



# NORTH CAROLINA FLOOD RESILIENCY BLUEPRINT

Lumber River Basin Action Strategy (RBAS)

Lumber River,  
Carvers Creek  
State Park,  
Cape Fear  
River

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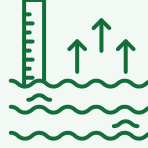
# EXECUTIVE SUMMARY

The Lumber River Basin Action Strategy (RBAS) is a core component of North Carolina's Flood Resiliency Blueprint, providing a comprehensive, data-driven plan to reduce flood risk and improve long-term resilience across the basin. The strategy integrates technical analysis, stakeholder engagement, and economic evaluation to identify and prioritize effective flood mitigation actions at regional and local scales.

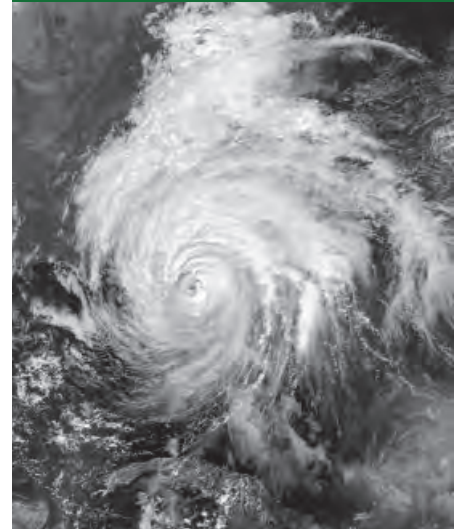
Flood resilience is the capacity of individuals, a community, a basin, or the environment to reduce, withstand, respond to, and recover from flooding by mitigating the impacts while also adapting to changing conditions including increased rainfall, sea level rise, and changes in land use.

The Lumber River Basin spans approximately 3,329 square miles across ten counties in southeastern North Carolina and serves a population of over 922,000 residents, with significant growth projected through 2060.

The basin faces substantial flood risk due to multiple contributing factors:

-  Riverine (fluvial), rainfall-driven (pluvial), coastal, and stormwater flooding
-  Dam and levee failure risks
-  Increasing impacts from climate change, sea level rise, and land development

10 counties  
3,329 sq. miles  
922,000 residents



Historically, severe storms such as Hurricanes Matthew (2016) and Florence (2018) caused widespread flooding, infrastructure damage, and economic losses. Future projections indicate:

- Increased precipitation and storm intensity (NCICS, 2020)
- Significant expansion of developed land (up to ~43% by 2100) (USEPA, 2025)
- Growing population pressures in vulnerable areas (OSBM, 2025)



These trends will increase exposure and vulnerability to flooding across the basin. Comprehensive modeling and analysis identified widespread and increasing flood risk:

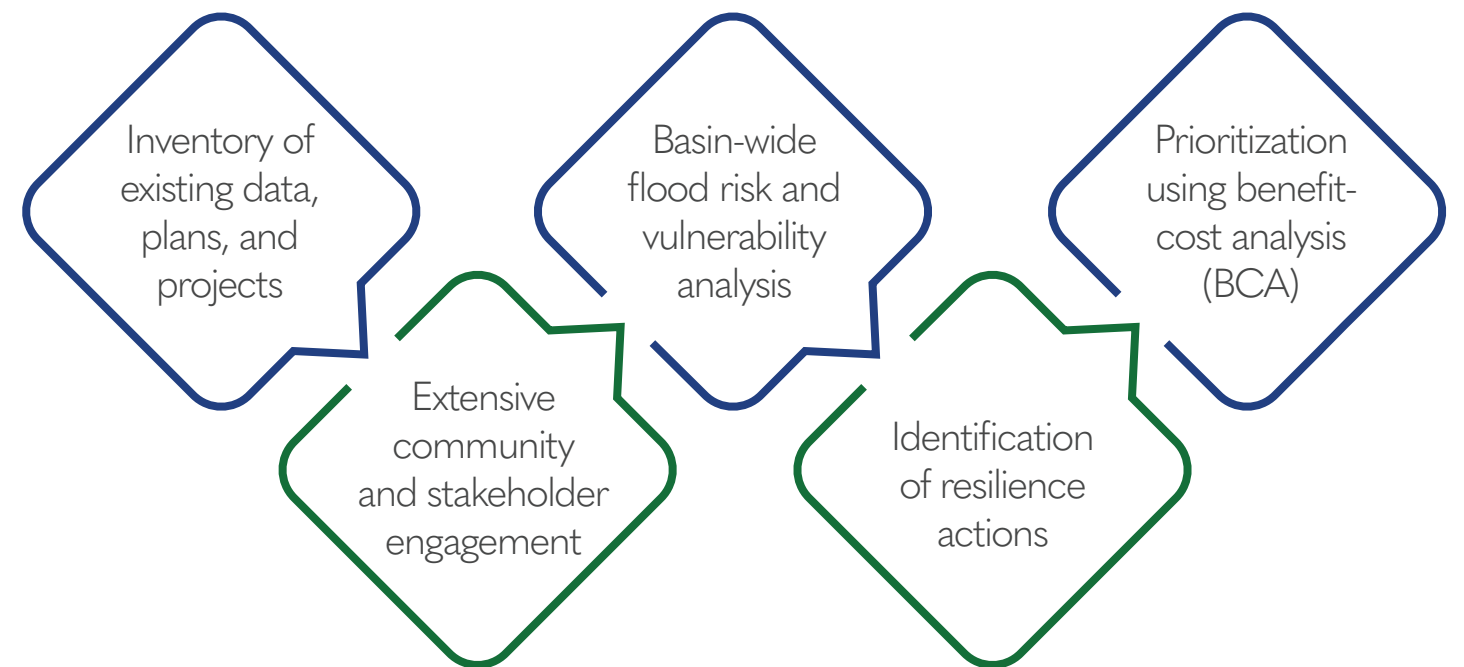
**18,000+** structures are currently at risk, with additional exposure under future scenarios

**52** high-risk dams and a high-risk levee system in Lumberton

**High Risk** Highly vulnerable areas including Lumberton, Fair Bluff, Whiteville, and coastal communities

Future conditions are expected to intensify flood impacts, reinforcing the urgency for coordinated mitigation efforts.

The RBAS was developed through a five-step process involving:



More than 300 existing or proposed resilience actions were reviewed, with additional regional actions developed to address high-risk areas. The strategy emphasizes inclusion of under-resourced and vulnerable communities, incorporating local knowledge into decision-making.

The plan identifies a set of high-impact, cost-effective actions (BCR ≥ 1.0 over 50 years), including four major regional initiatives:





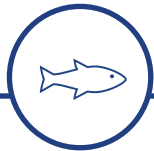
Fair Bluff Levee Construction



Lumberton Regional Flood Protection Improvements



Regional Dam Safety Program



Whiteville Stormwater and Stream Restoration Programs

Additional measures include building-level mitigation (e.g., elevation, acquisition) for residual high-risk structures.

These actions combine structural, nature-based, and policy solutions to create a multi-layered resilience approach.

The RBAS outlines a comprehensive funding strategy, identifying federal, state, and local sources such as FEMA mitigation programs, USDA watershed programs, and state grants.

Given the scale and cost of major projects, successful implementation will require:

- Leveraging multiple funding sources
- Strategic partnerships (e.g., FEMA, USACE, NC agencies)
- Support for cost-share requirements, especially in under-resourced communities

## Key Takeaways

- Flood risk in the Lumber River Basin is significant and increasing, driven by climate change and development.
- A data-driven and community-informed approach was used to identify the most effective mitigation strategies.
- Priority actions focus on protecting high-risk areas, critical infrastructure, and vulnerable populations.
- Implementation will depend on sustained funding, coordination, and capacity building.
- The Action Strategy provides a long-term roadmap for enhancing flood resilience and supporting safer, more sustainable communities.
- There are currently capacity challenges for local governments. The Blueprint process, including capacity building, will improve flood resiliency outcomes for these areas and the basin.



# TERMS & ACRONYMS

AADT	Annual Average Daily Traffic	CRS	Community Rating System
Action	in the Blueprint, "actions" denote specific flood resilience measures identified and ranked at the basin scale. DEQ, in collaboration with communities, utilizes the Flood Resiliency Blueprint Tool to assess and prioritize these actions based on a variety of parameters.	CWA	Carolina Wetlands Association
ALE	Annualized Loss Estimate	CWSRF	Clean Water State Revolving Fund
AMEXCAN	Association of Mexicans in North Carolina	DDF	Damage Depth Function
Annual-Chance Flood Event	the probability that a flood event will occur in a given year.	DOT	Department of Transportation
ADSO	Association of State Dam Safety Officials	DWR	Division of Water Resources
Basin	an area of land that contains a common set of waterbodies (streams, rivers, lakes, or wetlands) that all drain into a single larger body of water. Watersheds can be defined at multiple geographic scales. In North Carolina, 17 "major" watersheds (basins) are defined by statute.	DWSRF	Drinking Water State Revolving Fund
BCA	Benefit-Cost Analysis	ECL	End of Century Lower
BLE	Base Level Engineering	ECH	End of Century Higher
BRIC	Building Resilient Infrastructure and Communities	ECS	End of Century Severe
BUILD	Better Utilizing Investments to Leverage Development	EEG	Environmental Enhancement Grant
CDBG	Community Development Block Grants	EPA	Environmental Protection Agency
CDBG-DR	Community Development Block Grants- Disaster Recovery	EQIP	Environmental Quality Incentives Program
CDBG-MIT	Community Development Block Grants- Mitigation	EWP	Emergency Watershed Protection
CIP	Capital Improvement Plan	FAST	Flood Assessment Structure Tool
COG	Council of Governments	FEMA	Federal Emergency Management Agency
		FFE	Finished Floor Elevation
		Flood Resilience	the capacity of individuals, a community, business, or natural environment to reduce, withstand, respond to, and recover from flooding by positively mitigating the impacts of changing conditions and challenges including climate change, increasing rain fall, and sea level rise, and adapting to those conditions.
		FMA	Flood Mitigation Assistance
		H&H	Hydrologic and Hydraulic



