April 13, 2021

Update on North Carolina Policy Collaboratory Flood Resiliency Study

Senate Select Committee on Storm Related River Debris and Damage in North Carolina

Jeff Warren
Executive Director, North Carolina Policy Collaboratory

Mike Piehler
Director, UNC Institute for the Environment
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Outline

- RESEARCH TEAM
- INITIAL ENGAGEMENT
- RESULTS AND PRODUCTS
- NEXT STEPS

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Composition of Research Team

The project spanned a wide range of research topics and techniques and required a multi-faceted approach.

Multiple complementary projects led by researchers at UNC and NCSU allowed flooding and resiliency issues to be addressed in a comprehensive manner.

UNC Department of City and Regional Planning

UNC Environmental Finance Center

UNC Law

UNC Institute of Marine Sciences

UNC Geology

UNC Environmental Science and Engineering

NCSU Engineering

NC Sea Grant

UNC Institute for the Environment

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Initial Engagement

Met with the leadership of the **Division of Emergency Management** and the **NC Office of Recovery and Resiliency**. Each played a critical role in the development of a research plan.

Feedback was also sought out from state agencies, including:

- Department of Agriculture and Consumer Services
- Department of Commerce
- Department of Environmental Quality
- Department of Health and Human Services
- Department of Insurance
- Department of Transportation

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Study Focus

The Flood Resiliency Study is divided into five focal area.

FLOODPLAIN BUYOUTS

Costs and net change in aggregate risks

FINANCIAL RISK

Detailing community level flood risk and determining who holds that risk

NATURAL SYSTEMS

Natural infrastructure costs, compound flood modeling

INFRASTRUCTURE

Stormwater infrastructure and resiliency, financing strategies, operational flooding risks

PUBLIC HEALTH

Spread of pathogens, bacteria and microbial hazards

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Natural Systems

Compound Flood Modeling

Rick Luettich, Antonia Sebastian, et al.

FOCUS:

- Assess eastern NC modeling systems for compound flooding (combined effects of precipitation and coastal storm surge flooding).

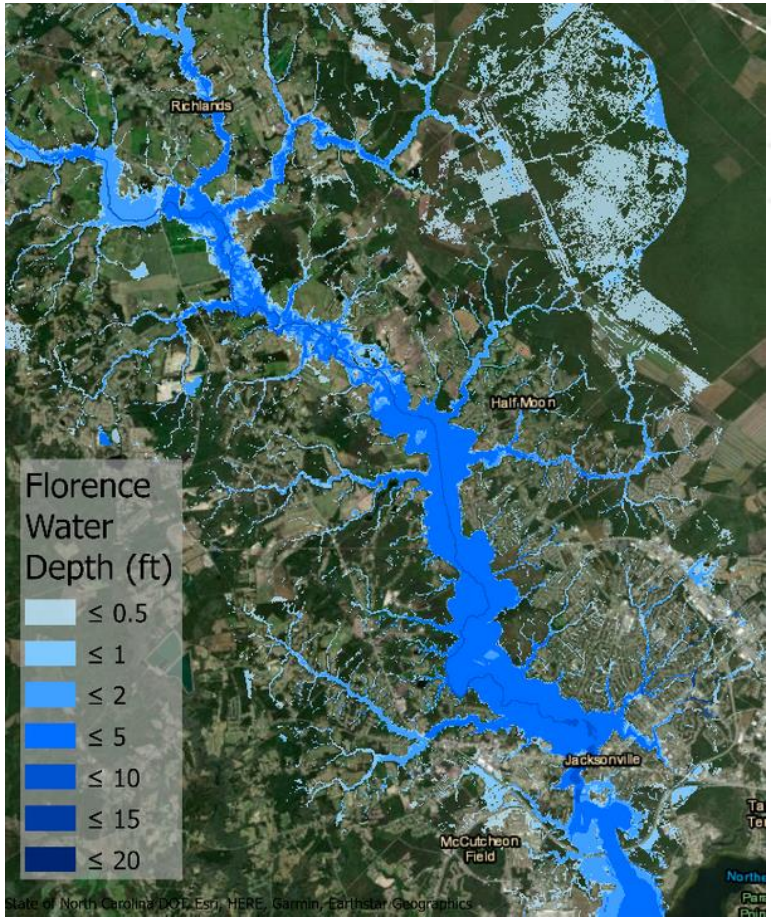
RESEARCH METHODS:

- Identify most susceptible areas
- Improve existing models and coastal hazard estimates to support cost-benefit analyses of flood mitigation alternatives.

INITIAL OUTCOMES:

- Found that **small coastal watersheds are disproportionately more susceptible to compound flooding.**
- Revealed that **current hazard models lack detailed information about channel bathymetry.**
- Concluded that the region south of Cape Lookout **indicates compound flooding components**.

