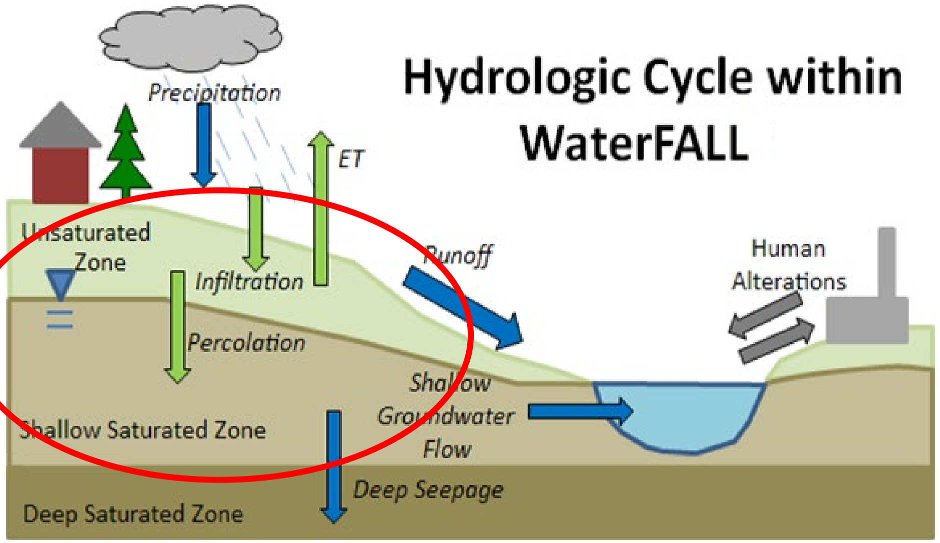


Eddy et al., 2017. JAWRA 53(1)

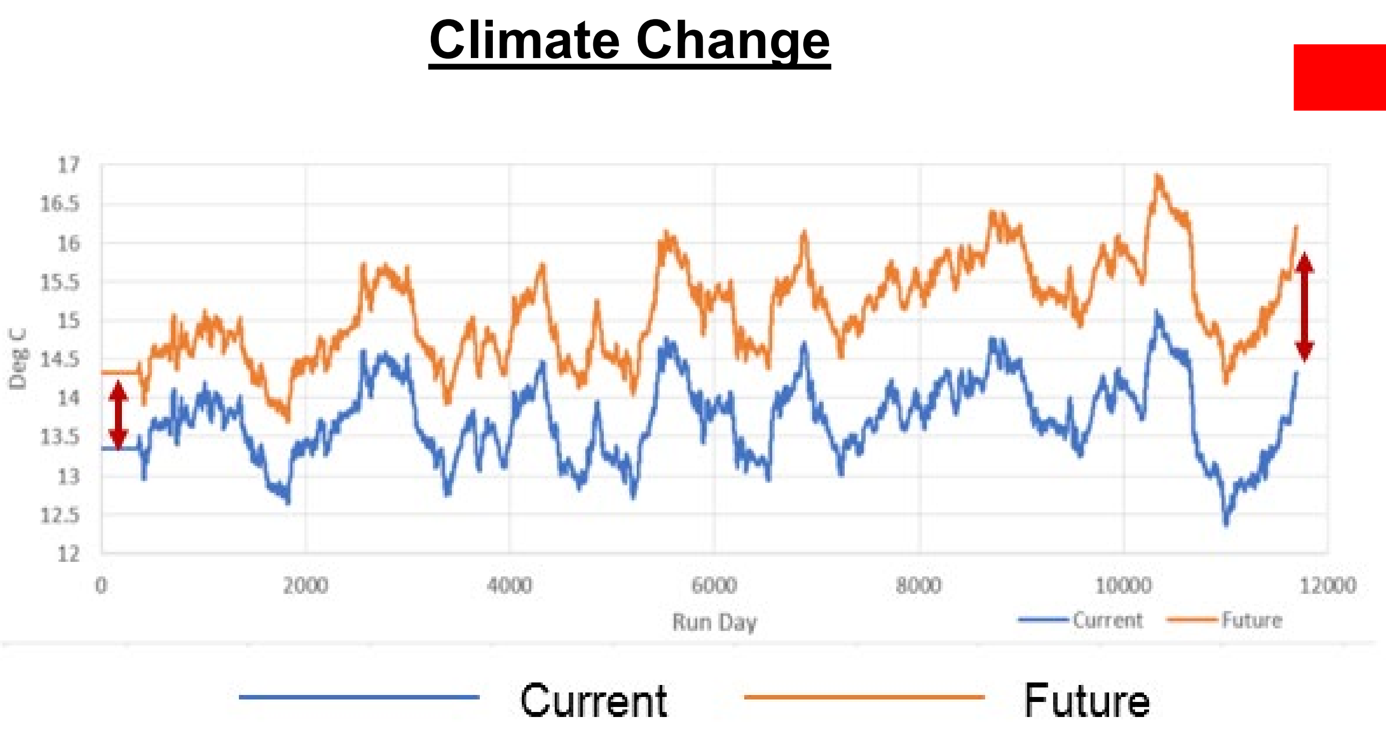
What if the land use changes?

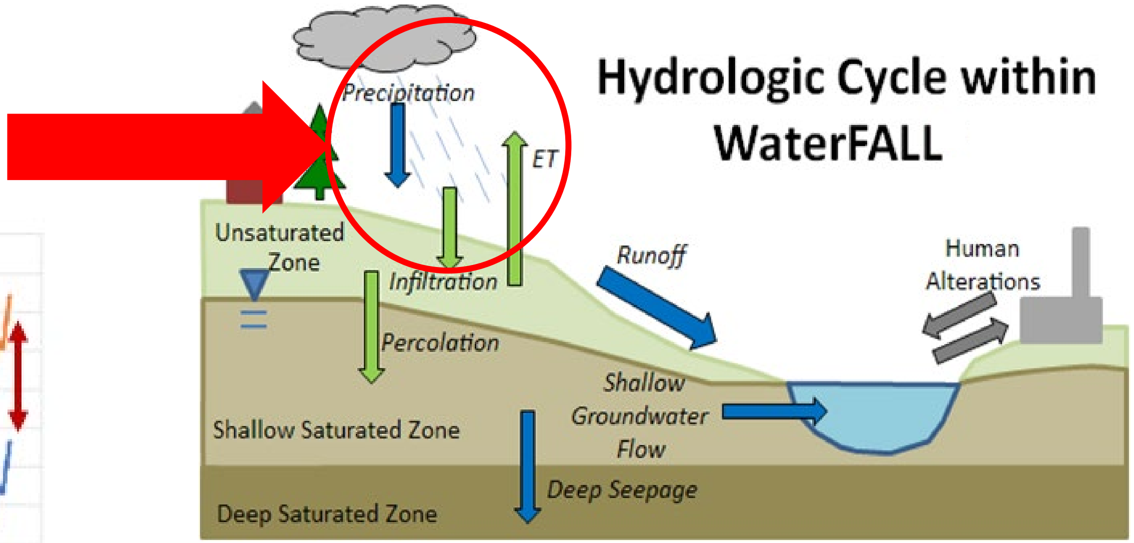






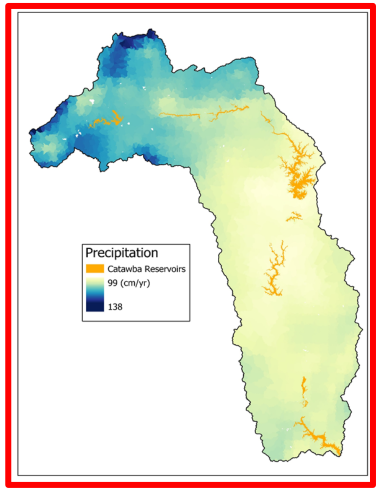
What if the climate changes?