HMGP	Hazard Mitigation Grant Program	NVA	Natural Valley Analysis
ICLUS	Integrated Climate and Land Use Scenarios	O&M	Operations and Maintenance
LRC	Lumber River Conservancy	OSBM	North Carolina Office of State Budget and Management
LSAC	Levee Safety Action Classifications	PDM	Pre-Disaster Mitigation
MCL	Mid Century Lower	PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation
MCH	Mid Century Higher	RCCP	Resilient Coastal Communities Program
MPO	Metropolitan Planning Organization	RBAG	River Basin Advisory Group
NC	North Carolina	RBAS	River Basin Action Strategy
NCB&TC	North Carolina Budget and Tax Center	RL	Repetitive Loss
NCBA	North Carolina Black Alliance	RPO	Rural Planning Organization
NCCN	North Carolina Conservation Network	SCOR	South Carolina Office of Resilience
NCDA&CS	North Carolina Department of Agriculture and Consumer Services	SDTSA	State Designated Tribal Statistical Area
NCDEQ	North Carolina Department of Environmental Quality	SERA	State Emergency Response Application
NCEM	North Carolina Emergency Management	SCSJ	Southern Coalition for Social Justice
NCGA	North Carolina General Assembly	SILC	North Carolina Statewide Independent Living Council
NCICS	North Carolina Institute for Climate Studies	SLR	Sea Level Rise
NCIDR	North Carolina Inclusive Disaster Recovery Network	SRF	State Revolving Fund
NCLWF	North Carolina Land & Water Fund	USACE	United States Army Corps of Engineers
NFIP	National Flood Insurance Program	USDA	United States Department of Agriculture
NFWF	National Fish and Wildlife Foundation	WFPO	Watershed and Flood Prevention Operations
NGO	Nongovernmental Organizations	WIFIA	Water Infrastructure and Innovation Act
NLCD	National Land Cover Database	WRDG	Water Resources Development Grant
NLD	National Levee Database	WSE	Water Surface Elevation
NOAA	National Oceanic and Atmospheric Administration		
NRCS	Natural Resources Conservation Service		
NRI	National Risk Index		

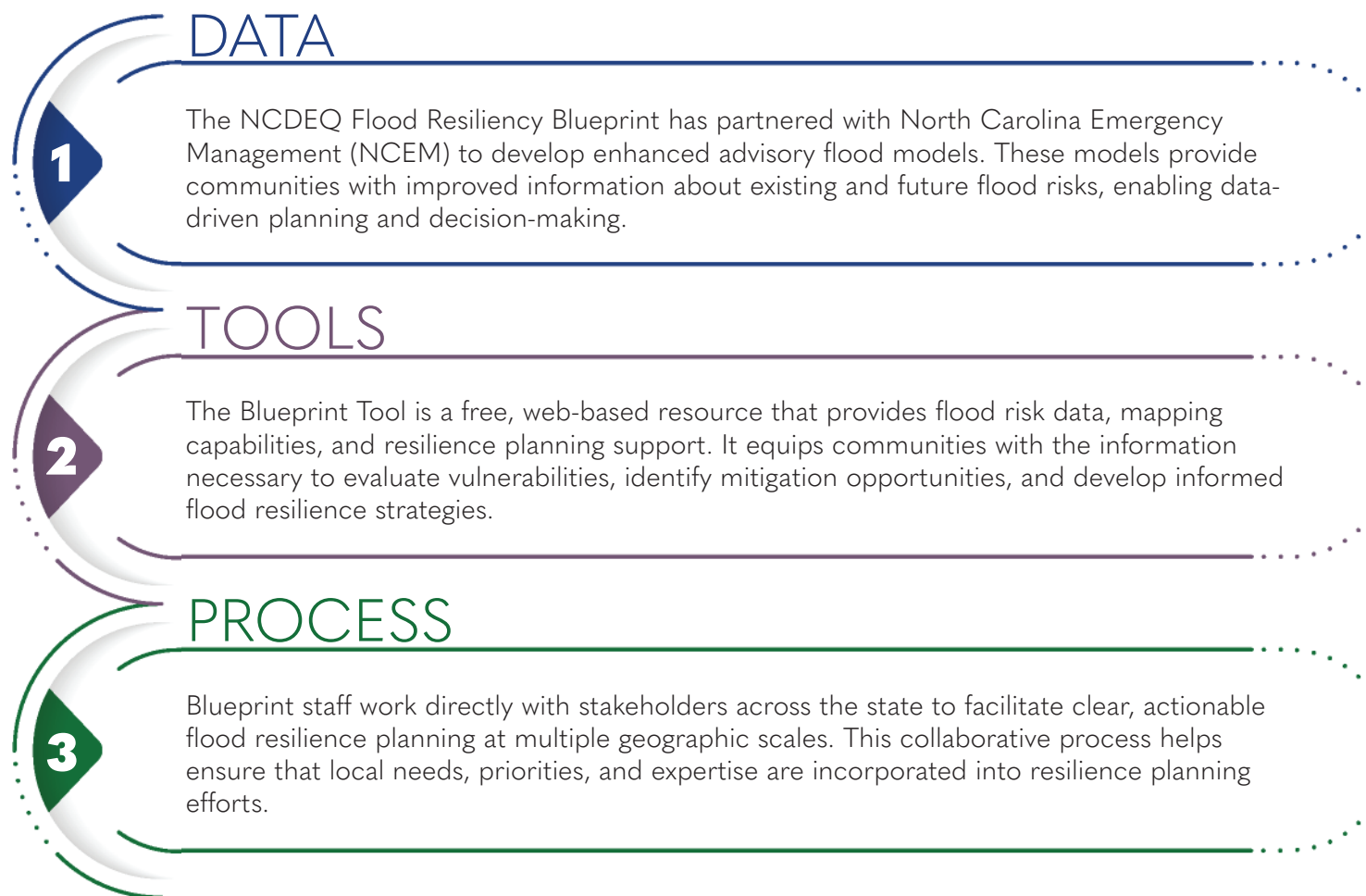


# INTRODUCTION

Over the past decade, North Carolina has experienced an increasing number of significant flood events, including Hurricanes Matthew (2016), Florence (2018), and Helene (2024). In just the last two years alone, Hurricanes Helene and Debby, Tropical Storm Chantal, and Potential Tropical Cyclone Eight have caused devastating impacts across the State of North Carolina. These events underscore the urgent need for proactive planning and strategic investments to strengthen flood resilience throughout the state.

Flood resilience is not the responsibility of a single agency or program. It requires coordinated action among communities, local, state, tribal, and federal governments, as well as a wide range of public and private stakeholders. Through effective planning, collaboration, and investment, communities can reduce flood damage and recover more quickly when flooding occurs. The North Carolina Flood Resiliency Blueprint was established to support this coordinated effort by providing the data, tools, and processes needed to guide decision-making and prioritize investments that reduce future flood risk, address gaps in existing mitigation efforts, and minimize the economic and social impacts of flooding.

The Blueprint is built upon three foundational components:



The North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS), was directed by the North Carolina General Assembly through Session Law 2021-180 (Senate Bill 105) to develop a Statewide Flood Resiliency Blueprint. Additional funding was later provided through Session Law 2022-75 (House Bill 911). The Blueprint serves as a statewide flood planning framework and decision-support system that enables state, tribal, regional, and local stakeholders to identify, prioritize, and implement effective flood resilience strategies.

By leveraging the best available science, data, and future-conditions modeling, the Blueprint help communities better understand long-term flood risks within their river basins. The framework is designed to be adaptive, incorporating new information as it becomes available to ensure that planning and investment decisions remain relevant and effective. Through improved coordination among agencies, programs, and all levels of government, the Blueprint seeks to maximize the use of available resources and support informed decisions that increase flood resilience across North Carolina.

## BLUEPRINT GOALS

The Blueprint is guided by three overarching goals:

- 1 Develop a statewide online decision-support tool.**  
The Blueprint Tool was created to serve stakeholders and communities in their flood resiliency planning efforts by offering flood risk data in tandem with a decision support tool. This Tool offers a flood resilience and community data hub to bolster the flood mitigation work that is already happening.
- 2 Establish community- and basin-specific planning processes.**  
Through the River Basin Action Strategies (RBAS), the Blueprint process creates a structured approach to identify and develop solutions tailored to the needs and priorities of individual communities and river basins. Addressing this challenge on a basin-wide scale allows for a more coordinated approach that is in concert with the hydrologic profile of the basin.
- 3 Create a repeatable statewide methodology.**  
Developing RBAS plans for all North Carolina river basins using a consistent methodology that enables each basin to identify and advance appropriate flood resilience solutions.

# PROGRAM APPROACH

To achieve these goals, the Blueprint program is being implemented through three integrated phases:

- Blueprint Process Development: Establishing a statewide planning framework that utilizes the best available data, science, and resources.
- Blueprint Tool Development: Creating an accessible platform that supports planning, analysis, and stakeholder engagement across North Carolina.
- River Basin Action Strategy Development: Developing RBAS plans for all North Carolina river basins using a consistent methodology that enables each basin to identify and advance appropriate flood resilience solutions.

Together, these efforts (broken down into the eight key steps in Figure 1) provide North Carolina with a comprehensive, data-driven approach to reducing flood risk, strengthening community resilience, and supporting long-term recovery and adaptation in the face of increasing flood hazards.