Modeled inundation during Hurricane Florence in the New River Watershed near Jacksonville, NC



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Improving Resilience to Coastal Riverine Flooding

Barbara Doll, Jonas Monast, et al.

Flooding in NC from Hurricane Matthew

FOCUS:

- Represent the impact of natural infrastructure projects on flood mitigation and water quality improvement efforts
- Focused on Nahunta Swamp, Bear Creek, and Little River.

RESEARCH METHODS:

- Identify ideal locations for implementing strategic natural infrastructure through GIS-based analysis.
- Develop hydrologic models to assess mitigation practices.
- Form an advisory board to survey farmers and landowners.

INITIAL OUTCOMES:

- Discovered that **peak flow during Hurricanes Floyd and Matthew would have been reduced significantly by natural infrastructure.**
- Explored opportunities to **enhance natural infrastructure for flood mitigation by implementing flood storage capacity projects** authorized in last year's HB 1087

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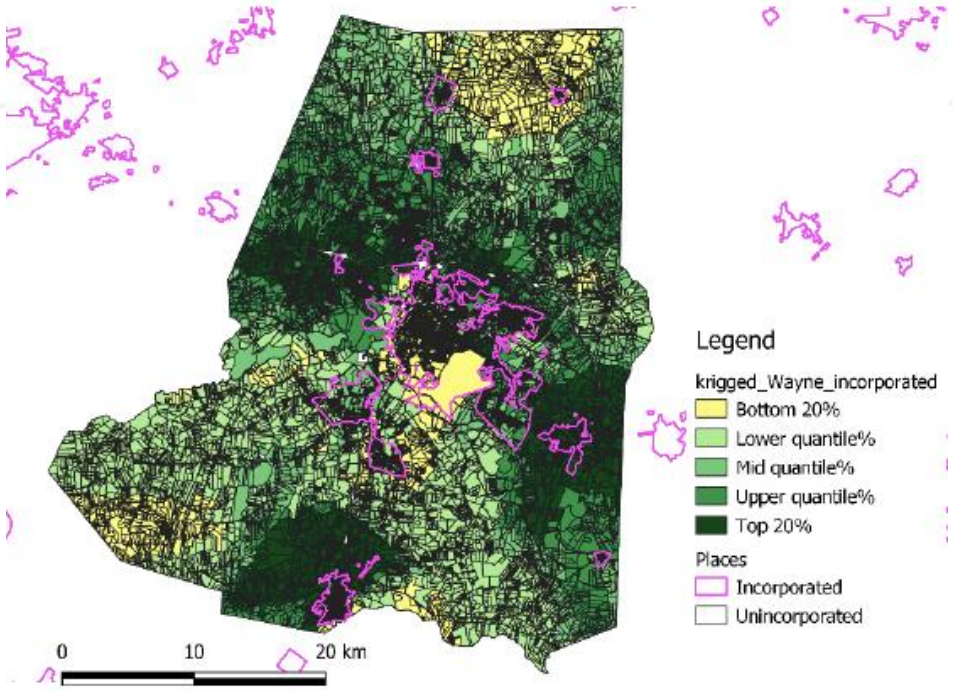
Financial Risk

Greg Characklis, et al.

Hedonic model for Wayne County, 2016



FOCUS:

- Analyze factors that heighten loss in property value or expedite recovery.
- Predict distribution of financial risk across property owners, lenders, and local and federal governments.

RESEARCH METHODS:

- Combine NFIP claim data, property value information, mortgage data and estimates of ‘adjusted loan-to-value ratios’
- Derive spatial relationships between flood damages and property values.
- Create models using property values and point-level flood damage and insurance data.

INITIAL OUTCOMES:

- Determined that **property owners retain the majority of the risk and one-third of flood losses are spread across the other three groups.**
- Completed hedonic model that illustrates estimated real estate, created spatial interpolations.
- Identified communities and properties that would benefit from flood insurance and pre-disaster flood mitigation efforts.

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Infrastructure

Assessing Operational Flooding Risks for Substations and the Wider North Carolina Power Grid

Jordan Kern, Luis Prieto Miranda

FOCUS:

- Assess the vulnerability of the electric grid to flooding in parts of eastern North Carolina.

METHODS:

- Discuss coastal and inland flood concerns with North Carolina Electric Membership Corporation.
- Conduct geospatial flood risk assessment.
- Investigate areas susceptible to long-term outages.