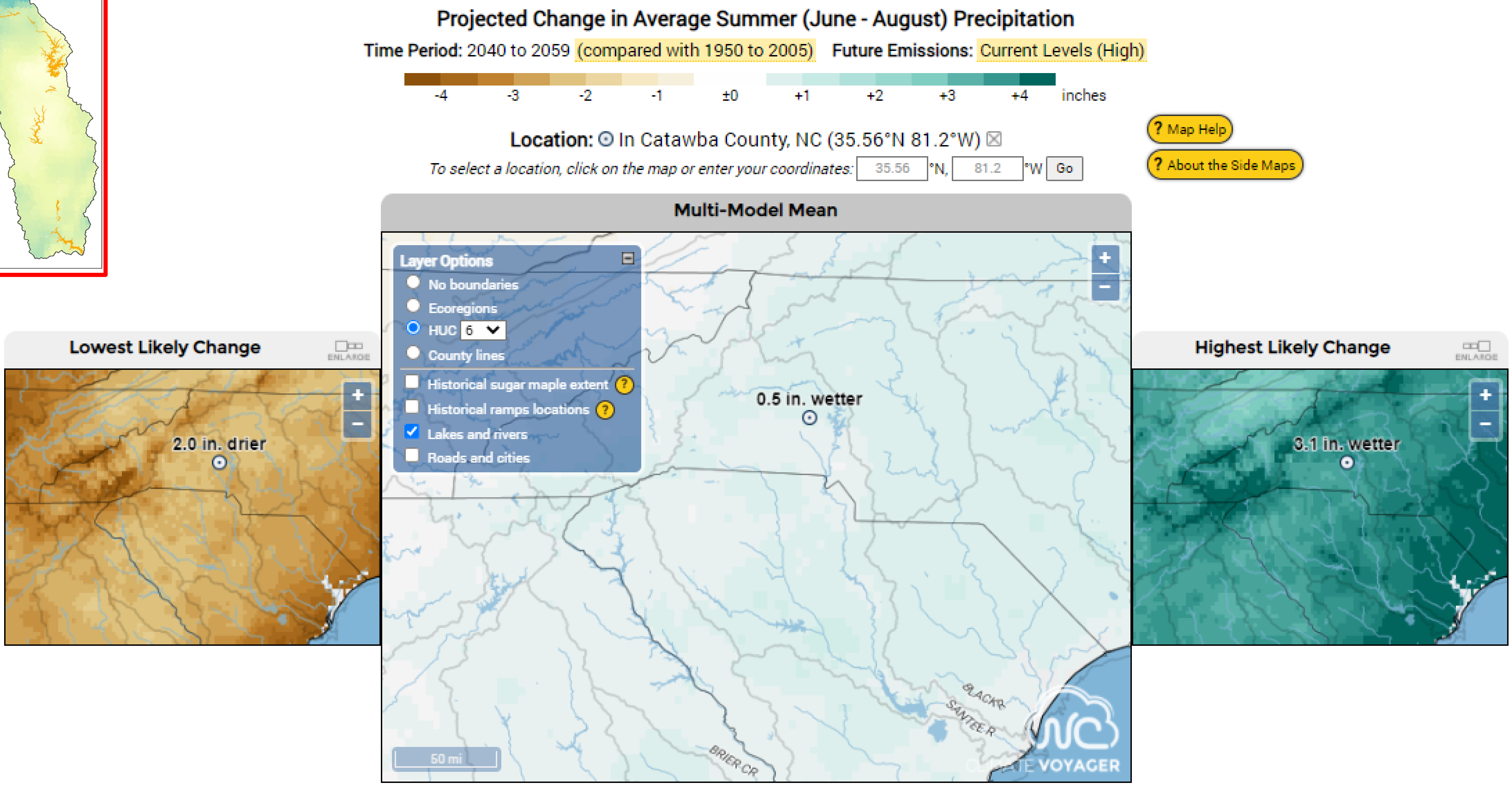




Source: Eddy et al., 2019

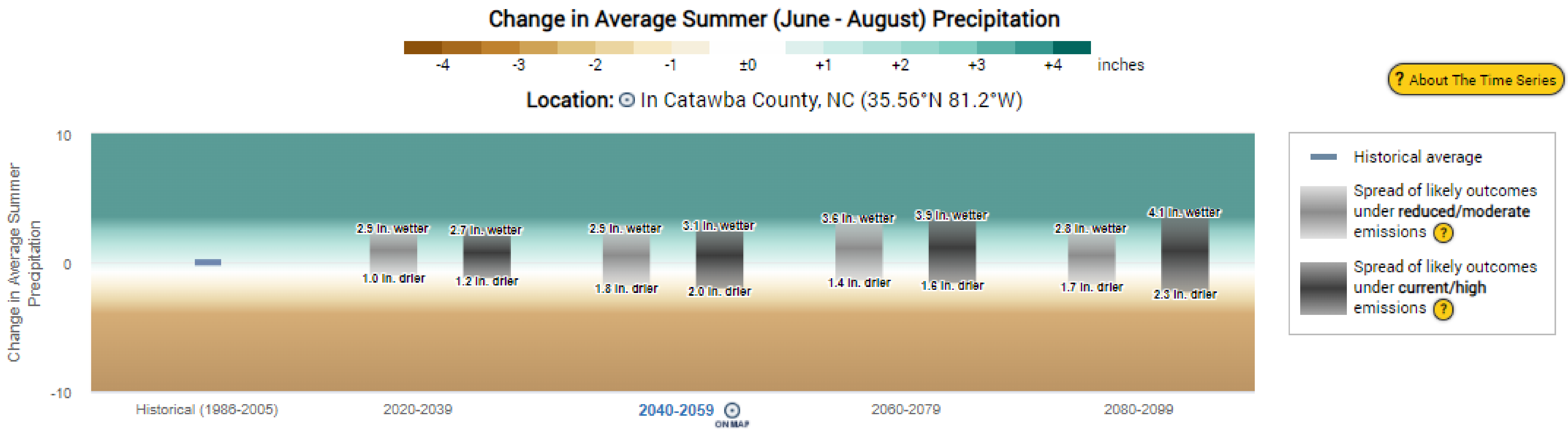
A Note on Future Precipitation





https://products.climate.ncsu.edu/voyager/index.php?tool=summer_precip

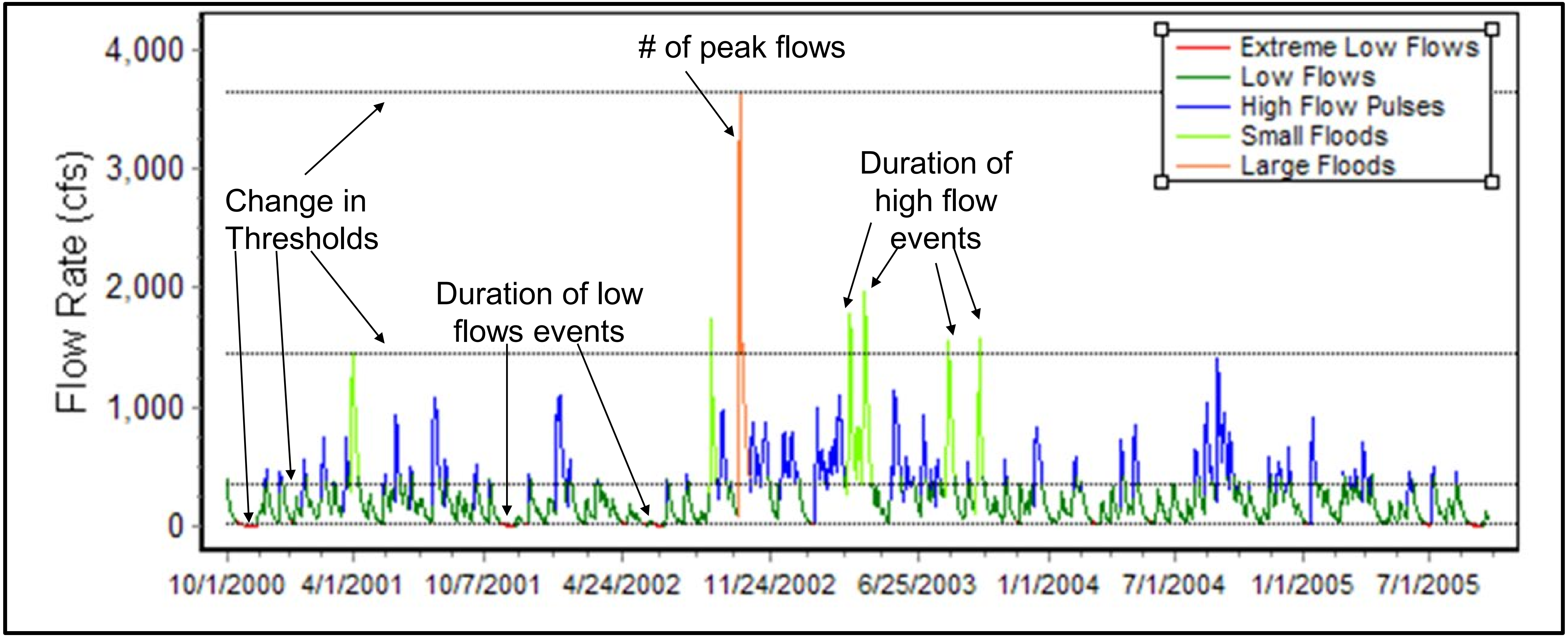
A Note on Future Precipitation



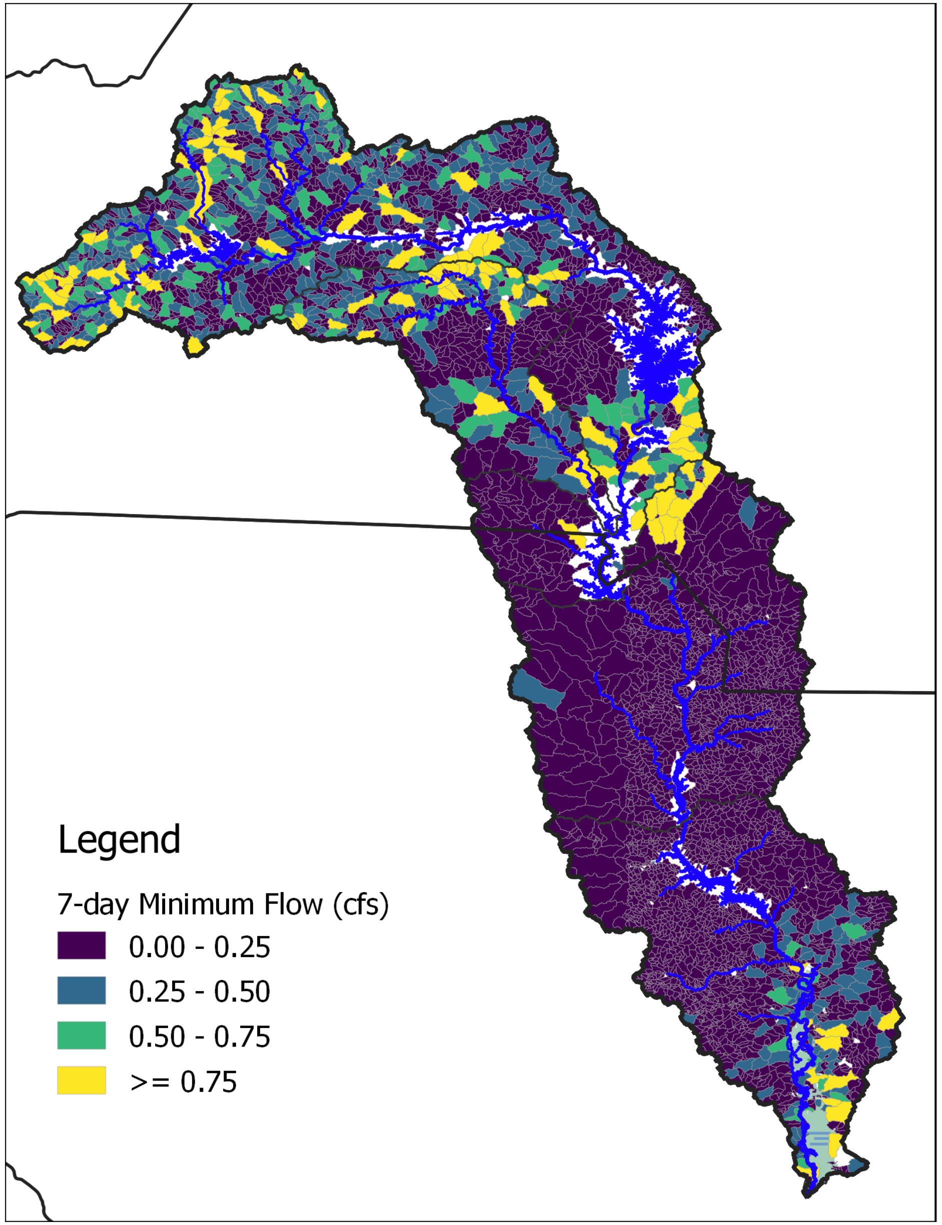
- Projections are split when focusing on average cumulative conditions – centering around little change
- Real story will be in change specific events – duration, intensity, timing