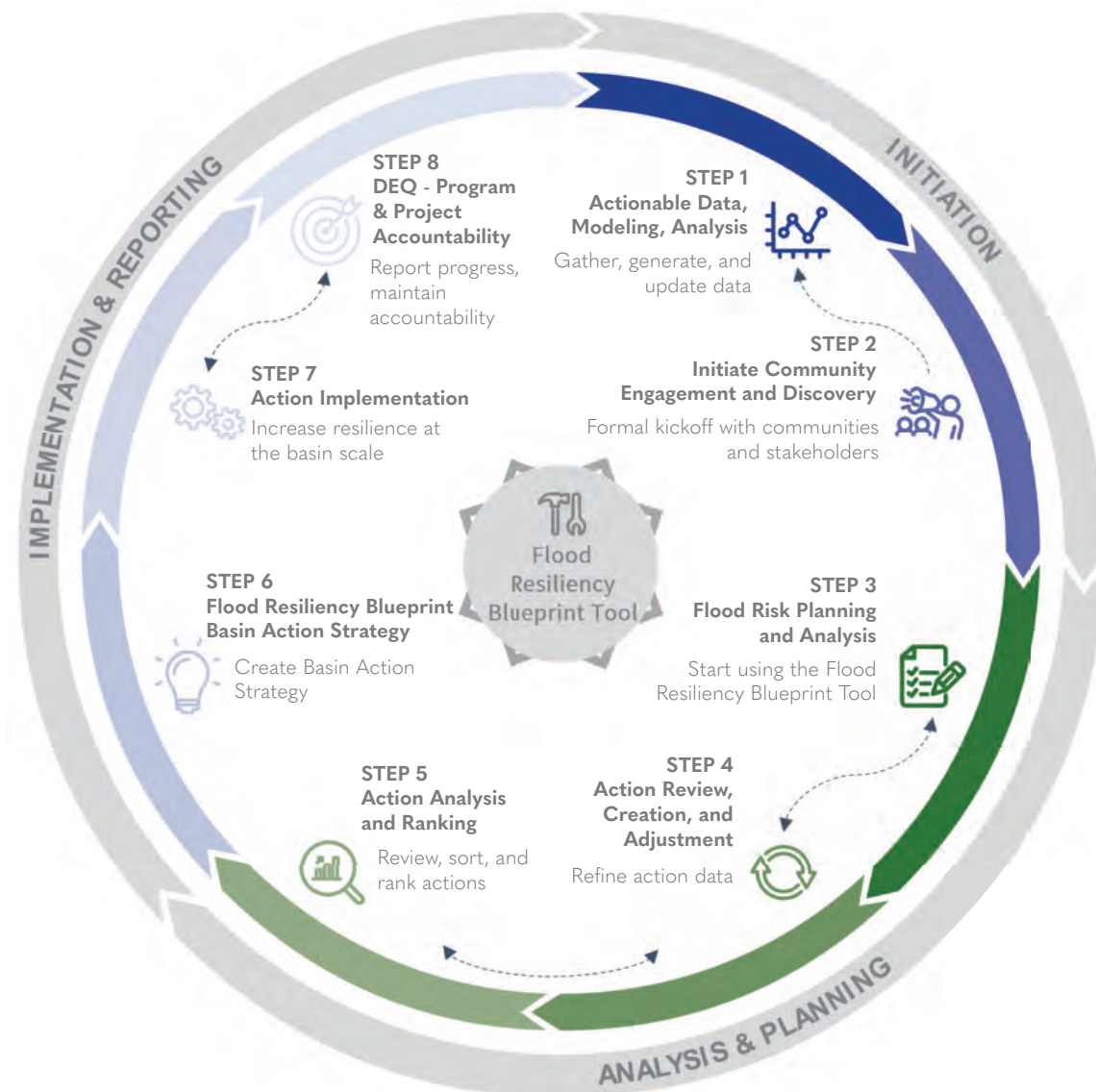


Figure 1. North Carolina Department of Environmental Quality (DEQ) Flood Resiliency Blueprint Tool and Planning Process (NCDEQ, 2024b).

# RATIONALE FOR RIVER BASIN ACTION STRATEGIES AND CONTEXT WITHIN THE BLUEPRINT

The RBAS is a strategic plan specific to an individual river basin developed with the assistance of the Blueprint Process and Tool. The strategy will be informed by community and stakeholder input and will outline specific flood resilience actions and potential funding sources.

## OBJECTIVES OF THE RBAS

The Blueprint process includes a unified approach to identifying resiliency actions across the state, but each basin has its unique needs. NCDEQ’s objective for the RBAS is to identify priority regions and mitigation actions within each basin. Additionally, any data needs or limitations are presented to highlight the growth and continued efforts needed within the basin. Development of an RBAS will utilize the latest detailed flood modeling datasets for both current and future conditions, ensuring that long-term planning is incorporated. Stakeholder engagement is also a large component of the RBAS process to ensure that decisions and recommendations are made in conjunction with local and regional entities and the specific needs of the basin. Overall, the RBAS will result in a list of prioritized actions, providing a starting point to making the basin more resilient to flooding.



Great Blue Heron in canal, Lake Waccamaw

American Alligator in canal, Lake Waccamaw



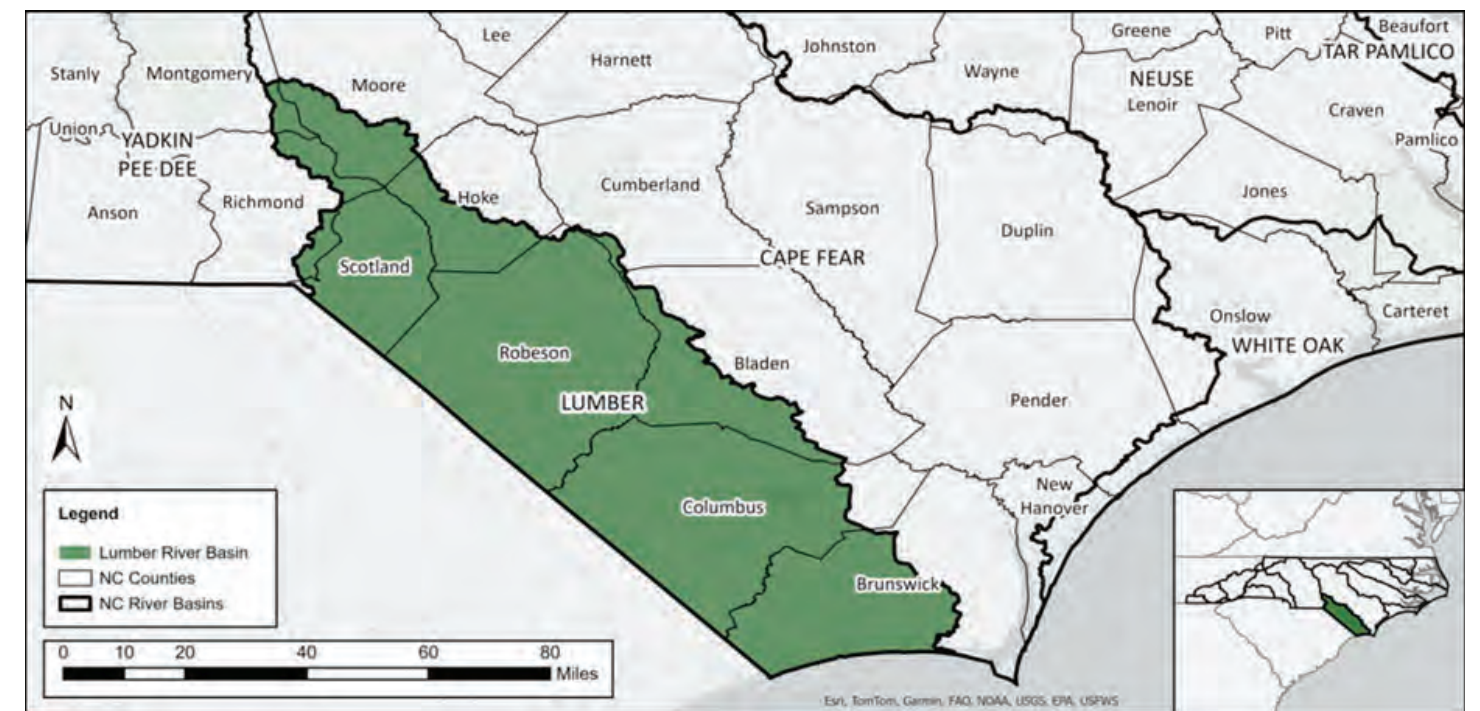
# BASIN OVERVIEW

## About the Basin

### Location

The Lumber River Basin occupies a total area of 3,329 square miles within southeastern North Carolina. The basin is made up of four smaller watersheds that ultimately flow into either South Carolina or the Atlantic Ocean. As shown in Figure 2, the basin encompasses portions of ten counties: Scotland, Robeson, Columbus, Brunswick, Bladen, Hoke, Richmond, Moore, and Montgomery. In these counties, the five most populous municipalities contained within the basin are the Cities of Lumberton, Laurinburg, and Whiteville and the Towns of Shallotte and Sunset Beach.

Figure 2. Location of the Lumber River Basin and the other North Carolina River Basins.



### Demographics

As of the 2020 US census, there are 922,860 people living in the Lumber River Basin. Census data reported that the population of the counties within the basin grew by 14.7% from 2000 to 2020 (US Census, n.d.). The North Carolina Office of State Budget and Management (OSBM) projects an additional 36.5% in growth by 2060 (OSBM, 2025).

The basin's counties are racially diverse, with the non-white population making up of 45.0% at the county level and 44.8% at the community level. The county level poverty rate of 18.9% is higher than the state average of 13.2%. Additionally, the median county household income of \$57,972 is lower than the state median of \$69,904 (US Census Bureau, 2023).



The basin contains two state designated tribal statistical areas (SDTSA), the Lumbee and the Waccamaw Siouan. The Lumbee Tribe has more than 55,000 members and resides in Robeson, Hoke, Cumberland, and Scotland Counties with its headquarters in the Town of Pembroke. The Waccamaw Siouan Tribe has more than 2,000 citizens in Bladen and Columbus Counties near its homeland on the edge of Green Swamp (NCDOA, n.d.).

There are five Councils of Government (COGs) serving these communities that provide additional services and support (Figure 3).

