

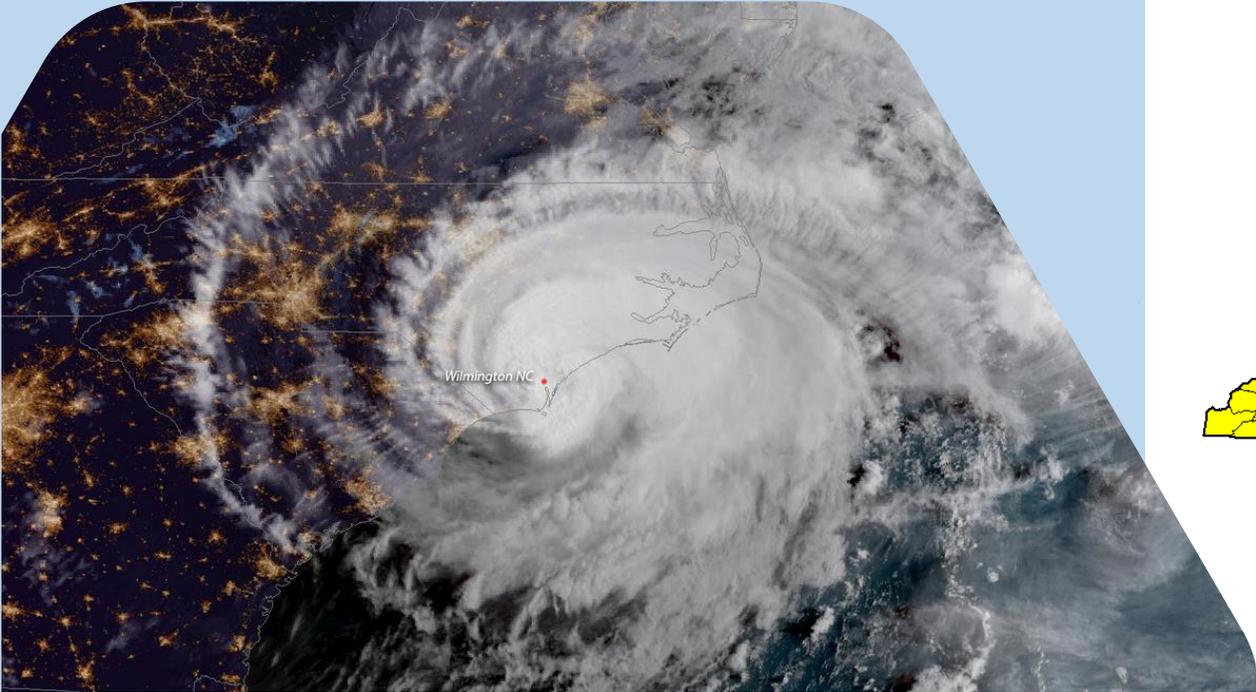
# Evaluating opportunities for resilience to extremes using remote sensing, watershed modeling, and nature-based solutions



Presented by Julie DeMeester, TNC  
and Danica Schaffer-Smith, TNC

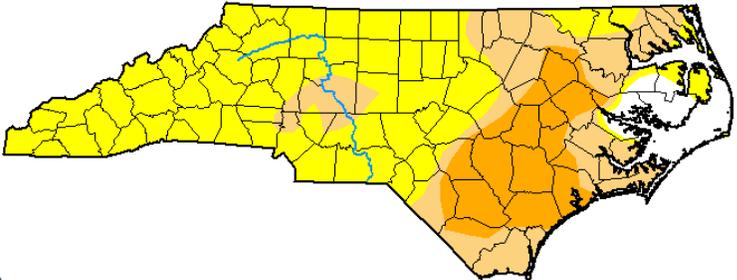


# North Carolina: From floods to droughts and back again



## U.S. Drought Monitor North Carolina

June 28, 2022  
(Released Thursday, Jun. 30, 2022)  
Valid 8 a.m. EDT



**Intensity:**

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

**Author:**

Curtis Riganti  
National Drought Mitigation Center



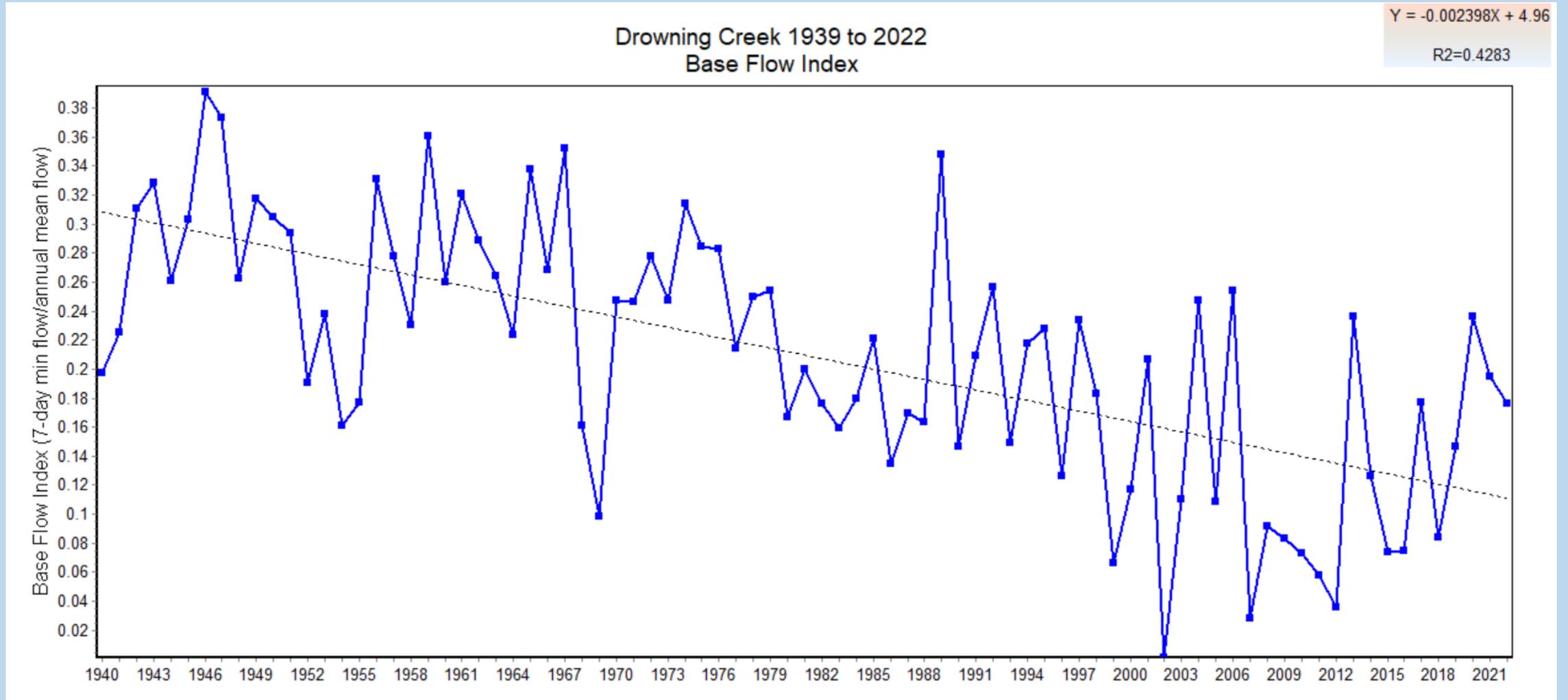
[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