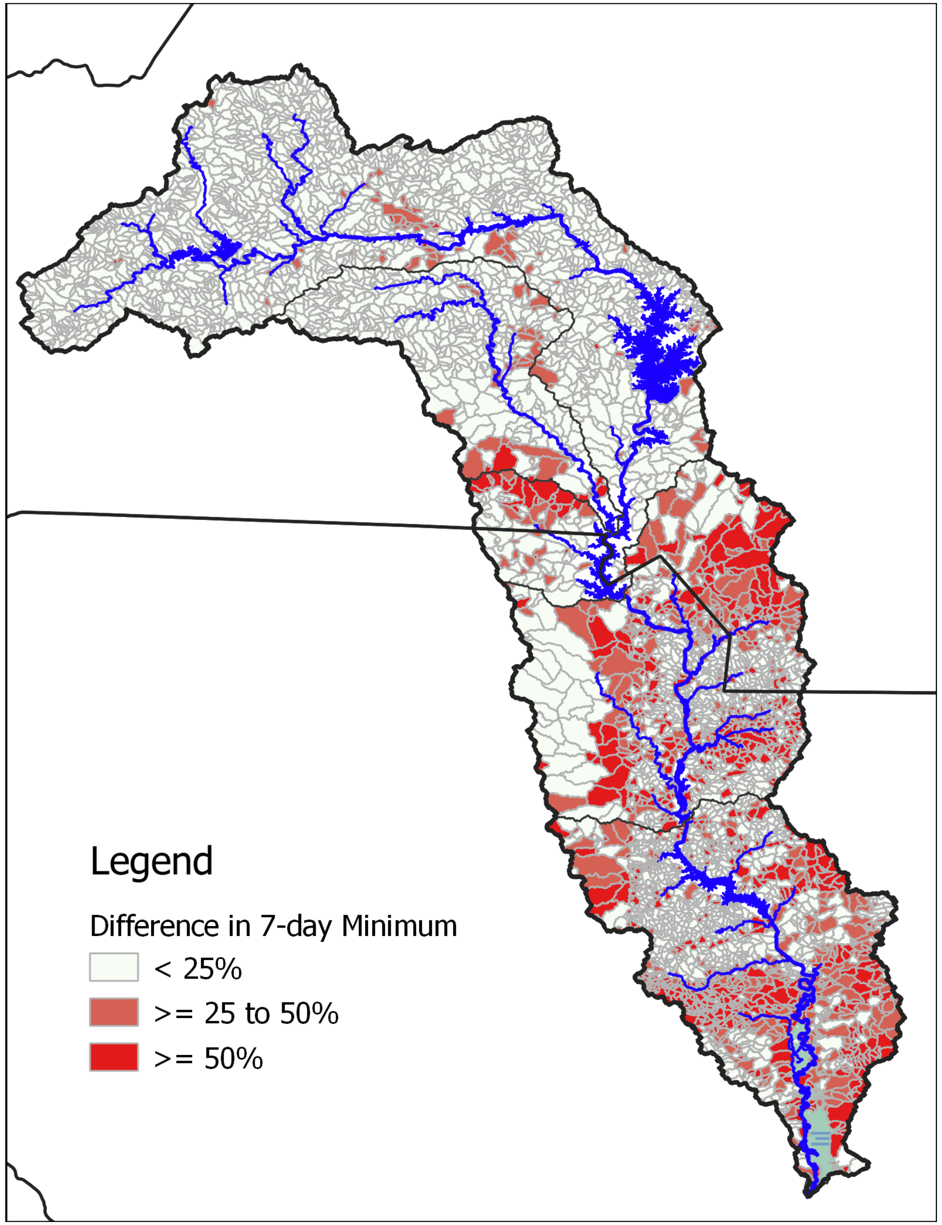
https://products.climate.ncsu.edu/voyager/index.php?tool=summer_precip

How do you get from modeling to decisions?



Assess changes spatially and by different measures of quantity and quality





*Flow generated within each catchment. Difference is absolute difference.

Calculating the Priority Score

$$Priority\ Score = \boxed{o_H \sum_1^n \Delta H_n h_n} + \boxed{o_W \sum_1^m \Delta W_m w_m}$$

Example 1: Equal weighting of hydrology and water quality, focused on high flows and sediment