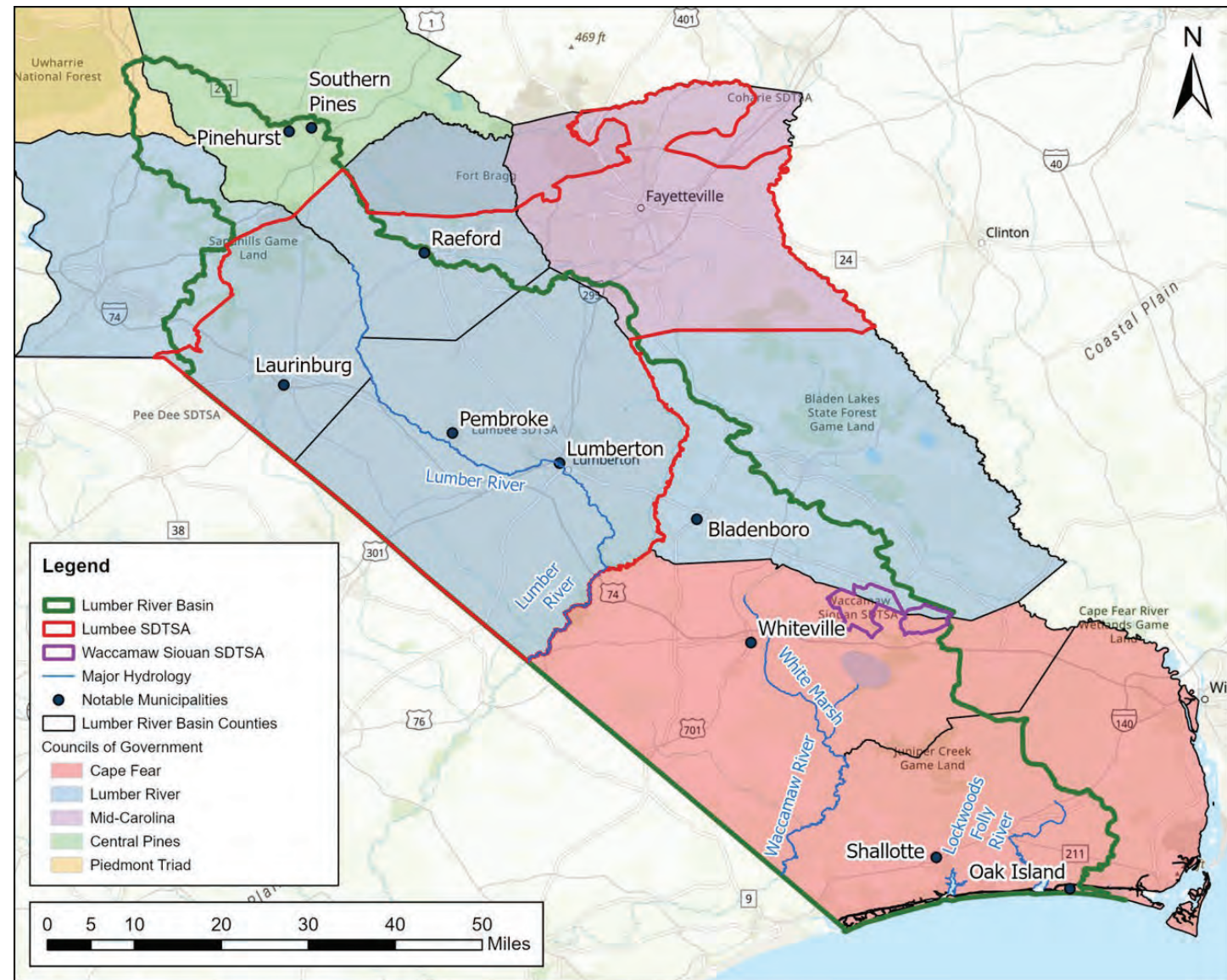


Figure 3. COGs, Counties, notable municipalities, SDTSA and major waterways of the Lumber River Basin.

## Climate

The climate of the Lumber River Basin, like much of the southeastern United States, is classified as a humid, subtropical climate, characterized by hot, humid summers and mild winters (Koppen-Geiger Climate Classification (GLOH2O, 2025). According to 1991-2020 climate normals, the average annual temperature in the basin is 62.7 degrees Fahrenheit, higher than the state average of 59.9 degrees Fahrenheit. The basin experiences an average annual rainfall of approximately 50.6 inches per year, just below the state average of 51.6 inches (PRISM, 2025).

## Flood Risk

The Lumber River Basin has faced multiple severe flooding events, causing widespread social, environmental, and economic impacts on communities throughout the basin.

Five main flooding sources were identified within the basin: fluvial flooding, pluvial flooding, coastal flooding and sea level rise, urban and stormwater flooding, and flooding resulting from the breach of dams and levees. Compound flooding is a concern within the basin, especially within the coastal communities. Compound flooding results from the interaction of two or more flooding sources, most commonly coastal, fluvial, and pluvial in any combination. Other secondary flooding sources including groundwater flooding may contribute to flooding within the basin. However, groundwater flooding was not assessed as a separate source in this report.

The Federal Emergency Management Agency’s (FEMA) National Risk Index (NRI) investigates a county’s vulnerability to 18 hazards, including riverine and coastal flooding, relative to all counties within the U.S. (FEMA, n.d.). All counties within the Lumber River Basin are in the top half of the state and top quarter of the U.S. for overall risk. NRI scores for counties within the Lumber River Basin are provided in **Appendix A**.

In addition to the NRI, FEMA’s National Flood Insurance Program (NFIP) collects data on flood related insurance claims including information on Repetitive Loss (RL) properties. These properties have flooded multiple times over a 10-year period causing more than \$1,000 in damages for each flooding event (FEMA, 2020). Counties within the Lumber Basin have had a disproportionately high numbers of NFIP payments (Figure 4).

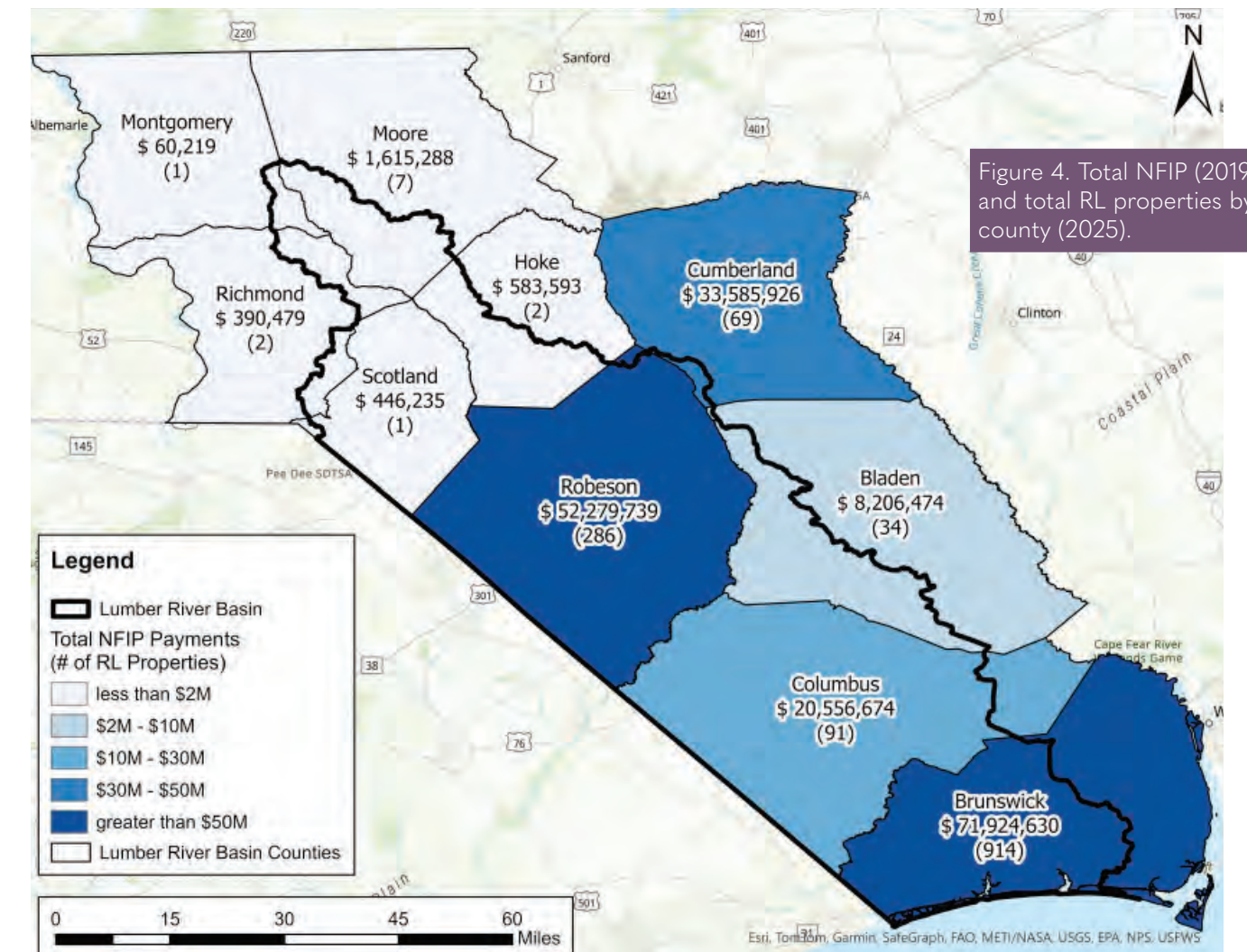


Figure 4. Total NFIP (2019) and total RL properties by county (2025).

# History of Flooding

<i>Hurricane</i>	<i>Year</i>	<i>Basin Impacts</i>
Hazel	1954	<ul style="list-style-type: none"> <li>Record storm surge (18ft) in Brunswick County, NC</li> <li>19 NC Deaths (NWS, n.d.-a)</li> </ul>
Fran	1996	<ul style="list-style-type: none"> <li>\$5+ billion in damages*</li> <li>23 NC deaths (NWS, n.d.-b)</li> </ul>
Floyd	1999	<ul style="list-style-type: none"> <li>Preceded by Hurricane Dennis 2 weeks prior which created highly saturated conditions</li> <li>15" of rain in Whiteville, NC</li> <li>36 NC deaths (NWS, n.d.-c)</li> </ul>
Matthew	2016	<ul style="list-style-type: none"> <li>\$1.5+ billion in flood damages*</li> <li>Record Lumber River peak flood stage (multiple locations)</li> <li>12.6" of rain in Lumberton, NC</li> </ul>
Florence	2018	<ul style="list-style-type: none"> <li>\$17+ billion in damages*</li> <li>Record Lumber River peak flood stage (multiple locations)</li> <li>27.4" of rain at Green Swamp in Brunswick County, NC (NWS, n.d.-d)</li> <li>Peak of 22.2 feet at the West 5th street at Lumberton stream gage (USGS Gage: 02134170) (NWPS, 2025)</li> </ul>

\*Damages not adjusted for inflation

Huge Waves From Hurricane Florence Crashing on Pier in the Outer Banks of NC



# Basin Dynamics

## Land Use Changes and Development

The percentage of the Lumber River Basin that is developed is expected to almost triple from 2023 to 2050 and increase by four-fold by 2100. The predicted increase in developed areas throughout the basin could impact surface runoff levels, water storage capacity, and reduce the level of natural stormwater mitigation.

<i>Current Conditions</i>		<i>2050 Land Use</i>		<i>2100 Land Use</i>	
<b>Land Use Type</b>	<b>Percentage</b>	<b>Land Use Type</b>	<b>Percentage</b>	<b>Land Use Type</b>	<b>Percentage</b>
Wetlands	32.9%	Wetlands	23.2%	Wetlands	14.6%
Planted/Cultivated	26.2%	Croplands	20.5%	High-Density Exurban	16.7%
Forest	21.6%	Timber	20.3%	Timber	15.8%
Developed Area	11.9%	Developed Area	30.1%	Developed Area	42.8%

Sources: (MRLC, 2023) and (EPA, 2025)



## Climate

Average temperatures across NC are projected to increase by up to 10 degrees Fahrenheit by 2100 (NCICS, 2020). The actual level of warming is dependent on future greenhouse gas emissions. Annual precipitation levels have increased and are projected to continue to increase in future conditions. With increasing temperatures, hurricane storm events are projected to become more frequent and more intense, leading to increased levels of flooding in coastal and low-lying communities (NCICS, 2020).