Contaminants spread  
via overland flooding

Concentration of pollutants  
during a dry period

Extreme events pose  
a variety of risks to  
water resources

# Drowning Creek

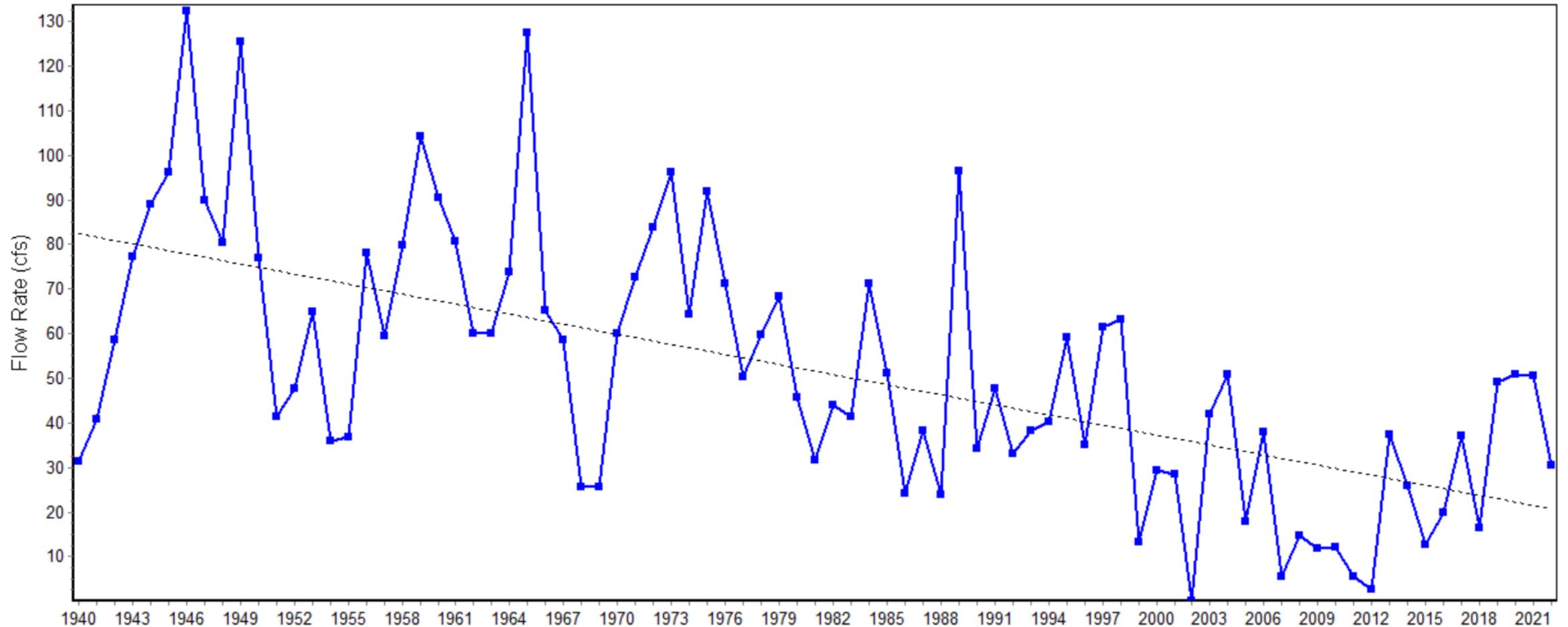


# Drowning Creek

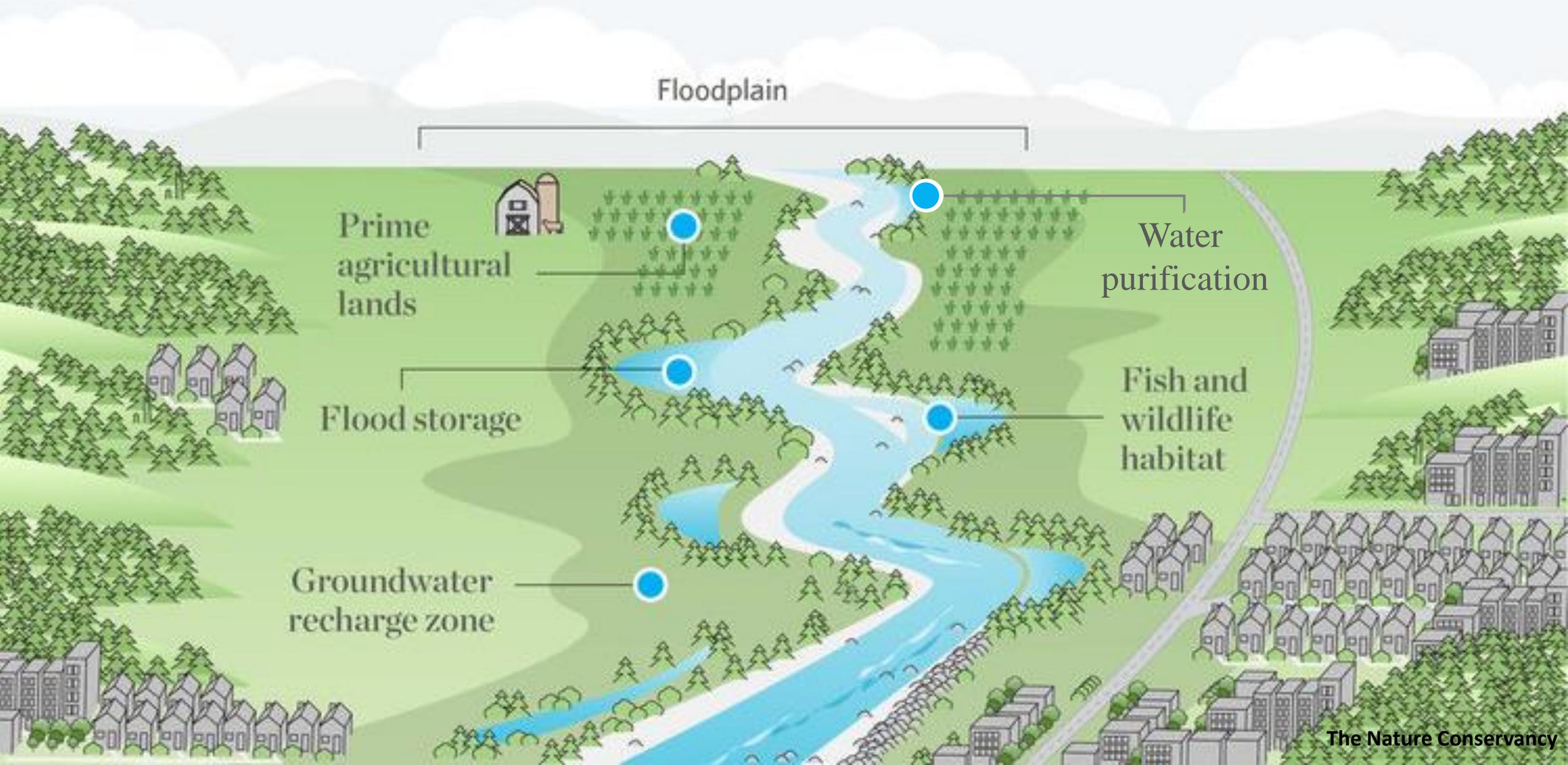
Drowning Creek 1939 to 2022  
7-Day Minimum

$$Y = -0.7524X + 1542$$

R<sup>2</sup>=0.3847



# TNC also focuses on Nature-based Solutions





Who and what flooded in recent large hurricanes?

Where can we optimize solutions that improve  
water quality and flooding?

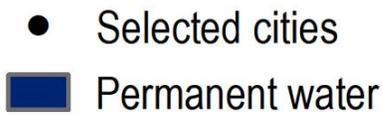
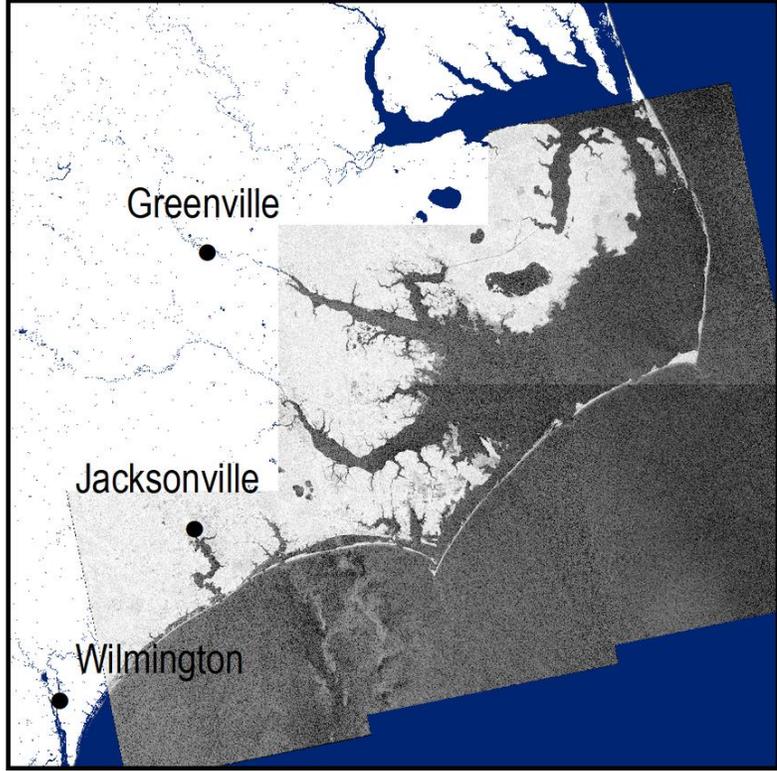
# During the Hurricanes, we mapped flooding using Sentinel-1 satellite radar