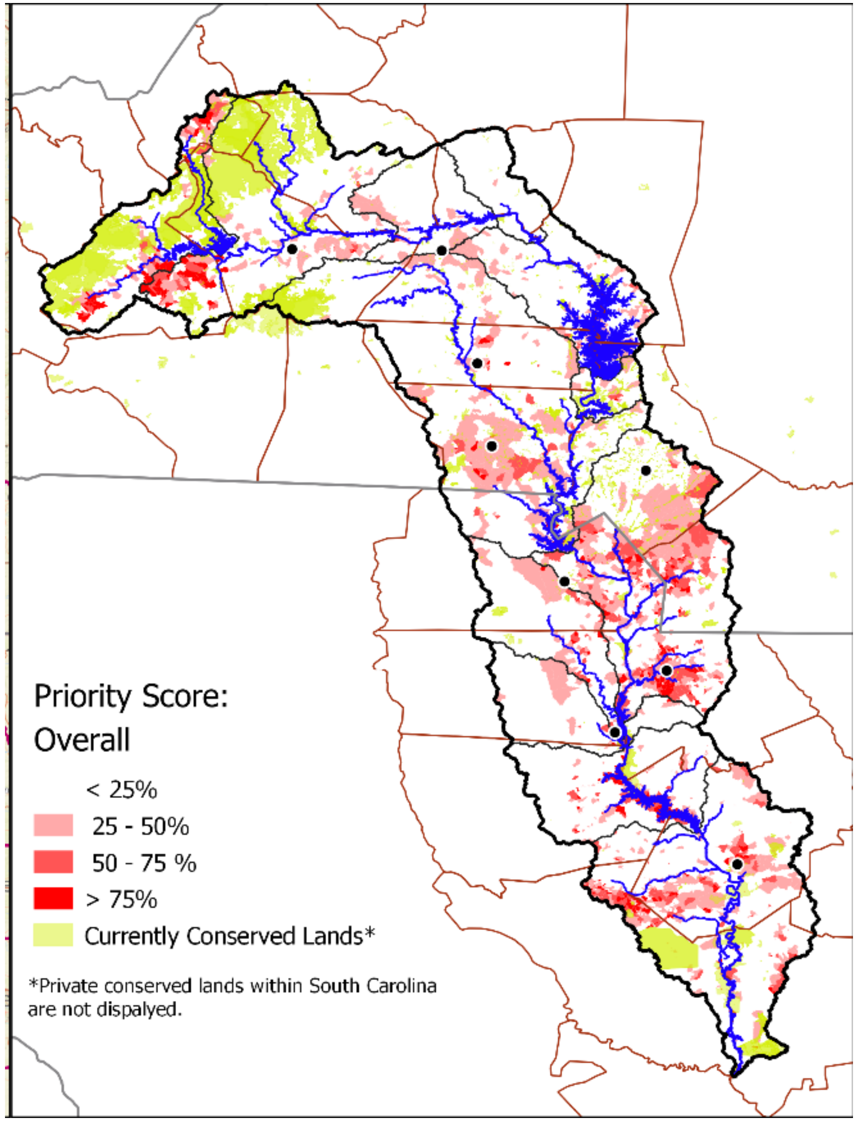
Priority Score = $\boxed{0.5 * (MAX * 0.4 + P75 * 0.6)} + \boxed{0.5 * (SED * 1)}$

Example 2: Focus on any change from current hydrologic magnitudes

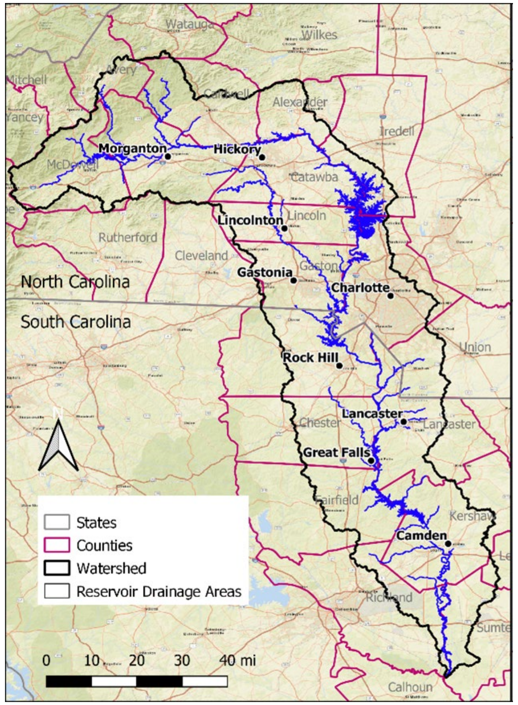
Priority Score = $\boxed{1 * (abs(MIN) * 0.33 + abs(MAV) * 0.34 + abs(MAX) * 0.33)}$

Combine changes to determine Hot Spots across the watershed

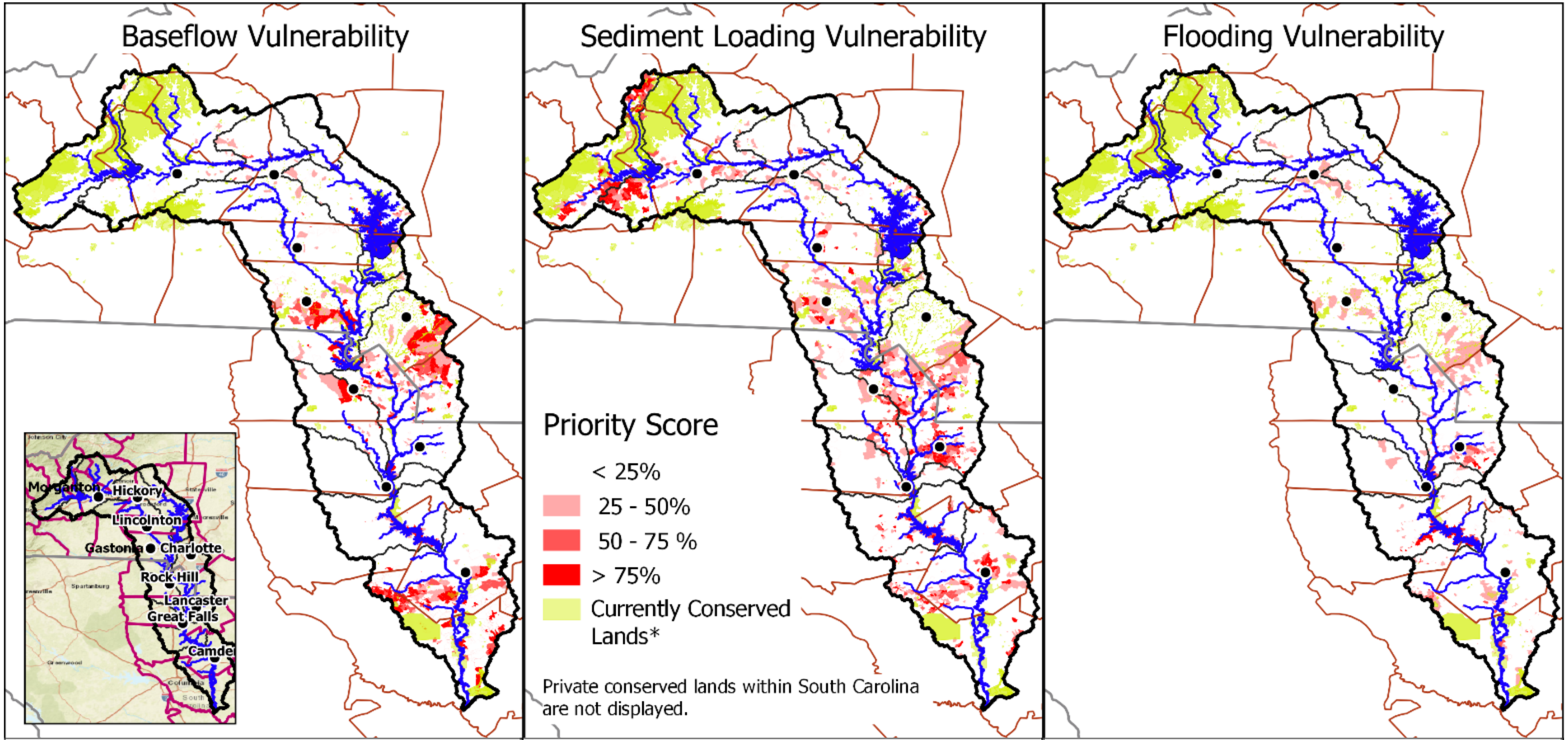
- Watershed scale analysis computes a <u>Priority Score</u> for entire set of catchments
- Scenario shown at the right:
  - Land Use Change as driver
  - Equal weighting across all hydrologic and water quality changes
- All shaded areas are hot spots but the pink to red gradation notes severity of the change causing the catchment to be a hot spot