## Population Shifts

The North Carolina Office of State Budget and Management (OSBM) projects an additional 36.5% in growth by 2060 across the Lumber River Basin. Although the total population within the Lumber River Basin is expected to increase, population changes will not be uniform across the communities within the basin. The populations of some communities are expected to increase while others are expected to decrease (**Table 1**). Brunswick County is expected to grow faster than any other county in the basin from 2020 to 2060 (OSBM, 2025).

Table 1. Population projections for the Lumber River Basin counties (OSBM, 2025).

County	Census 2020 Pop.	Projected 2040 Pop.	Projected 2060 Pop.	% Change 2020-2060
Bladen	29,606	35,281	43,371	46.5%
Brunswick	136,693	239,871	309,279	126.3%
Columbus	50,623	52,524	52,836	4.4%
Cumberland	334,728	337,972	337,971	1.0%
Hoke	52,082	68,776	86,329	65.8%
Montgomery	25,751	26,195	26,196	1.7%
Moore	99,727	148,540	196,130	96.7%
Richmond	42,946	39,830	39,683	-7.6%
Robeson	116,530	123,424	141,849	21.7%
Scotland	34,174	30,066	25,948	-24.1%
<b>Basin</b>	<b>922,860</b>	<b>1,102,479</b>	<b>1,259,592</b>	<b>36.5%</b>
<b>State</b>	<b>10,439,388</b>	<b>12,966,080</b>	<b>15,369,596</b>	<b>47.2%</b>

Lupine along the Lumber River at Chalk Banks in Scotland County, NC



# RIVER BASIN ACTION STRATEGY DEVELOPMENT PROCESS

The River Basin Action Strategy (RBAS) development process involved five main steps (Figure 1). Step 1 involved the development of an inventory of local actions, existing data, planning efforts, research projects, studies, and existing regional-scale modeling within the basin. The community engagement process (Step 2) has been an ongoing process, with the River Basin Advisory Group (RBAG) receiving updates and providing feedback throughout the process. Step 3 involved conducting flood risk and vulnerability analyses and development of regional resiliency actions to address identified areas of concern. Steps 4 and 5 of the Blueprint process involved the development of a list of priority resilience actions. This section summarizes the outcomes from these steps.

## ACTIONABLE DATA, MODELING, & ANALYSIS

### Inventory of Existing Data, Programs, & Studies

A literature review of all potential data, studies, plans, and programs (through January 2025) was performed to obtain knowledge on resiliency planning and action implementation within the Lumber River Basin. The outcome is a list of 328 resiliency actions that have been proposed, planned, or completed within the Lumber River Basin (See **Appendix A**). Qualifying actions fall under one of the following investment types: structural, non-structural, nature-based, planning, and policy. Common themes that emerged from the inventory of existing data, programs, and studies were post-hurricane recovery, future flood prevention through resiliency, and funding sources.

The existing flood risk data within the Lumber River Basin comes in the form of hydrologic and hydraulic (H&H) modeling and floodplain data. National, statewide, and local level data sources were inventoried, and this data was utilized to determine the level of flood risk and vulnerability in communities across the basin. NCDEQ collaborated with NCEM to complete 2D flood modeling for the Lumber River Basin as part of the Blueprint process and development of the RBAS. The 2D modeling work considered both current and future conditions flooding. A complete list of the modeling and dataset sources found through the literature review can be found in **Appendix A**.

## Local & Regional Capacity

The capacity of communities is a key factor in their ability to develop, fund, manage, and implement resiliency actions. Governmental structure, population, demographics, and socioeconomics all influence a community's capacity. Understanding each community's staffing, budget, and programmatic composition is vital to assessing its ability to successfully participate in the Blueprint process.

The Blueprint Capacity Analysis assessed each municipality or county's capacity to participate in the following six components:

1. Blueprint Tool and planning process training;
2. Independent or supported use of the Blueprint Tool to identify, analyze, and prioritize action strategies;
3. Project feasibility or conceptual design creation for selected strategies;
4. Action strategy funding;
5. Action strategy implementation; and
6. Ongoing stewardship or management of completed action strategies.

Cumberland, Bladen, Columbus, and Brunswick counties were deemed to have high capacity to participate in the Blueprint process while the rest of the counties were deemed to have moderate capacity (Figure 5). Municipalities and unincorporated communities were more varied, with 27 at low, 14 at moderate, and 11 at high for the overall capacity rating (Figure 6). Details on the metrics and data that were used in the capacity analysis can be found in **Appendix C**. A lower ability to engage in the six Blueprint components with communities leads to gaps in action with some of the highest risk and vulnerable areas. Capacity building is paramount to the effective resiliency in the Lumber River Basin.

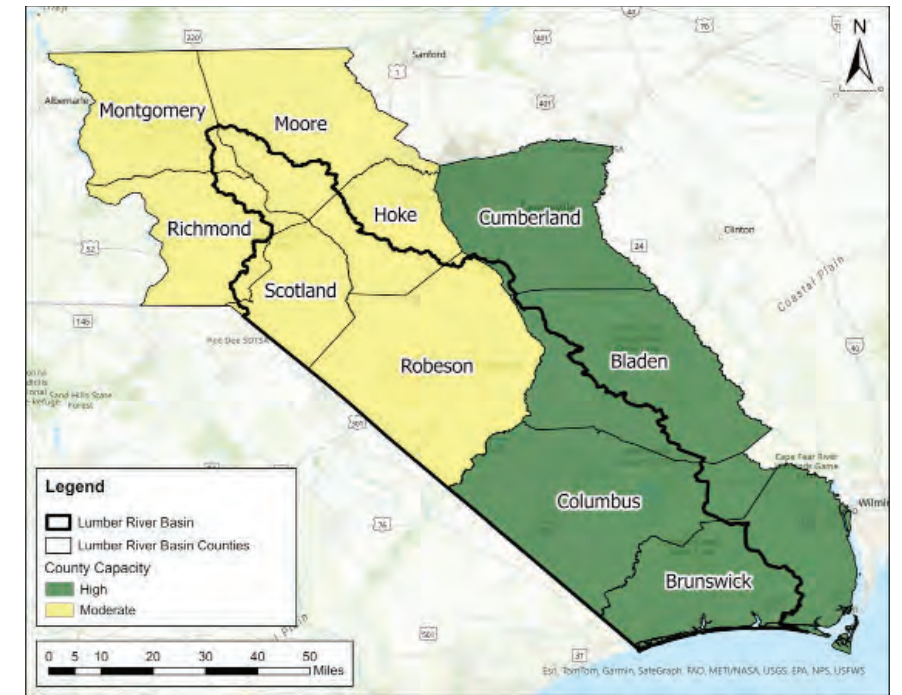


Figure 5. Lumber River Basin County level overall Blueprint capacity

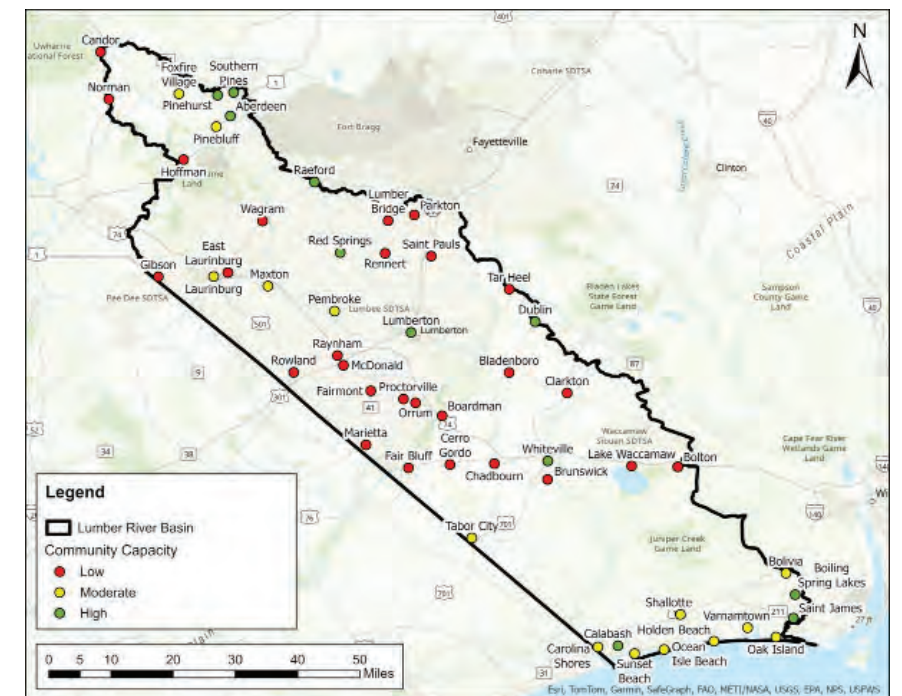


Figure 6. Lumber River Basin community level overall Blueprint capacity

# COMMUNITY ENGAGEMENT & DISCOVERY

## Engagement with Local Communities & Agencies

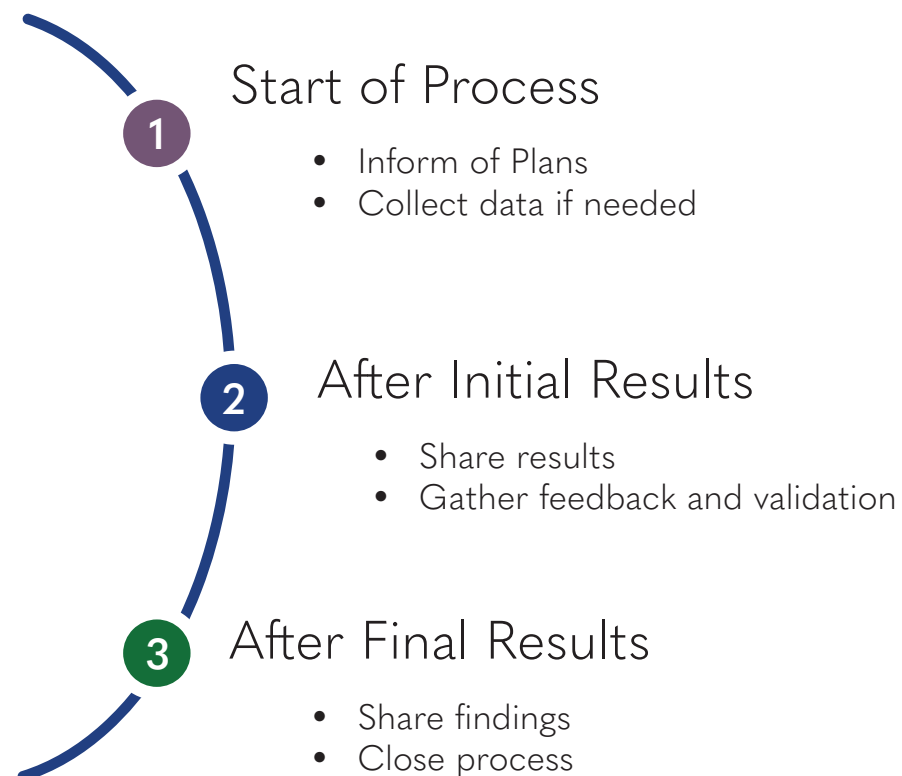
Planning for flood resilience works best when it is shaped by the people and communities who experience flooding firsthand. In the Lumber River Basin, outreach and engagement were designed to make sure local voices, experiences, and priorities played a central role in developing the Lumber River Basin Action Strategy.