**MODIS True Color Image**  
**September 14, 2018**

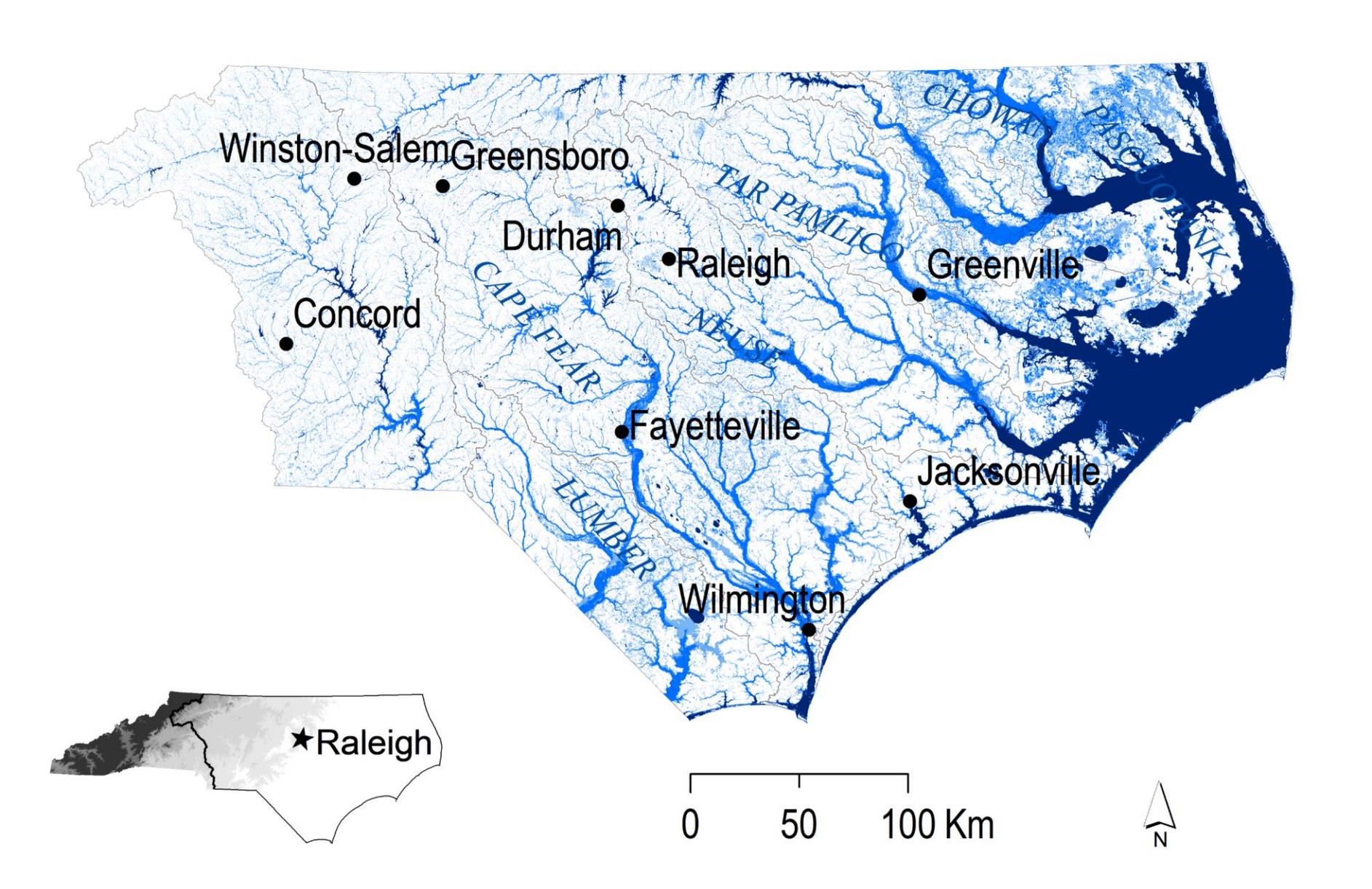


**Sentinel-1 Synthetic Aperture Radar Image**  
**September 14, 2018**

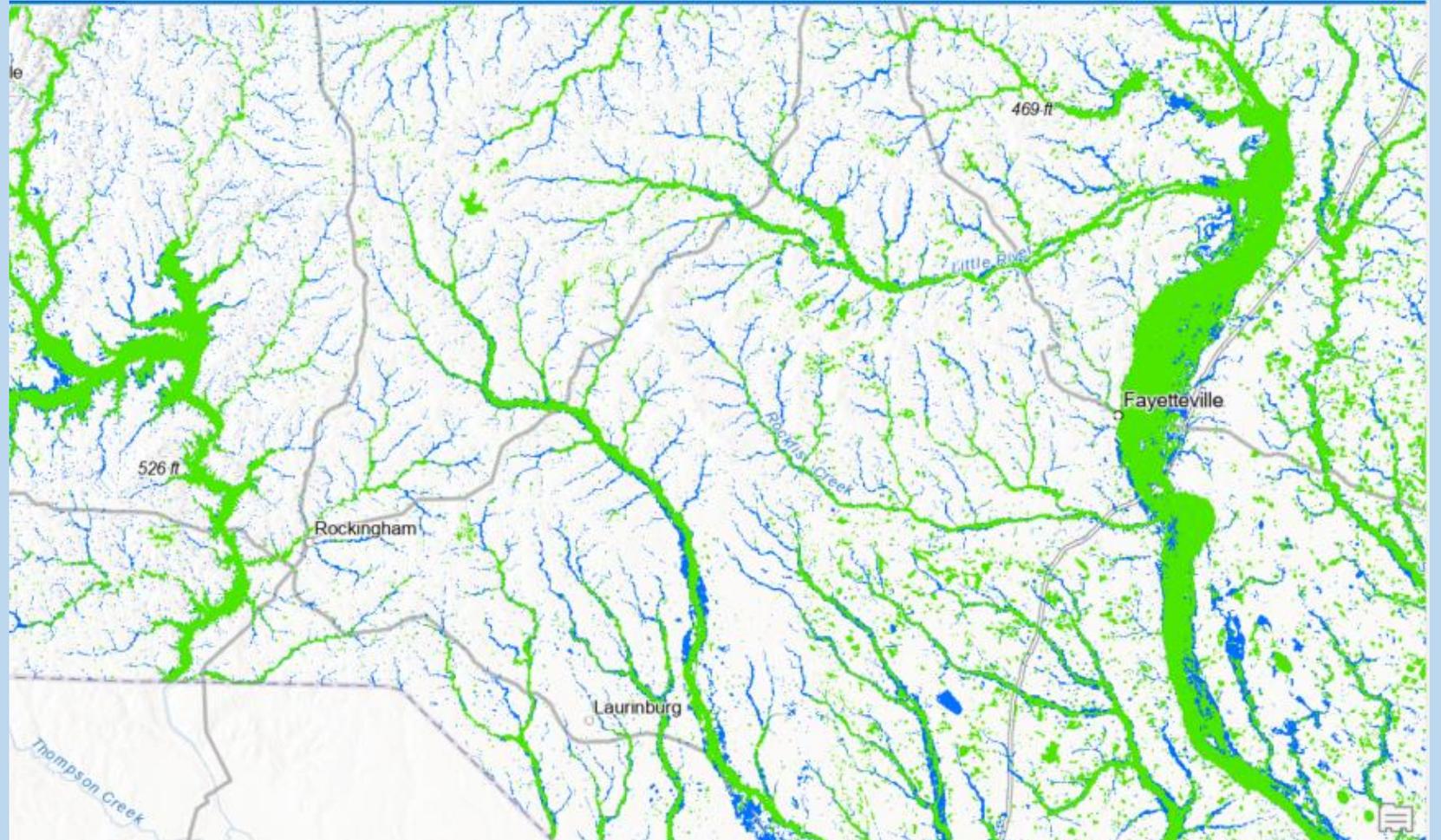
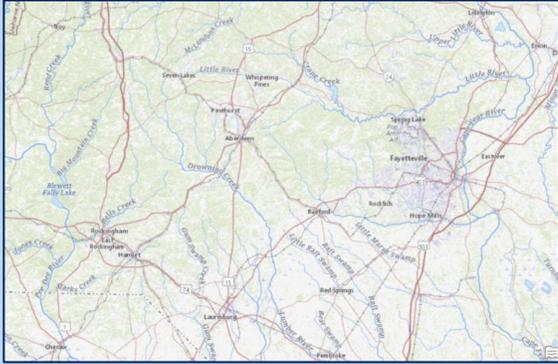


# Radar revealed repeated impacts from Hurricanes Matthew and Florence

- Selected cities
- Flooded once
- Flooded twice
- Permanent water
- Major river basins