Areas of biggest expected change



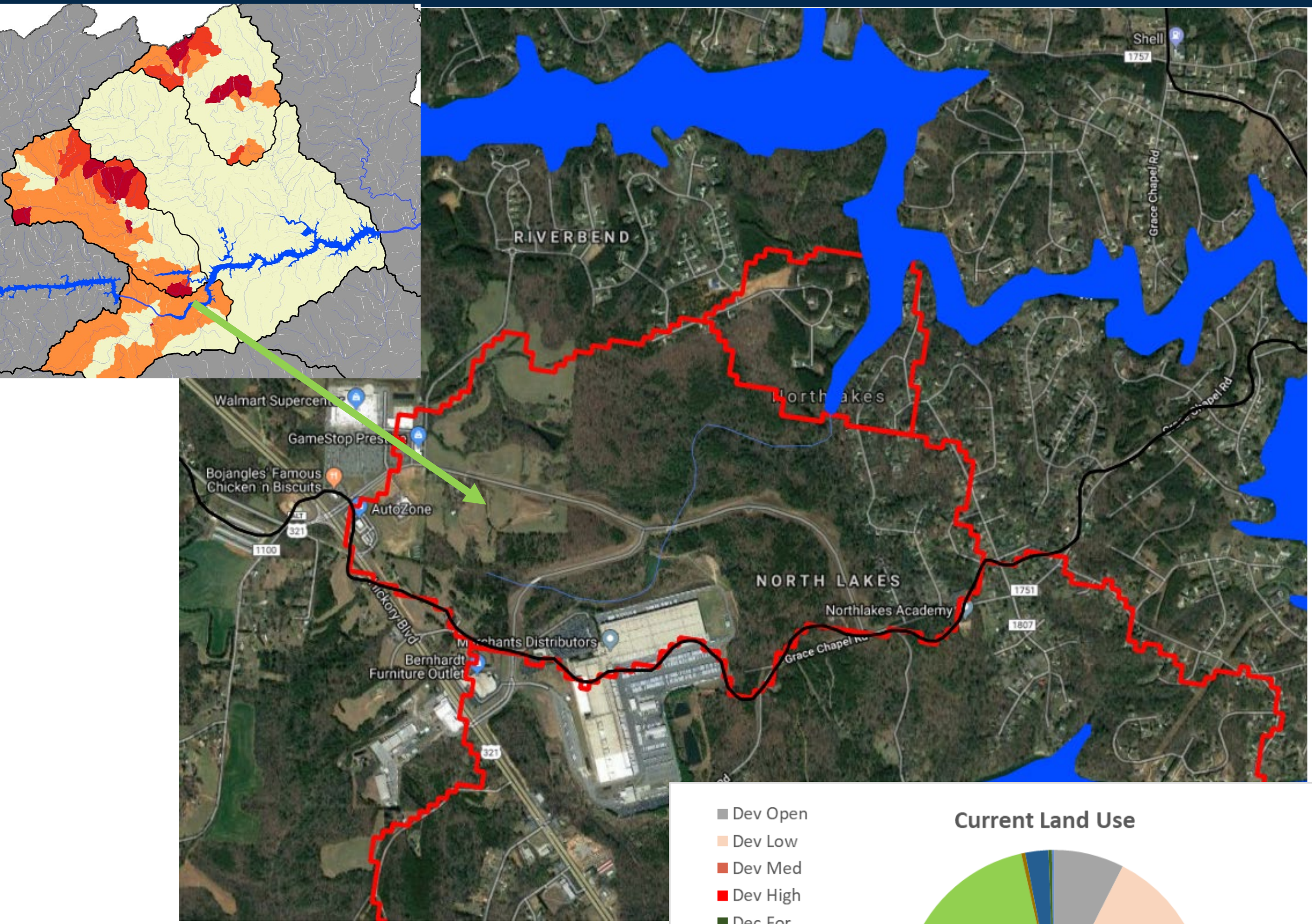
Alternate Assessment Scenarios



Baseflow Vulnerability:	Sediment Loading Vulnerability:	Flooding Vulnerability:
0.4 * ABS(MIN) + 0.2 * ABS(RBI) + 0.4 * ABS(7Q10)	0.2 * (0.6 * MAV + 0.2 * P25 + 0.2 * P75) + 0.8 * SedLoad	0.2 * MAX + 0.2 * RBI + 0.2 * P75 + 0.2 * HFP75 + 0.2 * HPFD75

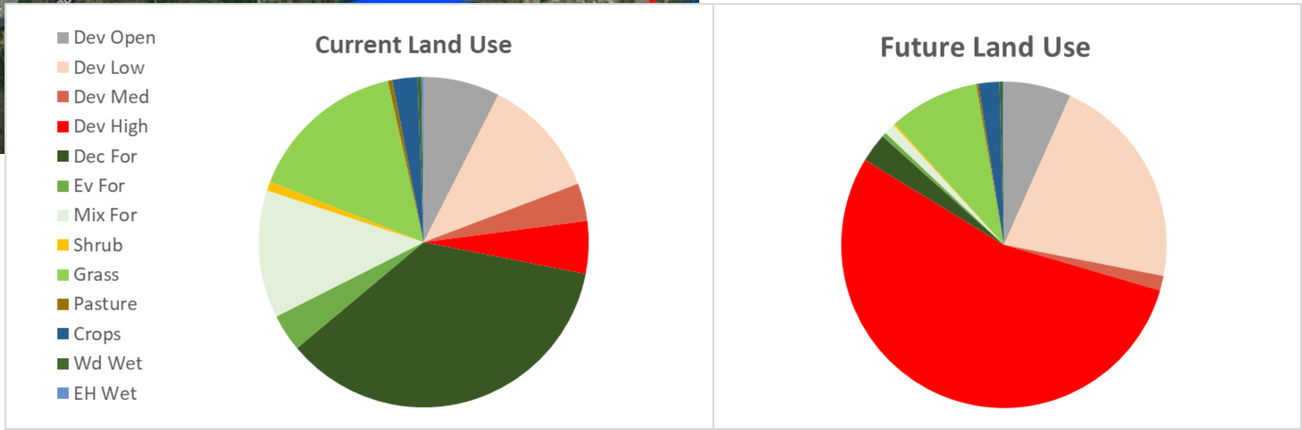
[1]Metrics used in scenario definitions are defined as: 7Q10 = mean 7-day low flow occurring every 10 years on average; ABS = absolute value; HPF75 = high flow pulse count using the 75th percentile flow; HFPD75 = high flow pulse duration using the 75th percentile flow; MAV = mean annual average flow; MAX = mean annual maximum flow; MIN = mean annual minimum flow; P25 = 25th percentile flow; P75 = 75th percentile flow; RBI = flashiness index; SedLoad = sediment load

Drilling Down: Lake Hickory in Detail



Catchment 9752792

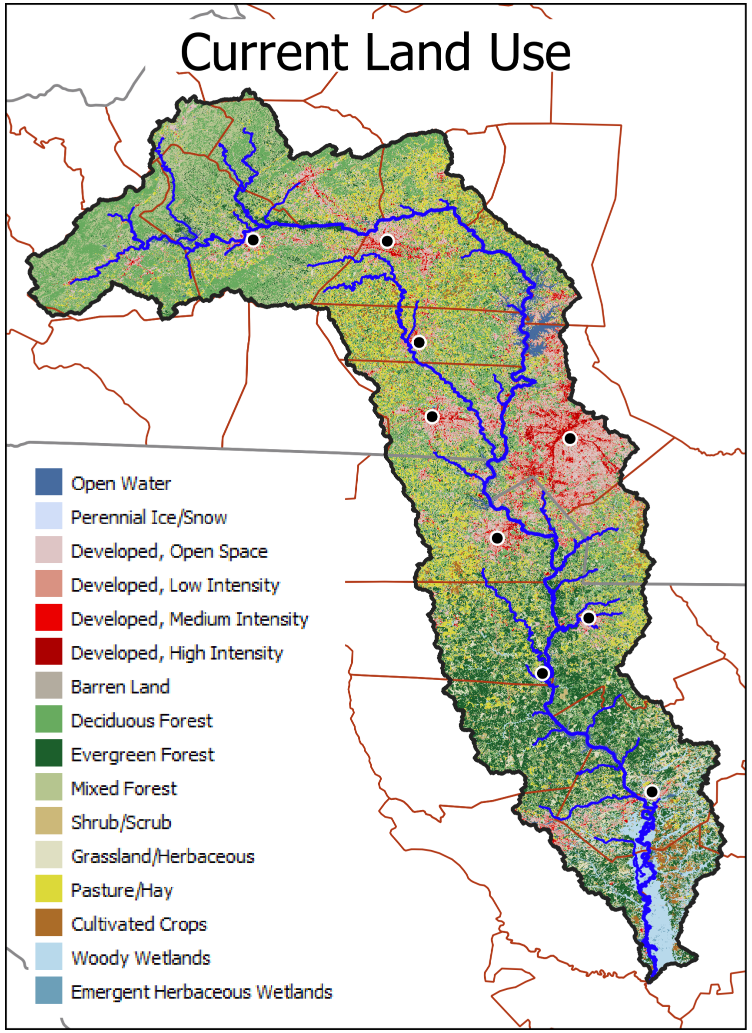
- Large increase in variability
  - Higher highs and lower lows
  - Huge increase in number of low flow periods (over 300% increase in count)
  - Variability metric nearly doubled in value
- Sediment loading doubled
- All metrics showed significant change except mean annual flow (23% increase)