During the development of the River Basin Action Strategy, engagement efforts focused on regional and basin-wide planning, and included communities, local governments, tribal representatives, along with nonprofit and regional organizations across the basin. A structured Outreach and Engagement Plan guided this work, establishing a coordinated approach to sharing information, gathering feedback, and building partnerships (Figure 7). A strong focus was placed on reaching and including vulnerable, under-resourced, and underserved communities to ensure their perspectives helped shape the process.

Central to this approach was the commitment to two-way communication and trust-building. Regular meetings, training sessions, and accessible “office hours” provided opportunities for stakeholders to learn, ask questions, and offer feedback. Continuous one-on-one support ensured that participants could engage at a level appropriate to their needs. As the process progressed, stakeholder input directly informed improvements to tools, data, and planning methods.

Through these sustained engagement efforts, the Action Strategy reflects a collaborative, data-informed approach to reducing flood risk. By integrating technical analysis with local expertise and community perspectives, the Blueprint process supports decision-making that is both regionally coordinated and responsive to on-the-ground needs.

Figure 7. River Basin Action Strategy Data Analysis Engagement Cycle.



## Blueprint Tool Trainings

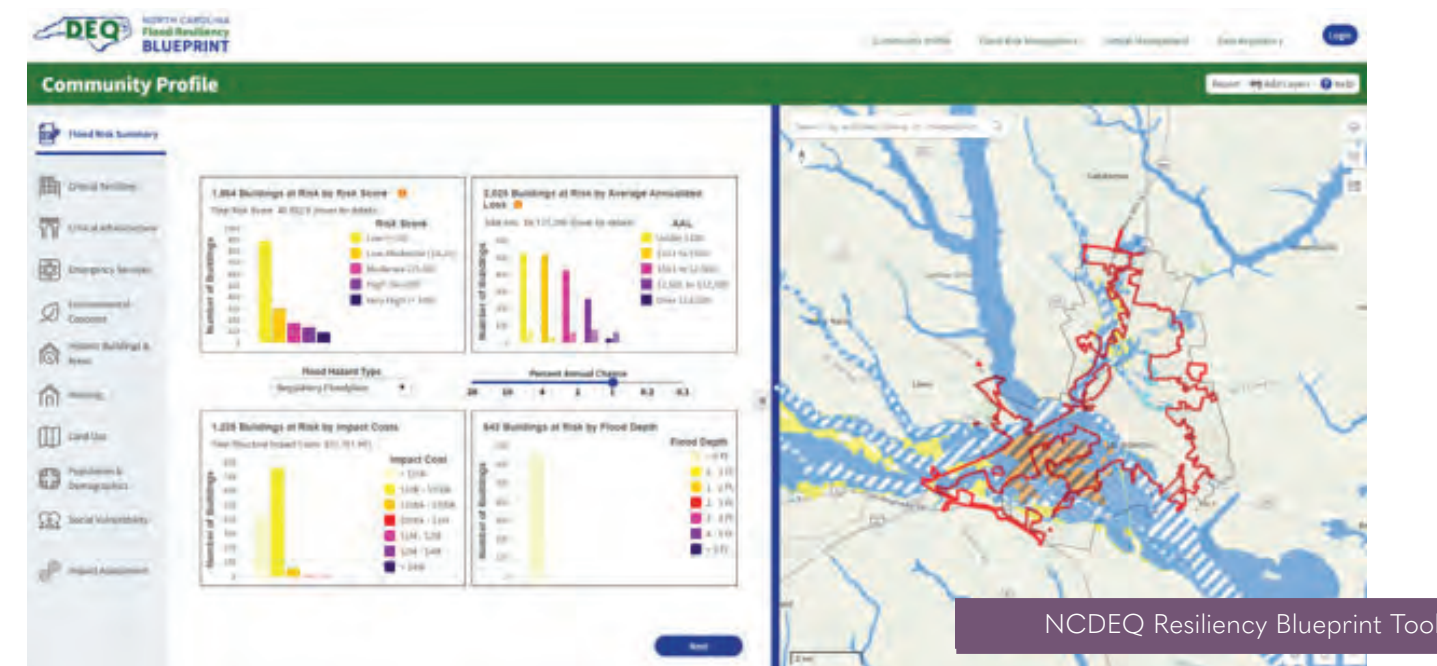
The Blueprint Tool is just one step within a structured planning and decision-making process. Stakeholder trainings and communications help to explain how users move from an initial vulnerability analysis to:

- identifying potential actions
- comparing multiple options
- including cost-benefit considerations and
- finally selecting an action or project concept for submission as a formal proposal.

To ensure the success of the Flood Resiliency Blueprint, stakeholders across the river basin were given multiple opportunities to become familiar with the Flood Resiliency Blueprint Tool, understand the planning process, and apply it to strengthen their community’s flood resilience. DEQ encouraged stakeholders to use the Tool and planning framework and committed to providing training and ongoing technical support to maximize project impact. Partners who become Blueprint Tool users can share information within their agencies or neighborhoods and help train others. Some Blueprint Partners may not use the Tool directly but can still contribute valuable community knowledge relevant to flood resiliency.

The Blueprint Tool training process began with a kickoff meeting introducing the Tool, its purpose within the broader Blueprint process, and available training options. Regular email updates kept stakeholders informed about Tool developments, planning progress, and meeting activities, while also offering a structured way to submit questions, concerns, and suggestions.

Virtual office hours and one-on-one meetings provided Partners with additional opportunities to ask about Tool registration and strengthen community networks. Stakeholders were also invited to review and provide feedback on community guidance materials and the effectiveness of the overall use of the Blueprint Tool, with the process being continuous such that changes can continue to be incorporated.



NCDEQ Resiliency Blueprint Tool

## River Basin Action Stakeholders

Several main groups were involved in developing the Action Strategy: the Blueprint Partners, River Basin Advisory Group, and the General Public, including collaborations outside of regularly scheduled meetings. These groups met from March 2025 through July 2026 and were structured to include a diverse range of participants, including municipal and county staff, watershed experts, nonprofit leaders, and community representatives. The result is a network of individuals at varying levels of involvement that will continue to engage and grow after the action strategy is complete. Detailed information on the network of stakeholders and meeting summary notes can be found in **Appendix B**. The roles of Additional Collaborators and Councils of Government Participation in the process are included in the appendix.



### Blueprint Partners

Blueprint Partners are community leaders and end users who are interested in the Blueprint Tool and can assist with training and communication to other members of their community and the broader river basin. Partners had several opportunities to learn about the Blueprint process and Tool at information and hands-on training sessions. Details about this group and meeting summary notes are included in **Appendix B**.



## River Basin Advisory Group

Because the Lumber River Basin is the first basin in the Flood Resiliency Blueprint project to cross state lines, at least one RBAG member represents South Carolina.

Geographical representation of the basin was a key consideration as stakeholder groups were formed. To create inclusive and effective groups, DEQ staff selected a diverse set of representatives from local and tribal municipalities, as well as regional and statewide resilience groups.

Advisory Group members represent diverse perspectives, with emphasis on under-resourced communities, including rural and unincorporated areas, people of color, individuals with disabilities, non-English-speaking communities, and those with low socioeconomic status. Members come from local and tribal governments, community and faith-based organizations, and other groups involved in flood-related issues across the basin.

RBAG members provided guidance on how to effectively engage with and use information from the NC Flood Resiliency Blueprint at the regional scale. They reviewed summaries of existing flood mitigation plans, flood risk and vulnerability analyses, and potential actions to strengthen regional flood resilience. They also helped prioritize these actions and offered feedback on DEQ's community guidance for using the Blueprint Tool and planning process.



## Engagement with the General Public

Throughout the development of the River Basin Action Strategy, DEQ Basin Leads connected with community-focused individuals and organizations interested in the Blueprint Tool and planning process. While these groups wanted to stay informed, they were not identified as Blueprint Partners or Advisors due to limited capacity, roles that did not align with intended tool users, or commitments in other Blueprint river basins.

This two-way relationship building, which took place outside specific stakeholder meetings, enabled DEQ to share information and learn from communities. Participants shared their organization's priorities, challenges and on-the-ground experiences, many of which were in vulnerable, underserved, and under-resourced communities. Basin Leads provided updates and resources that could be shared with networks. These partnerships gave DEQ a clearer understanding of local needs and strengthened DEQ's engagement approach. This collaboration also ensured that the Blueprint Tool and planning process better supported DEQ's goal of making all of North Carolina's communities more resilient to flooding.

These additional collaborators include, but are not limited to:

- The Association of Mexicans in North Carolina (AMEXCAN)
- North Carolina Black Alliance (NCBA)
- NC Statewide Independent Living Council (SILC)
- Southern Coalition for Social Justice (SCSJ)
- North Carolina Budget & Tax Center (NCB&TC)
- North Carolina Conservation Network (NCCN)
- North Carolina Inclusive Disaster Recovery Network (NCIDR)
- Carolina Wetlands Association (CWA)
- Lumber River Conservancy (LRC)
- South Carolina Office of Resilience (SCOR)
- North Carolina Department of Environmental Quality Division of Coastal Management
- NC State Coastal Dynamics Design Lab
- The Stimulus

The NC Flood Resiliency Blueprint Program also hosted a public information session in March 2026. The session recording can be viewed on DEQ's YouTube page.