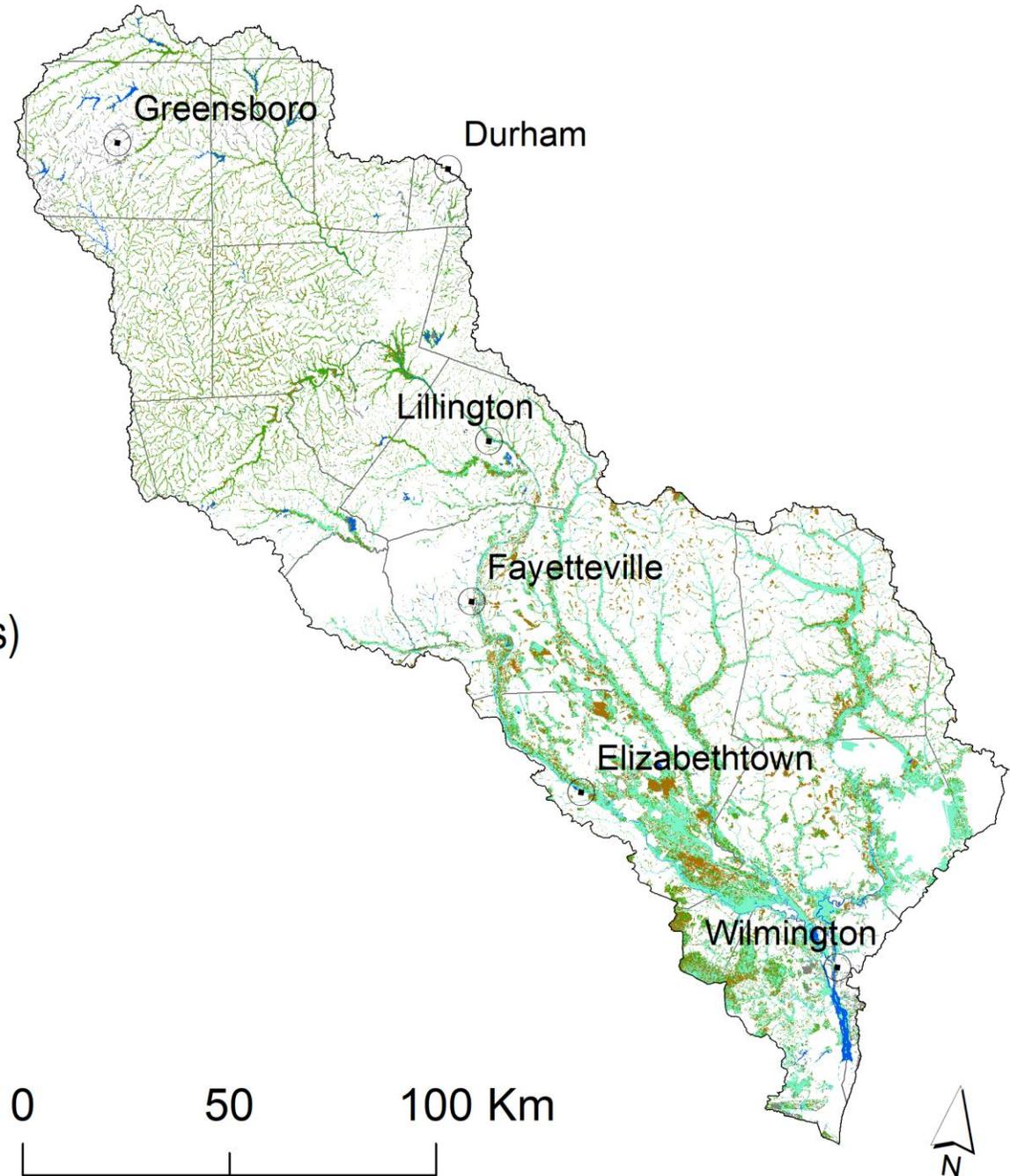
# Zoom-in of Sandhills



Green = Matthew, Blue = Florence

# There are substantial intervention opportunities

- Developed (Buyouts)
- Forest (Conservation)
- Open Water
- Wetlands (Conservation)
- Not Forest or Wetland (Restoration, Easements)
- Counties
- Selected cities