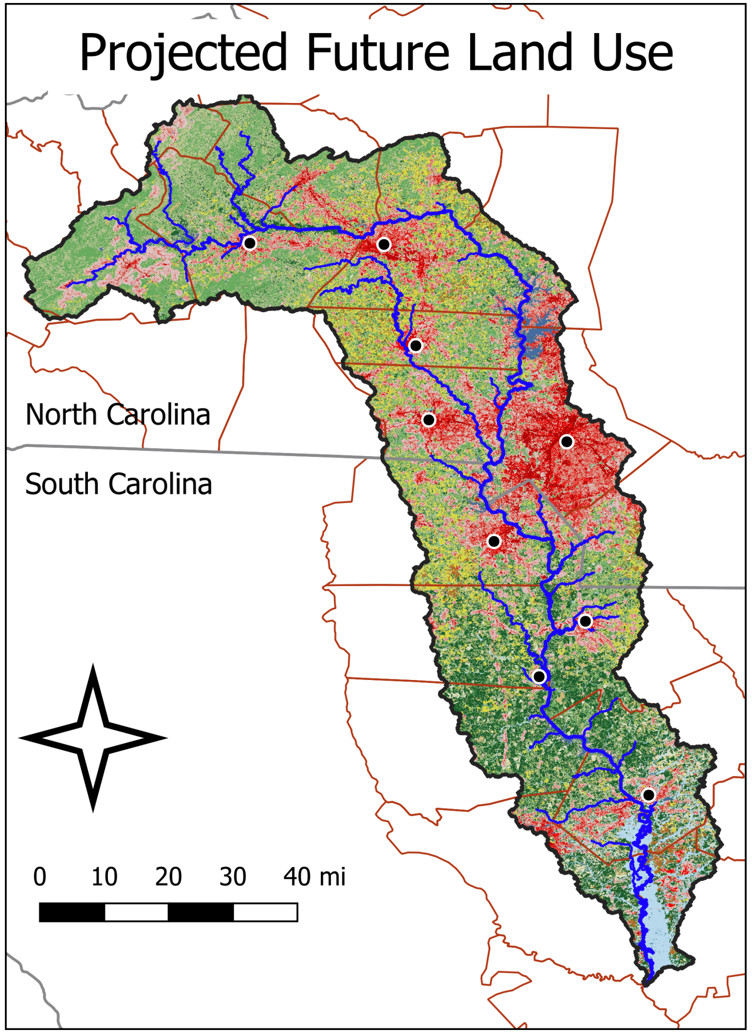


Source: Eddy et al., 2019

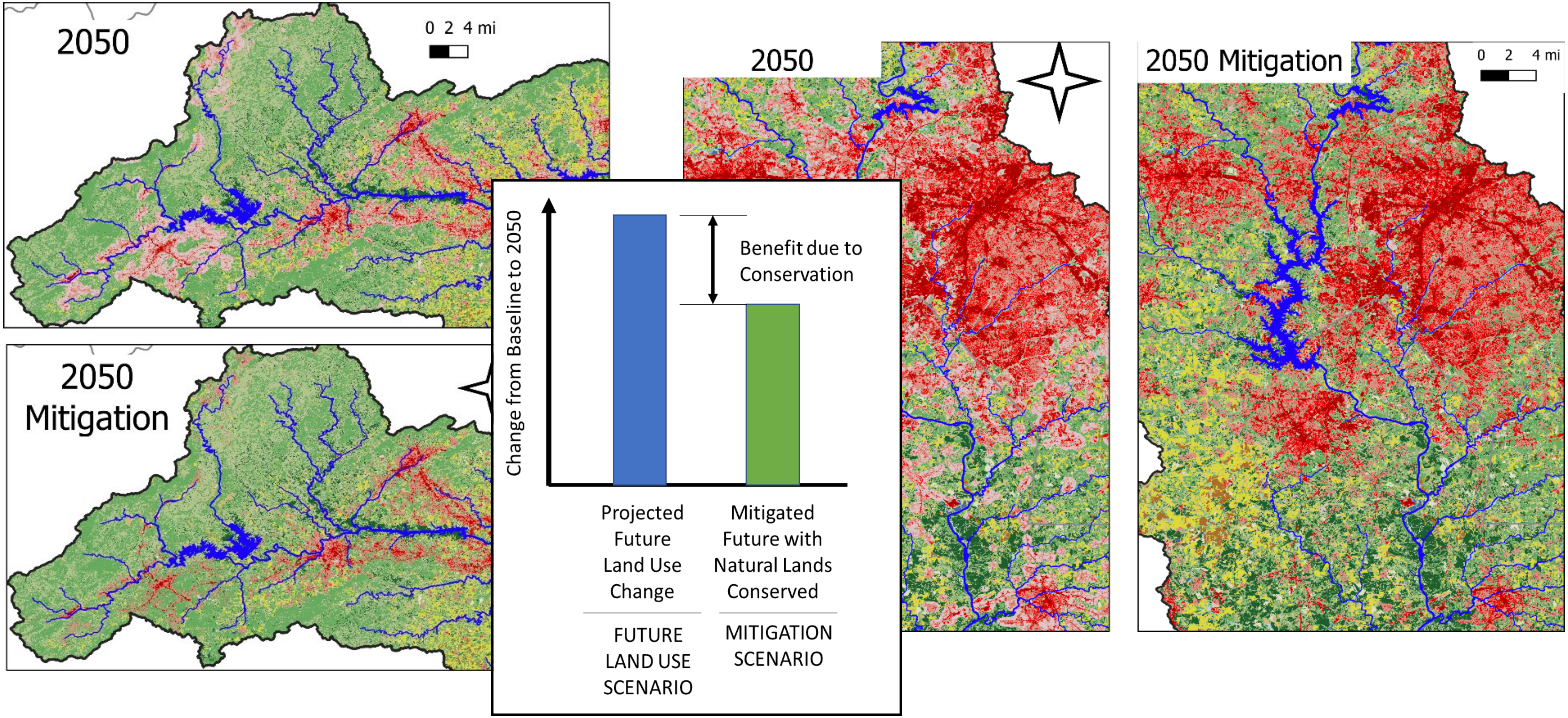
Determining and valuing the impacts of conservation

Mitigation Scenario: Hold lands currently in a natural state constant as the remaining areas of the watershed develop or increase in development intensity





A Closer Look at the Mitigation Scenario



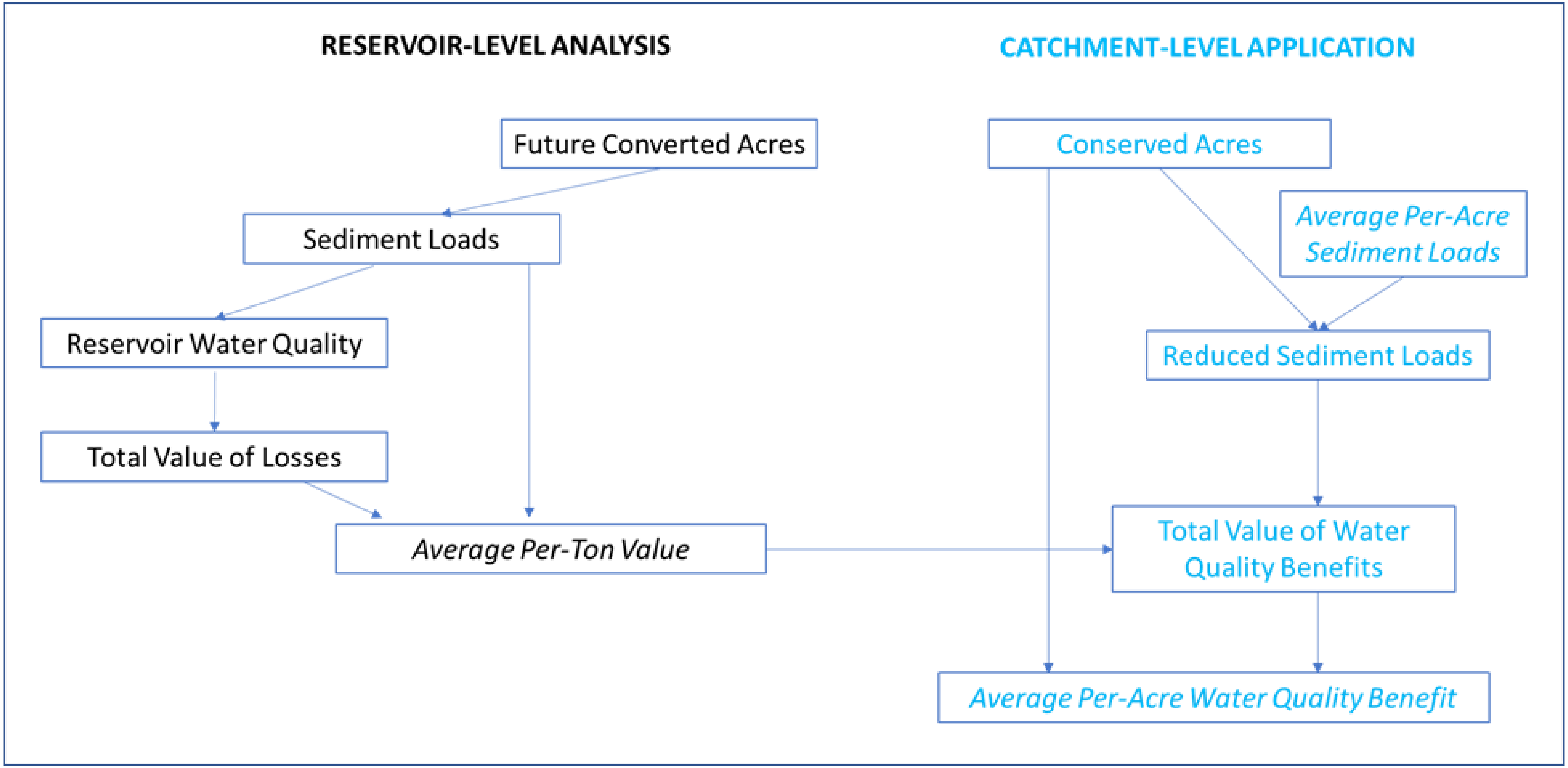
Determining the Economic Benefits of Land Conservation