## Engagement with Under-Resourced Communities

To help ensure engagement efforts included the basin communities most affected by flooding, DEQ and project partners used a data-driven approach to identify areas with higher flood risk and greater social and economic challenges. This analysis combined national and state data with local knowledge to better understand where support and engagement were most needed.

Using mapping and analysis tools, the project team reviewed data on flood risk, economic conditions, and community vulnerability across the basin and identified and ranked areas based on overall vulnerability and flood risk. The initial findings were presented to the Basin Lead and the engagement team who work in these communities. Based on their input, additional communities and counties were identified for outreach.

DEQ then contacted representatives from these communities and invited them to take part in the engagement process, including Blueprint Partners and RBAG meetings. Stakeholders were also encouraged to meet one-on-one with the Basin Lead for more personalized conversations about the community's interest and ability to be involved in the Blueprint process. In some cases, outreach resulted in community representatives inviting the Basin Lead to present information about the Blueprint Tool and process to their local government.

This approach helped ensure outreach was fair and reached the communities most impacted by flooding. It also created new connections and strengthened existing relationships.

Detailed information on the data inputs used, findings, and additional outreach completed, are included in **Appendix B**.



# FLOOD RISK PLANNING & ANALYSIS

A basin-scale risk and vulnerability analysis was completed to identify vulnerable areas within the basin and develop up to 20 new regional or multi-jurisdictional resiliency actions that mitigate the risk of flooding. The regional actions, however, may not mitigate all the risk within the basin. Local actions were selected to mitigate the residual risk, after the regional actions are in place.

The flood risk analysis estimated the potential damage to buildings and other infrastructure because of flooding.

The vulnerability analysis identified the areas that

exhibit the highest levels of risk density across the basin. Regional or multi-jurisdictional resiliency actions were developed for the areas that exhibited the highest levels of risk density. To develop a comprehensive list of areas vulnerable to flooding and potential mitigation actions, the risk and vulnerability analysis was completed separately for the dam and levee breach flooding source, and for the combined fluvial, pluvial, coastal, and urban and stormwater flooding sources.

The combined fluvial, pluvial, coastal, and urban & stormwater flood risk was assessed under existing climate conditions and future climate conditions.

## Flood Risk Analysis

### Dam and Levee Breach Risk

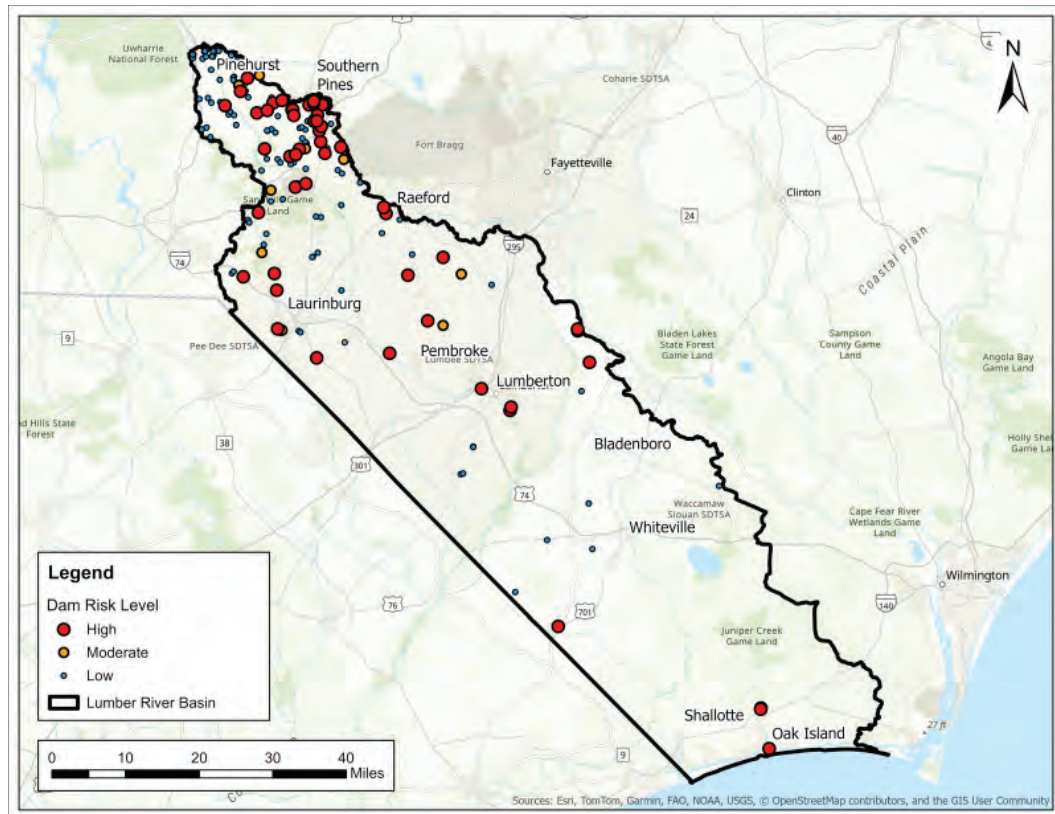
There are 186 dams and one levee embankment system - the Lumberton Levee, within the Lumber River Basin.

Four key criteria were summarized at the dam level to provide a comprehensive view of dam risk: the average damage ratio, total losses, maximum Annual Average Daily Traffic (AADT) disrupted (NCDOT, 2025), and impacts to other critical infrastructure.

Levee breach risk analysis was performed on the Lumberton Levee system utilizing information from the National Levee Database (NLD) (USACE, n.d.), NCEM 2D BLE modeling, NC Statewide building footprints, and terrain data provided by NCEM (NCEM, 2026).

The risk levels for the 186 dams show a picture of dam breach flood risk. In total, 52 dams were identified as high risk, 9 moderate risk, and 125 low risk (Figure 8).

Figure 8. Lumber River Basin dam breach risk analysis results.

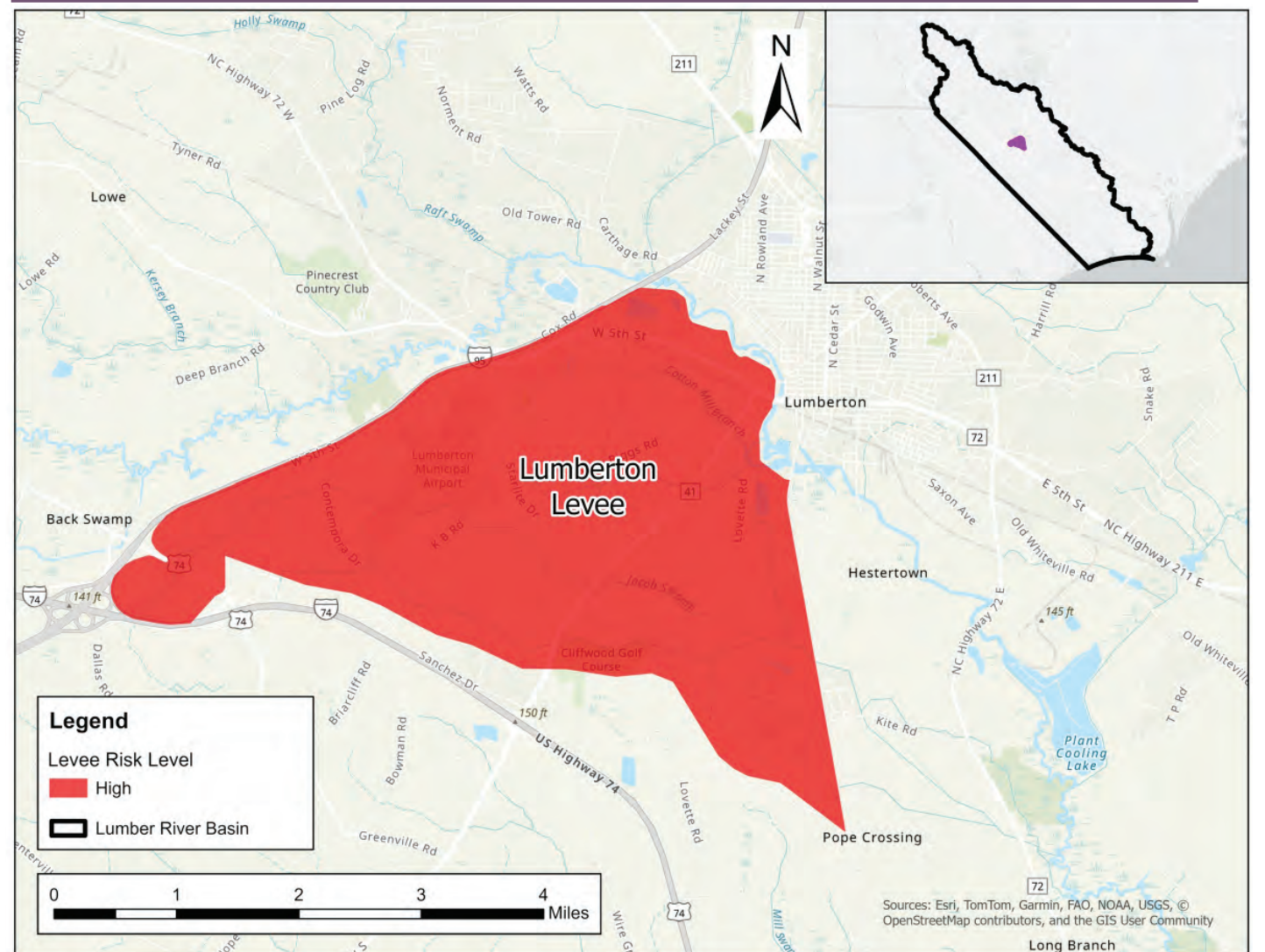


Lake Waccamaw

The Lumberton Levee system was observed as a high-risk levee based on the flood risk analysis and the criteria listed above. Figure 9 identifies the area that would be impacted if the levee were to breach and floodwater is not held back.

Further information on the dam and levee breach flood risk analysis can be found in **Appendix E**.

Figure 9. Lumber River Basin levee breach risk analysis results.