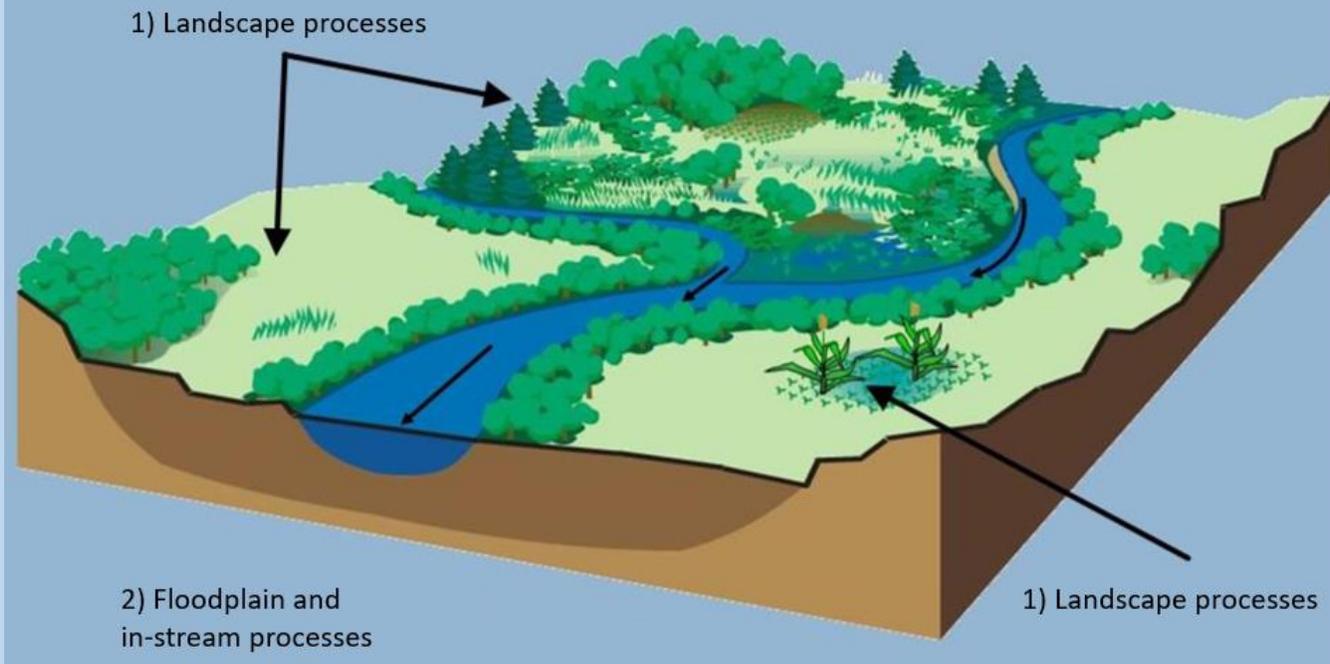
# SWAT



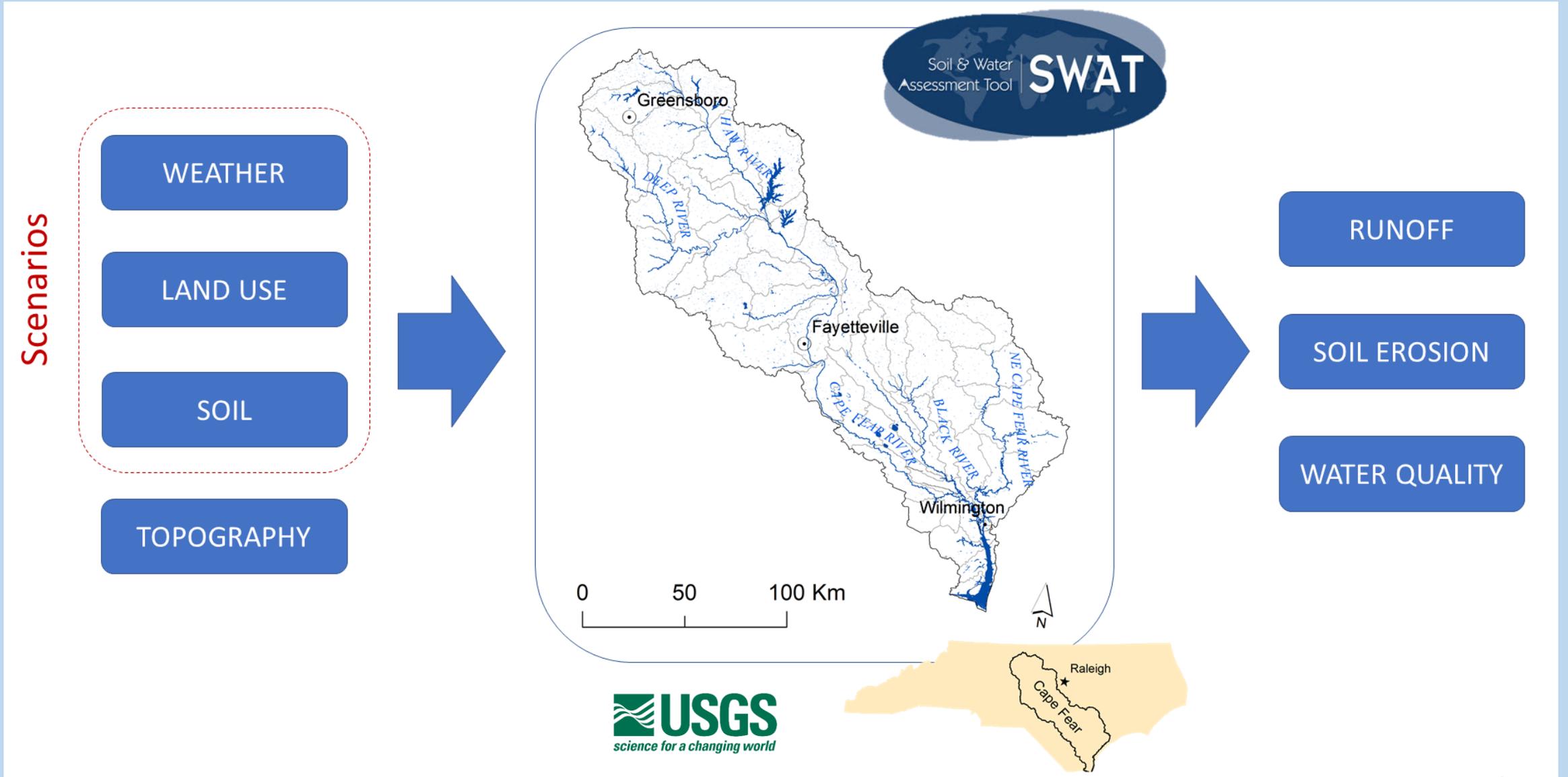
## Soil & Water Assessment Tool

A spatially referenced watershed model used to simulate the impact of land use, land management, and climate on water quantity and water quality.

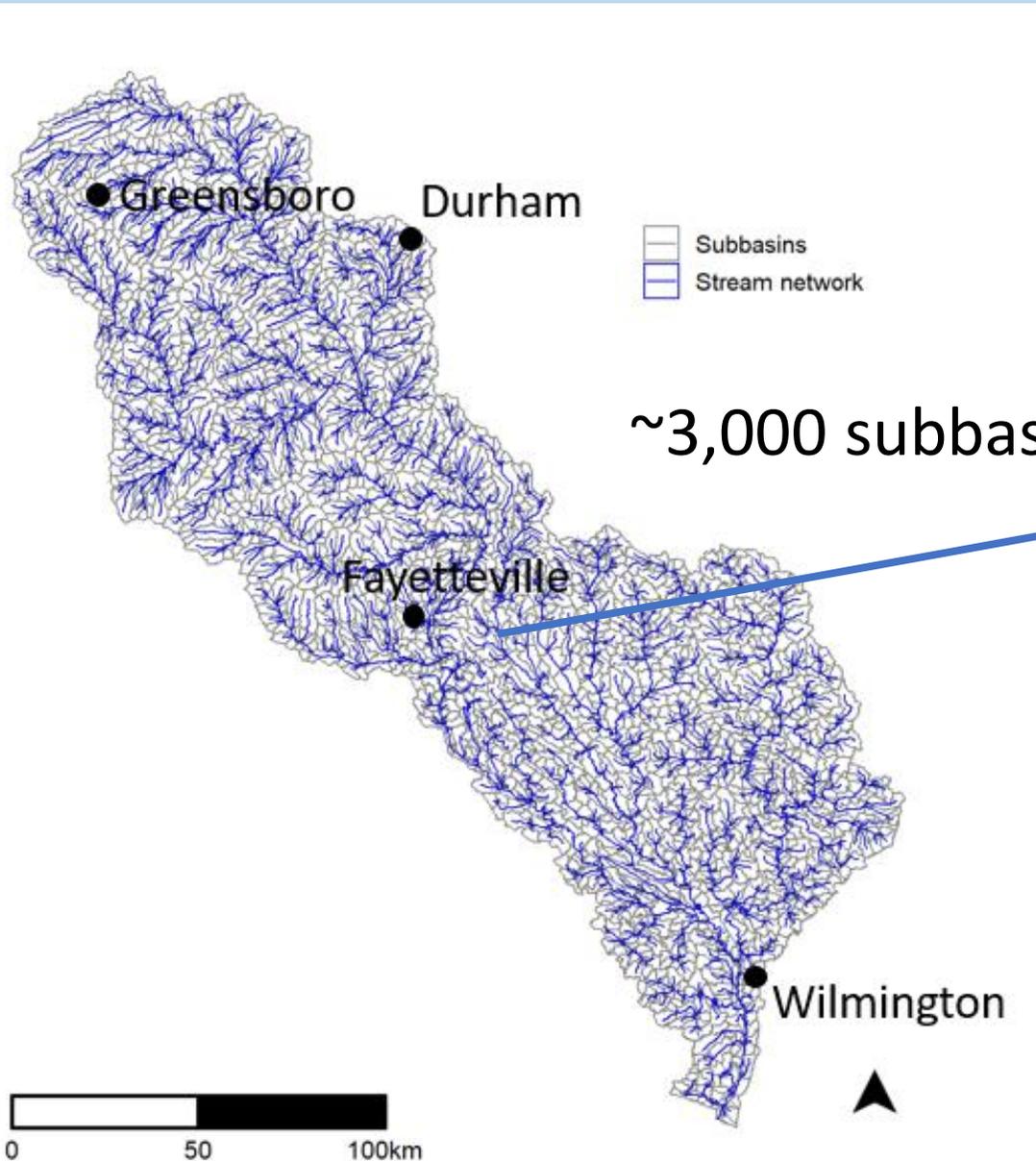
### SWAT Watershed System: 'a model of models'



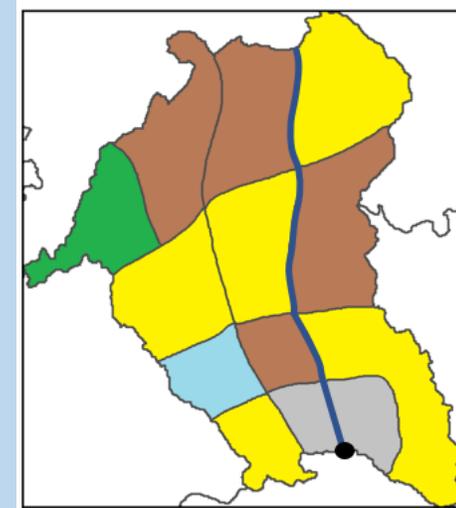
# Advanced water modeling will help evaluate solutions



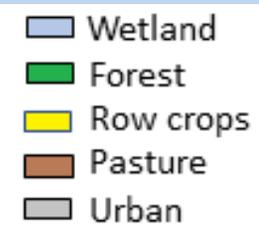
# Base Model for the Cape Fear Basin (>9100 mi<sup>2</sup>)