- **Benefits of land conservation**
  - Benefits from avoided sediment loads to reservoirs
    - For recreational visitors to lakes benefit from higher water quality
    - For lakeshore residents benefit from higher water clarity
    - For drinking water treatment systems and customers from cleaner source water
  - Benefits from maintaining forest cover
    - Carbon sequestration benefits through reduced climate change damages
    - Human health benefits via air filtration by trees

Combined Benefit

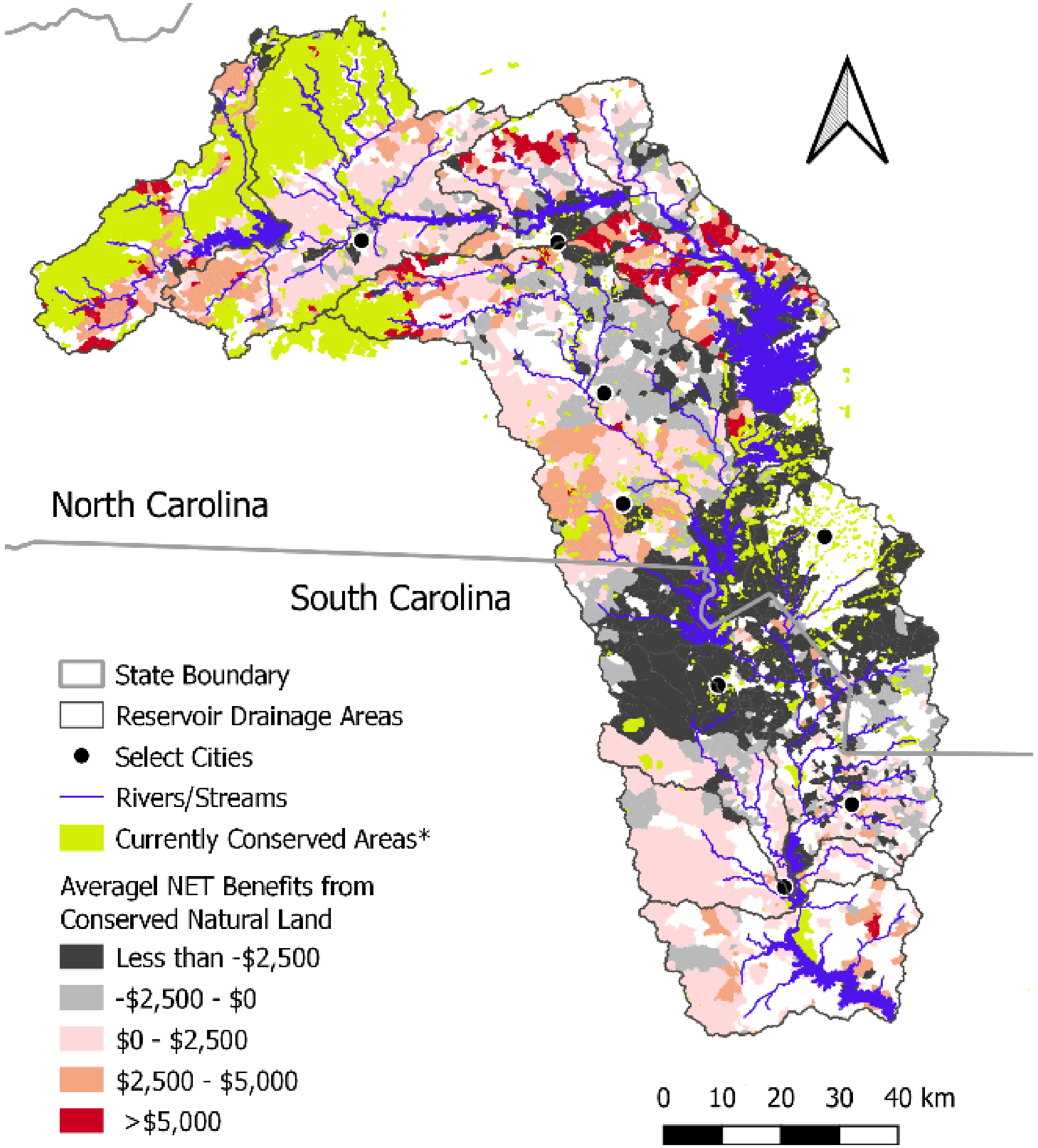
- **Costs**
  - Study uses tax assessed values of parcels
  - Local studies can replace those costs with actual transaction costs anticipated