OUTCOMES:

- Identified grid assets in flood inundation zones.
- Developed holistic model of state's power grid infrastructure.
- Assessed grid's response and determined that **current risk-based maps underestimate risks posed by recent storms.**

Substation in NC after Hurricane Florence

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Public Health

Hurricane Public Health Response

Jill Stewart, Rachel Noble

FOCUS:

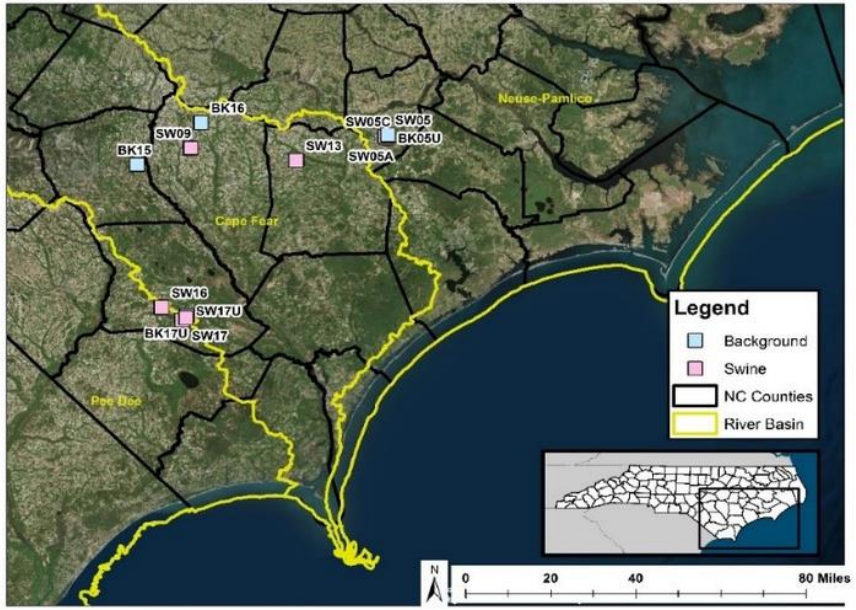
- Understand and mitigate public health risks from the spread of pathogens, antimicrobial-resistant bacteria, and other microbial hazards.

RESEARCH METHODS:

- Evaluate microbial hazards associated with flooding.
- Collect and analyze samples from before and after Hurricane Florence.
- Build capacity in molecular pathogen analysis.

INITIAL OUTCOMES:

- Confirmed that **flooding and other precipitation events are associated with increased levels of pathogens and antimicrobial resistance in surface waters**, especially in areas close to human and animal wastewaters.



Sampling locations post-Florence

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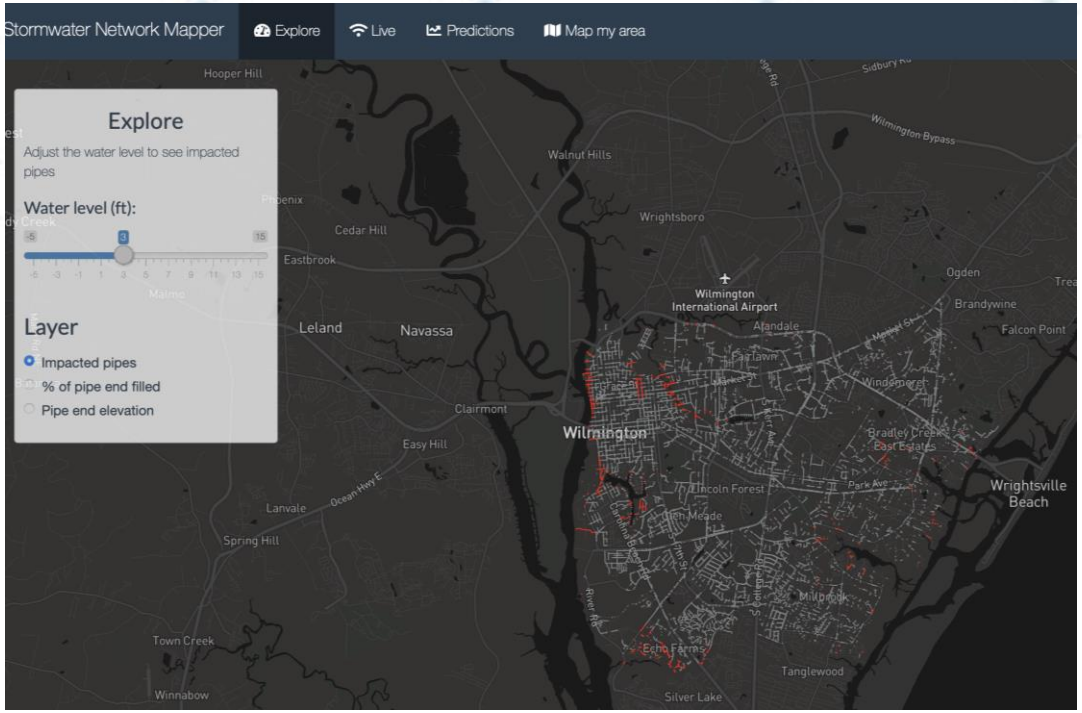
Infrastructure

Assessing Stormwater Infrastructure Resilience

Mike Piehler, et al.