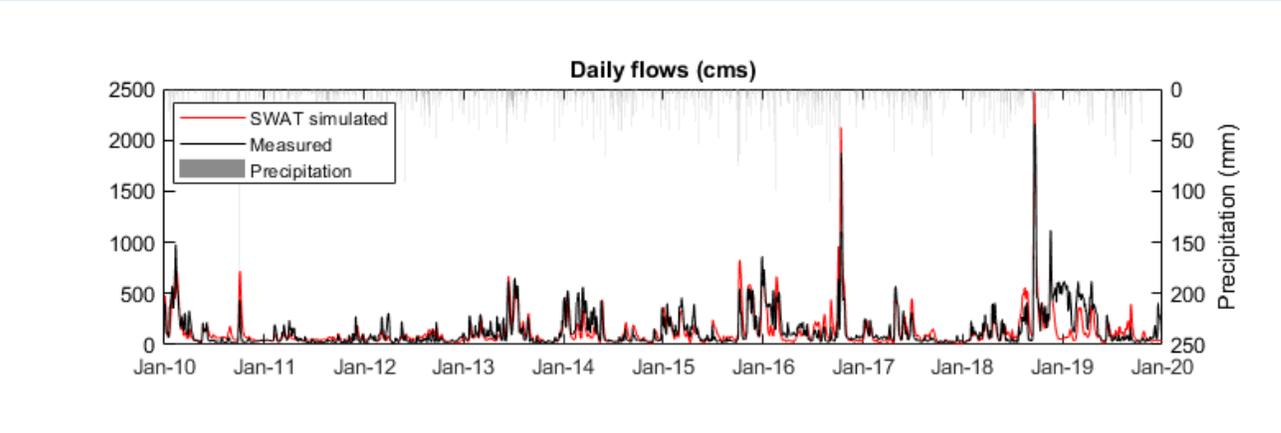
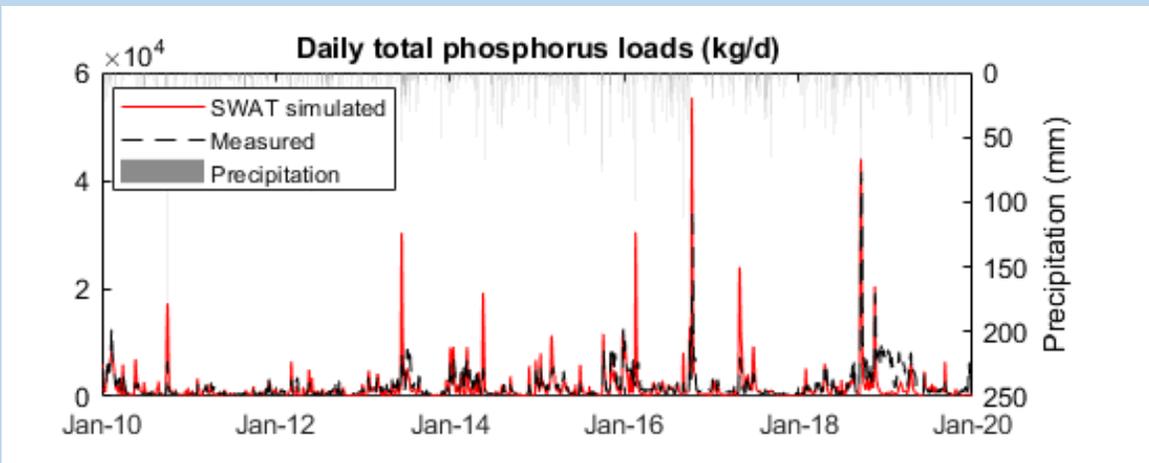
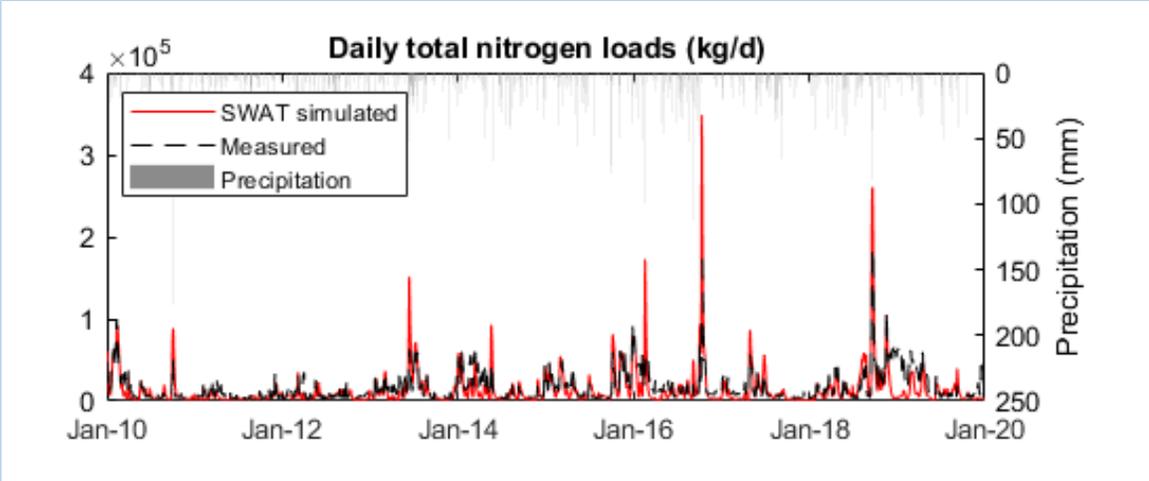
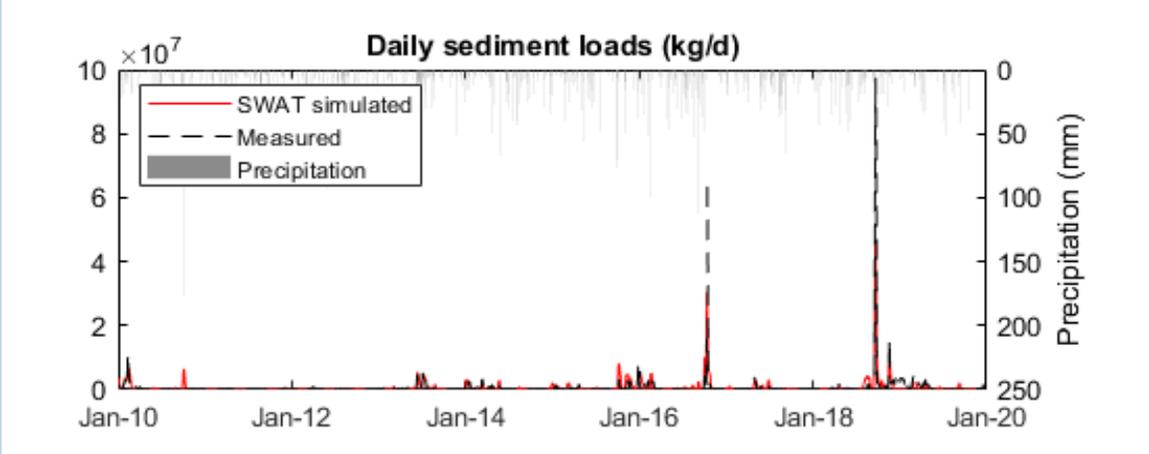
~3,000 subbasins



~13,600 smaller units with consistent slope, land use, soil

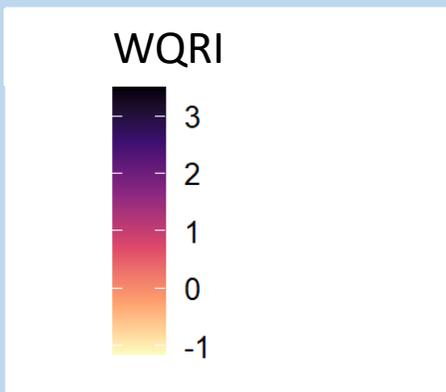


It performs well for flow, sediment, nitrogen, and phosphorus



We summarized hotspots  
across pollutants, across conditions,  
with a Water Quality Risk Index (WQRI)

- Sediment
- Total Nitrogen
- Total Phosphorus



***High risk areas are <16% of the basin***

# Which interventions, where can reduce flooding and improve water quality?

- **TNC's priority scenarios:**

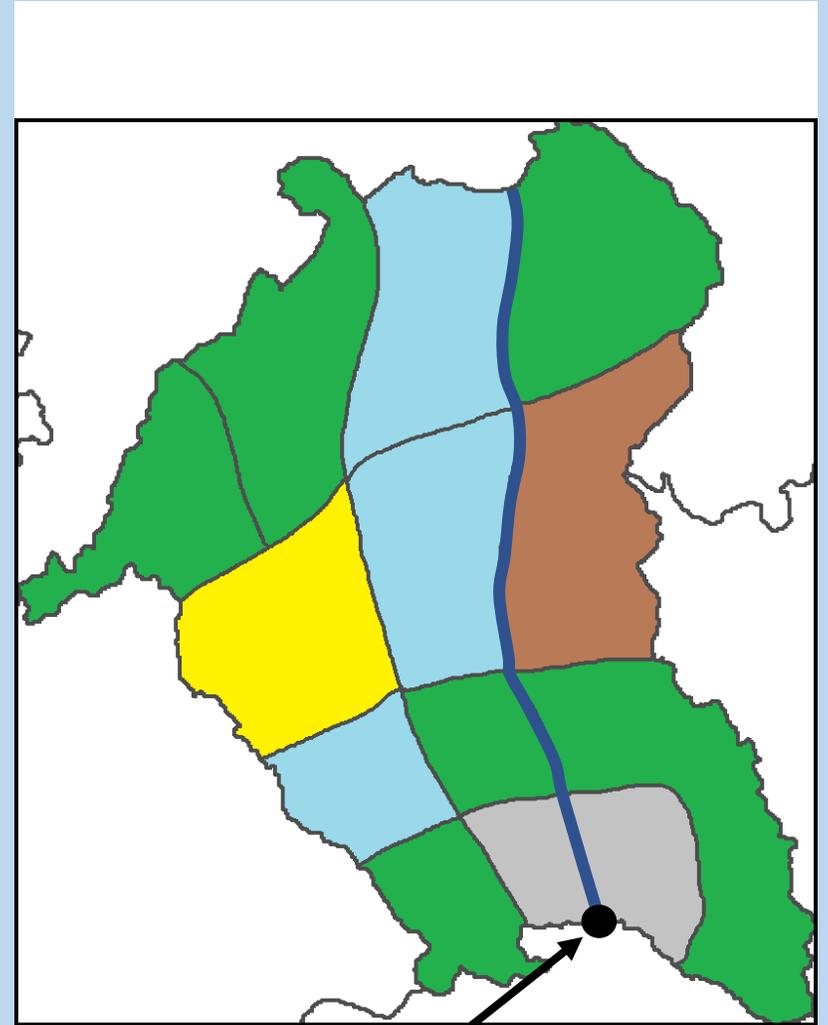
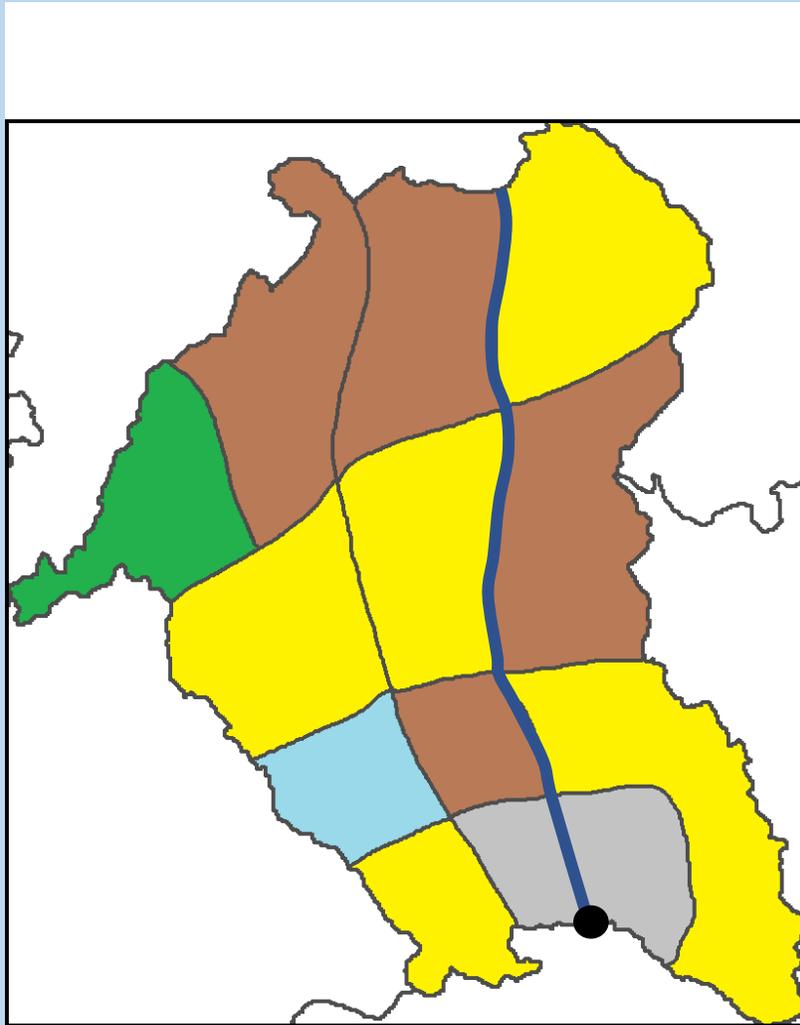
- Wetland restoration (headwater, floodplain)
- Forest restoration (upland, floodplain)