Approach: Estimating Average Benefits per Conserved Acre by Catchment

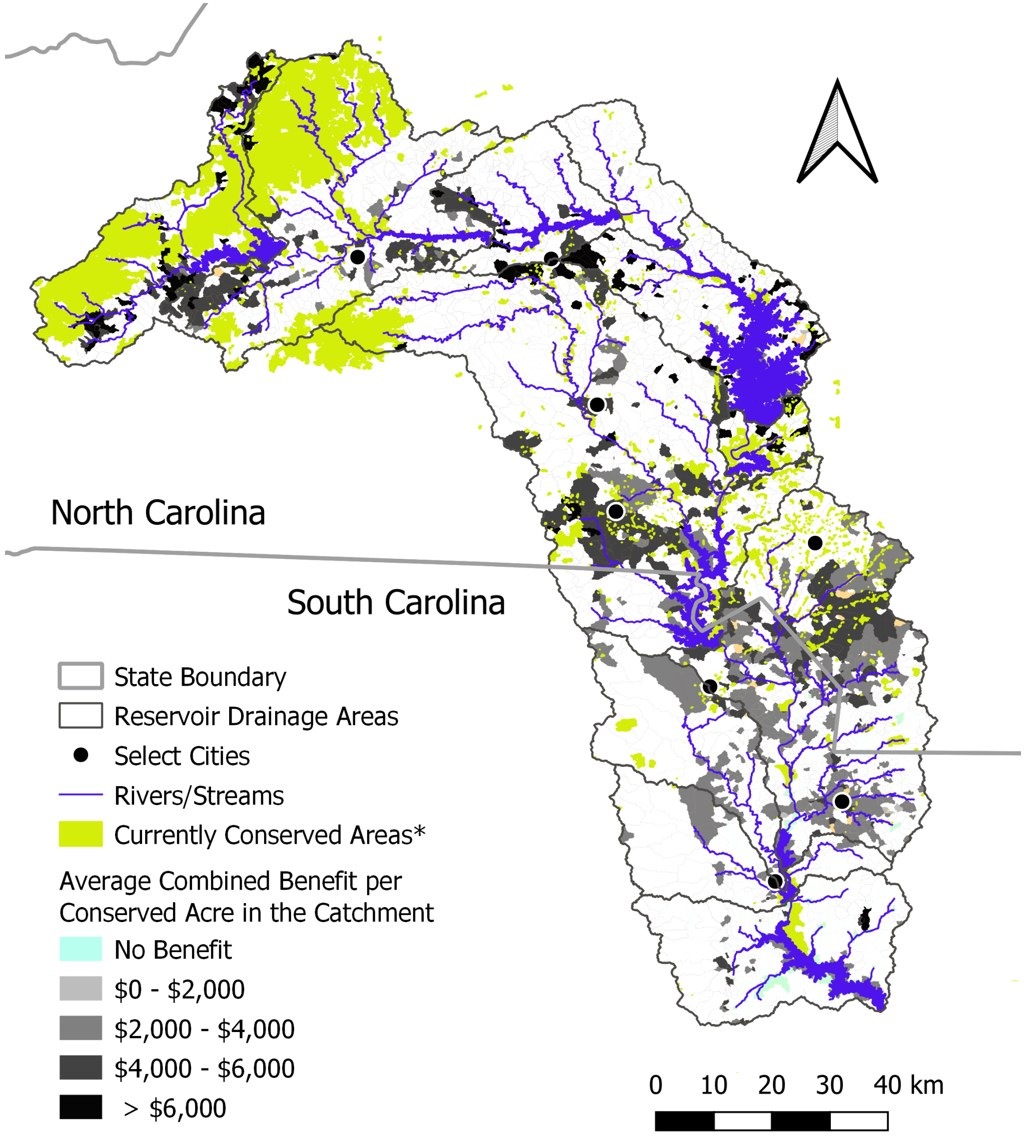


Results: Comparing Average NET Benefits per Conserved Acre

(Water Quality + Carbon + Air Quality) Benefits per Acre - Land Costs per Acre



Results: Average Benefits per Acre in Hot Spot Catchments

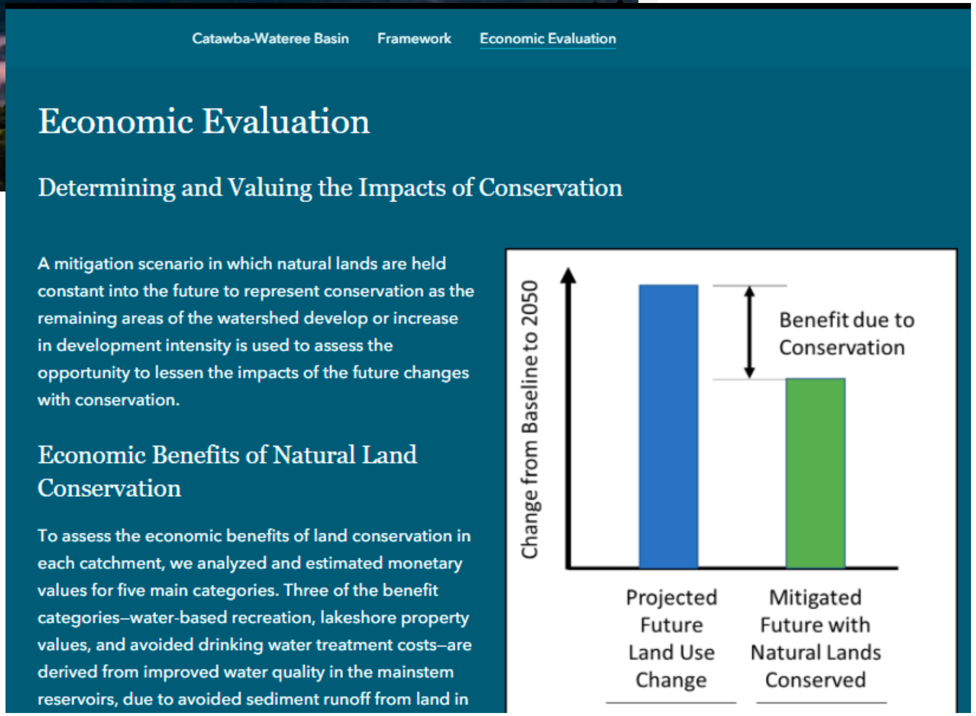


*Private conserved lands within South Carolina not shown

Online StoryMap User Tool

- Created by RTI and Catawba Lands Conservancy
- Hosted by Catawba Lands Conservancy
- Provides:
  - Project overview
  - 8 Static pre-defined assessment scenarios
  - Economic Benefits
  - Point and click map-based display of Hot Spot and Benefits data

https://catawbalands.org/cwi



Conservation Prioritization for Source Water Protection

A Story Map

Equal Weight | Mitigated Equal Weight | Drought Protection | Sediment Loading/Supply | Flood Mitigation | Erosion / Scouring Risk | Water Supply | Increasing Extremes | Economic Benefits

A dry streambed in Union County, NC.

Drought conditions exposed a drinking water intake facility.

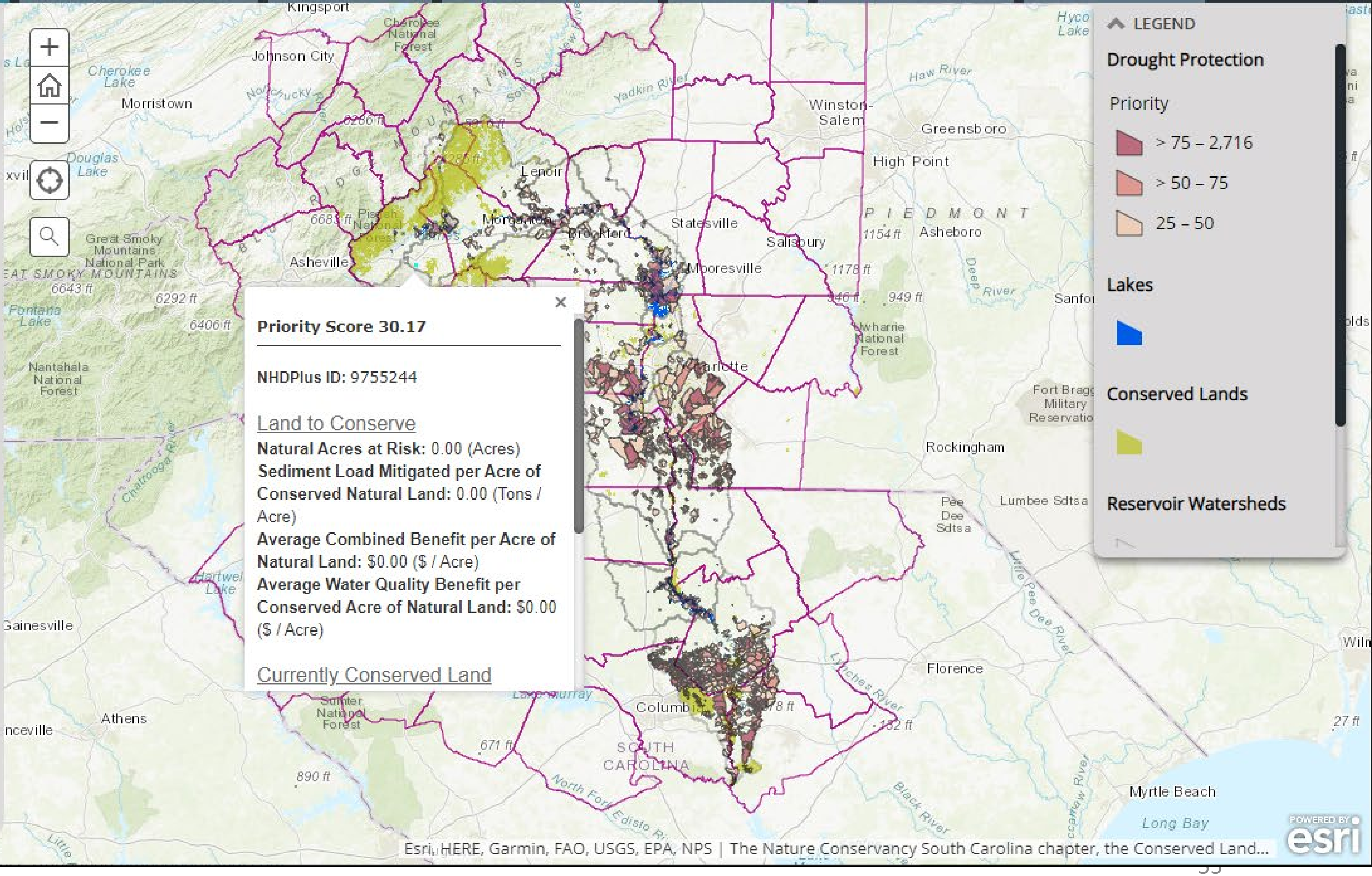
This assessment selects hot spots where there is any change to the two low flow metrics or to streamflow variability to identify hot spots for where there are potential changes to the baseflows that would support the Basin during the time of drought. No water quality concerns are included in this assessment. It uses the two minimum flow metrics (minimum and 7Q10) with weights of 0.4 and a secondary metric for variability (RBI) with a weight of 0.2. The assessment takes the absolute value of the changes in each of these metrics to examine any change from current conditions as a risk.

Scenario: Land Use Change

Statistic: Percent Difference

Priority Score Formula: 1 * (0.4 * ABS(MIN) + 0.4 * ABS(7Q10) + 0.2 * ABS(RBI))

Threshold for Hot Spots: >= 25%



Acknowledgements:

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Samuel Kovach and Jake Serago (formerly with RTI)

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Reference:

Eddy, M., K. van Werkhoven, B. Lord, S. Kovach, J. Serago, and G. Van Houtven. September 2019. Quantifying the Potential Benefits of Land Conservation on Water Supply to Optimize Return on Investments. **Project #4702**. Denver, CO: The Water Research Foundation.