FOCUS:

- Analyze impact of water level on coastal North Carolina's stormwater infrastructure.

RESEARCH METHODS:

- Model inundation impacts on stormwater networks throughout eastern NC
- Develop flood risk models illustrate inundation.

INITIAL OUTCOMES:

- Found that **stormwater infrastructure inundation would rapidly increase with as water level rose**
- **65 NC municipalities had road area impacted by high tide flooding**
- Identified specific areas to **adapt quickly to mitigate inundation.**

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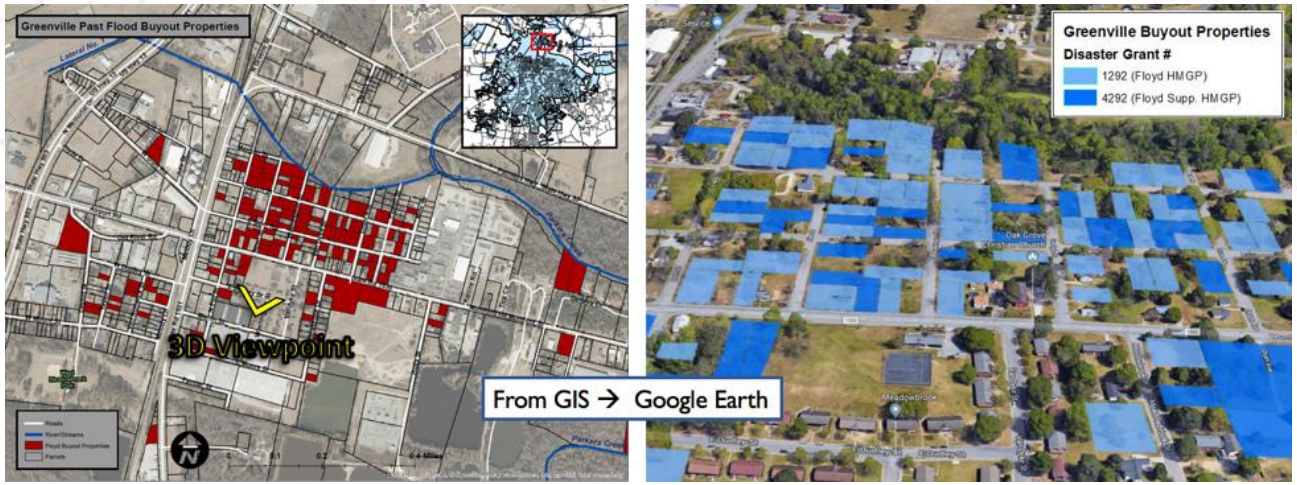
Floodplain Buyouts

Todd BenDor, et al.

Checker-board pattern of floodplain buyouts in Greenville, NC



FOCUS:

- Analyze current buyout processes
- Determine financial cost and aggregate risks
- Work with relevant consultants and officials with experience

RESEARCH METHODS:

- Review funding mechanisms
- Clean and merge buyout data to create a nationwide database about spatial distribution, aggregate risk, and economic impact.
- Evaluate new development in areas marked for buyouts, survey buyout experts

INITIAL OUTCOMES:

- Recommended that **the State should explore the wide variety of local and state funding mechanisms that were created to smooth and speed buyout processes.**
- Concluded that **most budgets fail to factor in financial cost of buyouts.**

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Stormwater Control Measure Resiliency

Bill Hunt, et al.

FOCUS:

- Transfer information collected through interviews into resiliency-based guidelines for design and maintenance strategies for SCM infrastructure

RESEARCH METHODS:

- Develop four SCM resiliency fundamentals.
- Identify impactful design features (proximity to surface, use of forebays, emergency spillways).

INITIAL OUTCOMES:

- Determined that **appropriately situated, well-designed, specifically constructed, reliably maintained SCMs were most resilient**.
- Recommended **incorporating vegetation in areas faced with high water flows, inundation, and lack of maintenance**.

Financing Strategies for Resilient Infrastructure

Erin Riggs, Austin Thompson

FOCUS:

- Compile dataset of sources of funding for flood-resilient infrastructure.
- Perform case studies on eastern NC communities impacted by hurricanes.

RESEARCH METHODS:

- Analyze environmental impact bonds, resilience bonds, parametric insurance, community rating system.
- Gather financial data and information by surveying communities in three river basins.

INITIAL OUTCOMES:

- Developed free tool for utilities to evaluate their financial resilience.

- Floodplain Buyouts
- Financial Risk
- Natural Systems
- Infrastructure
- Public Health

Next Steps

The final report will be submitted to legislature on June 1, 2021.

The interim report submitted in February can be found at collaboratory.unc.edu

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