- **Additional scenarios for future exploration:**

- Agricultural field measures (no-till, cover crops)
- Urban measures (stormwater retention ponds)
- Animal farm buyouts, or waste treatment
- Nutrient limits on wastewater treatment plants
- Community buyouts

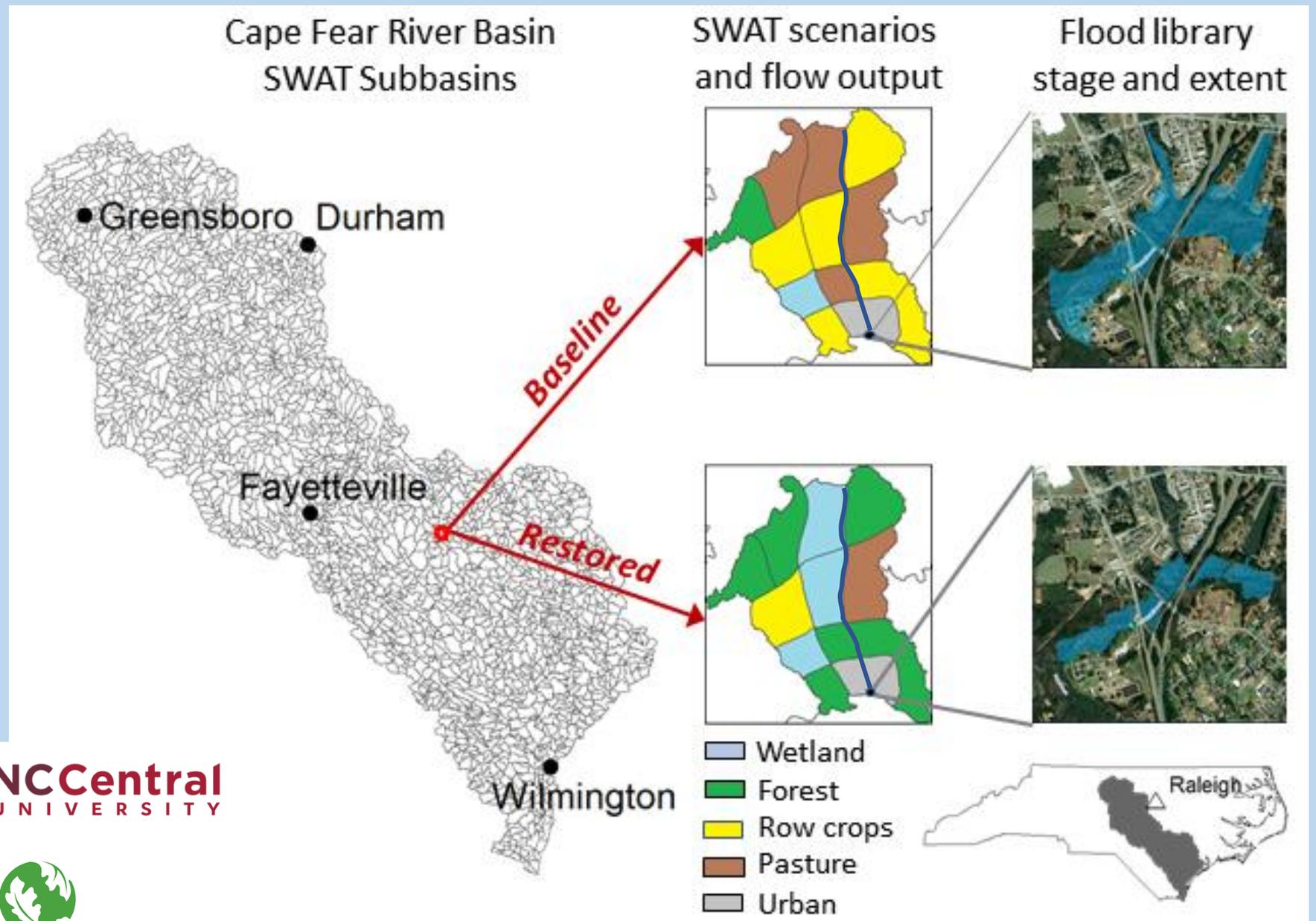
# Restoration - land use + water storage change

- Wetland
- Forest
- Row crops
- Pasture
- Urban

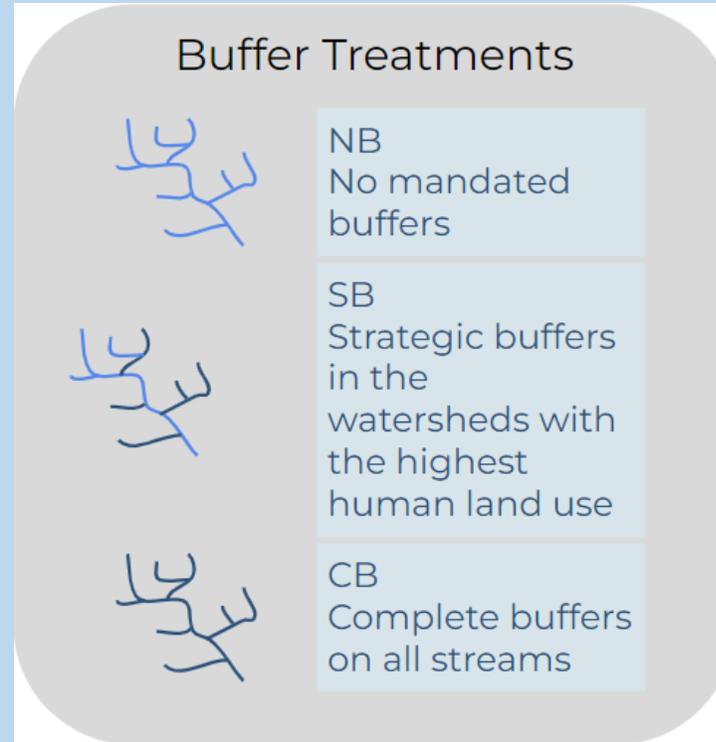
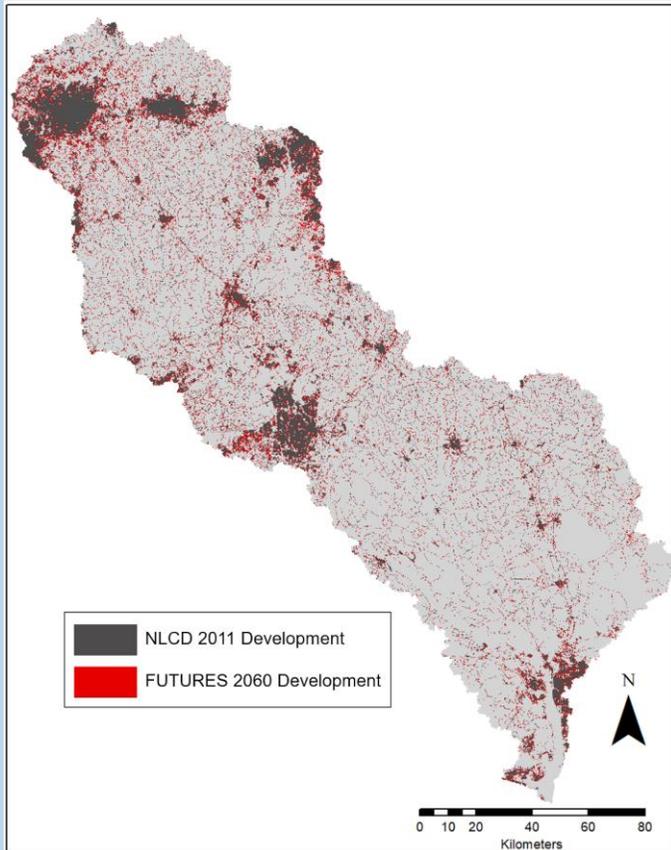


Measures changes in flow, sediment, N, P

# Estimating the benefits of restoration for vulnerable communities

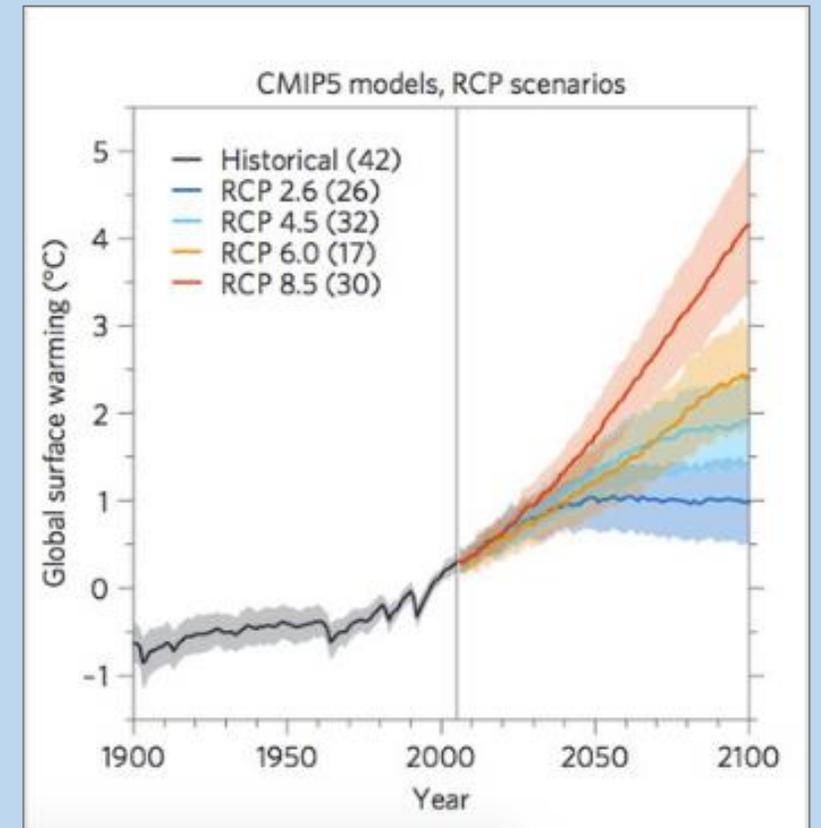


# Evaluating effectiveness of strategic buffers under projected climate and land use changes (Dr. Katie Martin, NCSU)



**NC STATE UNIVERSITY**

The Nature Conservancy

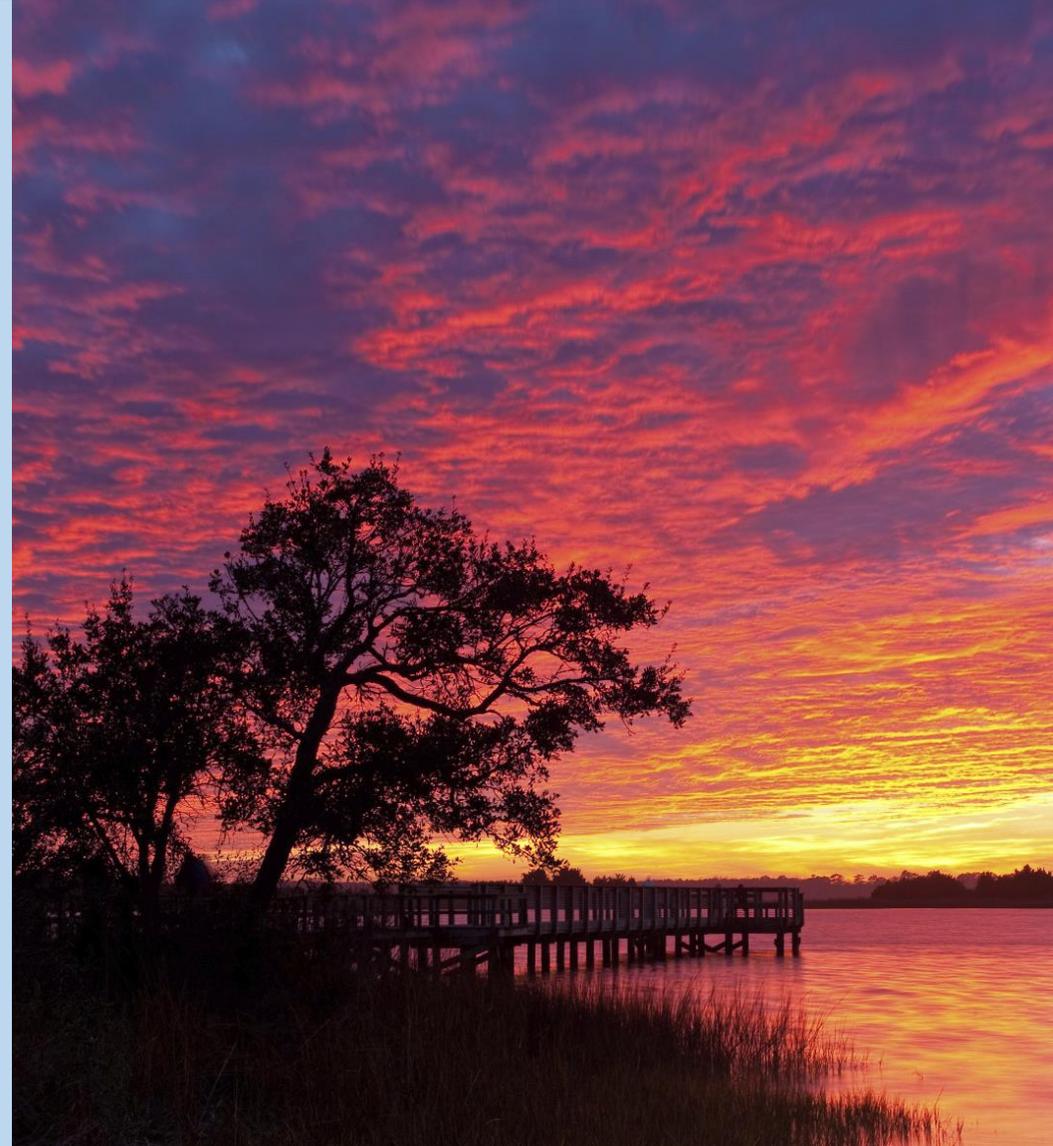


# Next steps for watershed modeling and outreach

- Publish base model and data
- Web-based visualizations for partners and stakeholders
- Scenario modeling
- Coordinating with others on efforts re: flooding and water quality
  - State agencies
  - Conservation groups
  - The U.S. Army Corps of Engineers
  - Water utilities

# How you can get our data

- Free publication: ‘Repeated hurricanes reveal risks and opportunities for social-ecological resilience to flooding and water quality problems’ in *Environmental Science and Technology* at <https://pubs.acs.org/doi/10.1021/acs.est.9b07815>
- Free flood data and associated products at: <https://knb.ecoinformatics.org/view/doi:10.5063/F1JM280P>
- Online pre-print of SWAT base model with water quality hotspot analysis: <https://www.essoar.org/doi/10.1002/essoar.10512303.1>



# Questions?

## Special thanks to:

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