## Fluvial, Pluvial, Coastal, and Urban and Stormwater Flood Risk Analysis - Current Conditions

A part of the Blueprint process was the development of 2D BLE deliverables, which included building-level risk data for current land use and precipitation conditions, reported as risk scores, for all impacted buildings in the Lumber River Basin. A risk score provides an estimate of the likelihood that a structure would experience damage during a flood event using an annualized loss estimate (ALE) value and the building's replacement value (NCNCDEQ, 2025a).

Of the 217,244 total buildings within the basin, 18,456 had a risk score greater than zero based on current conditions modeling (Figure 10). Additional details can be found in **Appendix E**.

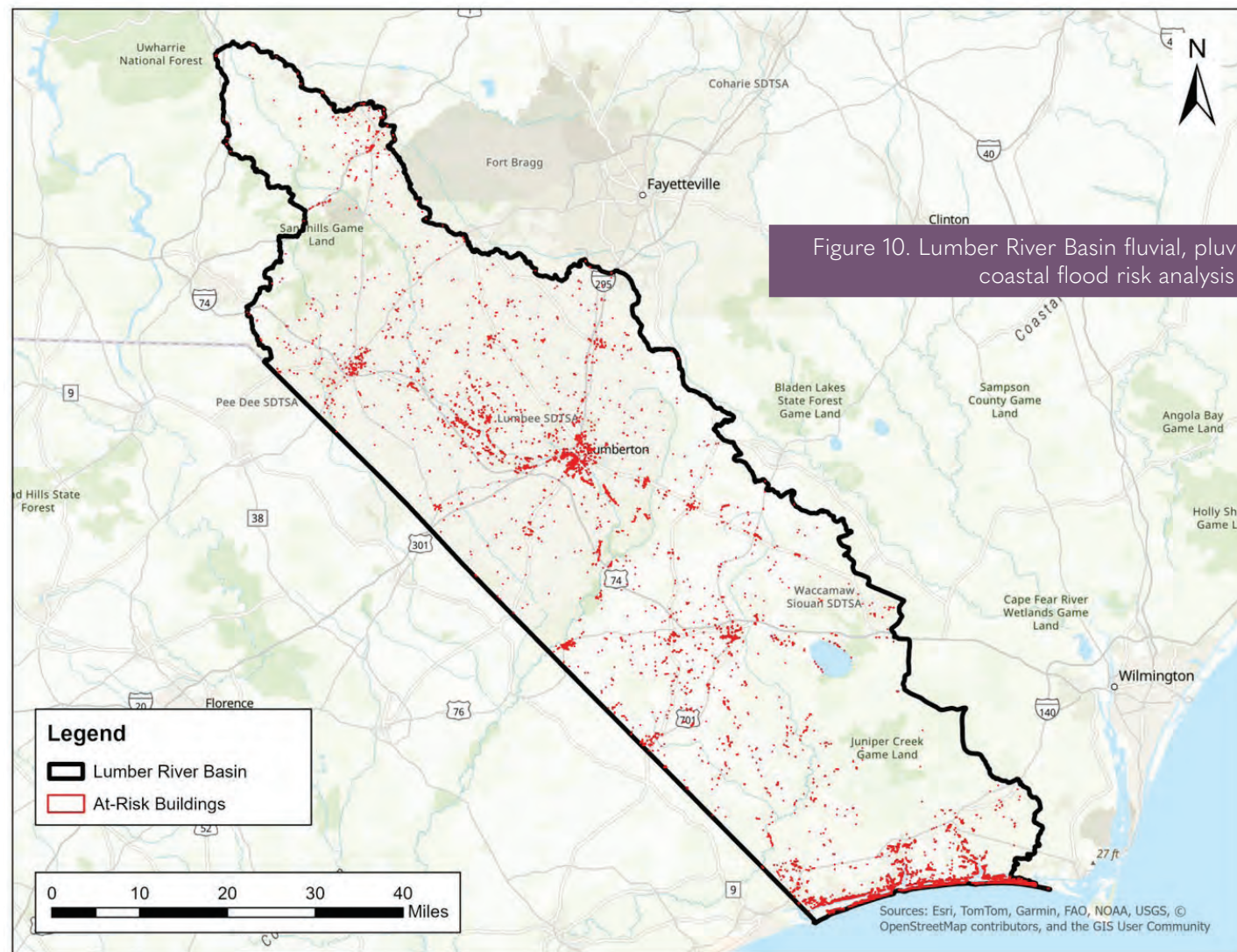


Figure 10. Lumber River Basin fluvial, pluvial, and coastal flood risk analysis results

## Fluvial, Pluvial, Coastal, and Urban and Stormwater Flood Risk Analysis - Future Conditions

The NCEM 2D BLE models incorporated future land use and precipitation conditions for five climate scenarios (Mid Century Lower (MCL), Mid Century Higher (MCH), End of Century Lower (ECL), End of Century Higher (ECH), and the End of Century Severe (ECS)) and two buildout conditions scenarios that incorporate future land use (2050 Buildout and 2100 Buildout).

To understand the total losses in relation to each future event, the ratio of the total losses relative to the total building replacement value was calculated, referred to here as the "damage ratio." The ratio was then scaled to make the possible range 0 to 100. A damage ratio value of zero indicates the flood depth would not cause any damage at that building and 100 indicates that the total losses were equal to the total building replacement value.

The future flood risk analysis indicates that there are 16,765 buildings impacted by at least one of the seven future or buildout condition scenarios (Figure 11). The results of the future flood risk analysis point to increased flood risk in the future. More information on the future conditions flood risk analysis can be found in **Appendix E**.

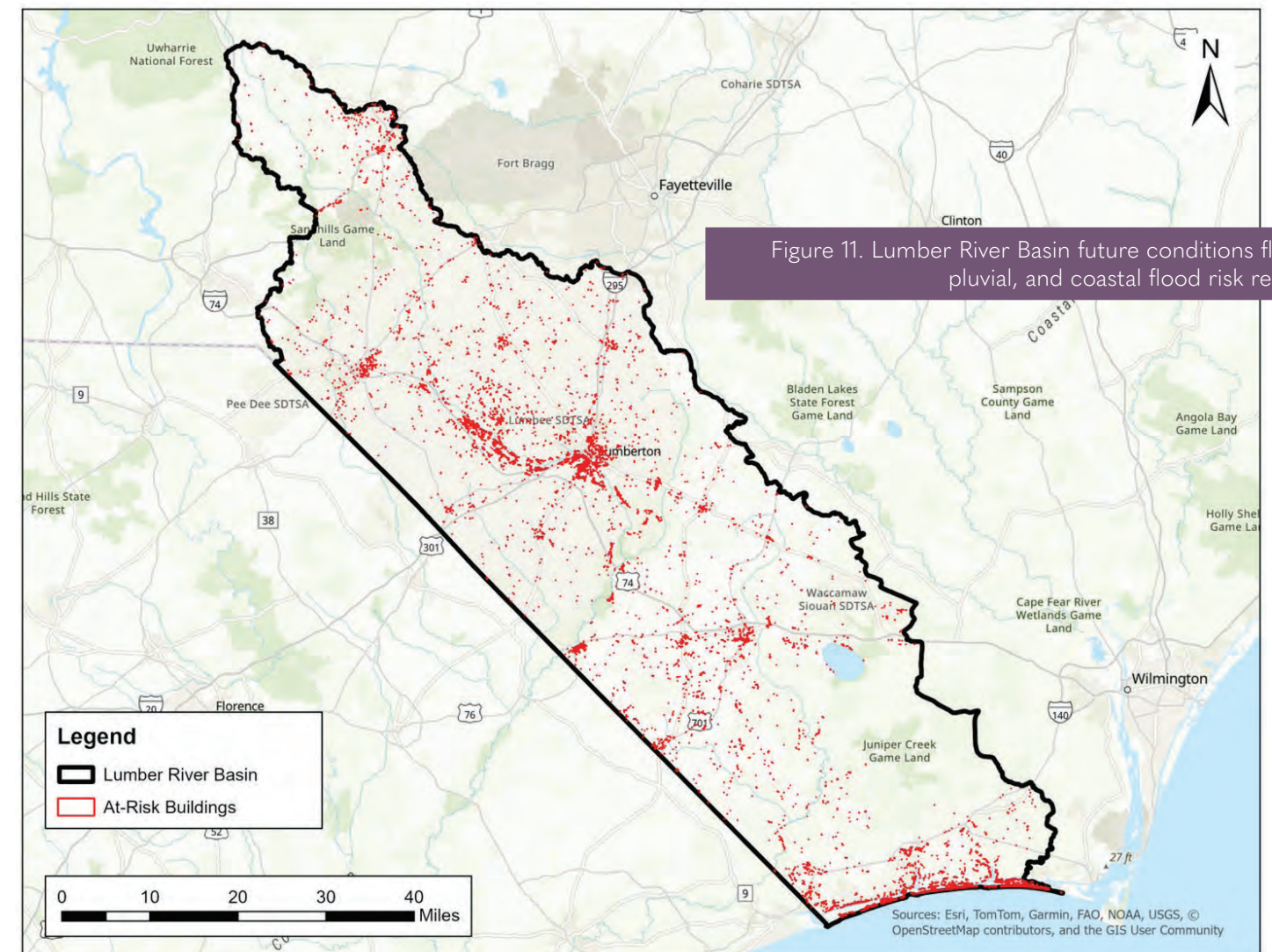


Figure 11. Lumber River Basin future conditions fluvial, pluvial, and coastal flood risk results.

# Flood Vulnerability Analysis

## Dam and Levee Breach Vulnerability

Two factors that influence the likelihood of a dam breach are condition and age, with both metrics included in the NC Dam Inventory (NCNCDEQ, 2025b). A poor rating indicates that action may be necessary to reduce risk for realistic conditions, while an unsatisfactory rating indicates a deficiency that requires “immediate or emergency remedial action for problem resolution” (ASDSO, 2025). Therefore, the downstream impacted area of an identified high risk dam which is also noted as being in poor or unsatisfactory condition was classified as highly vulnerable.

The age of a dam is important because the quality and integrity of the structure itself can degrade over time. Older dams are also likely to have been designed using outdated design standards and may not be equipped to handle the same hydrologic loads as newer dams. As such, the downstream impacted area of an identified high risk dam which was also indicated as being over 50-years old was classified as highly vulnerable.

Overall, current analysis and available data identified 52 areas vulnerable to dam flooding. Of these, 26 of the areas were classified as highly vulnerable, as they are also downstream of dams with either an age greater than 50 years or in poor or unsatisfactory condition.

The National Levee Database (NLD) describes the condition and past performance of the levee, which provides context for the risk ratings. A levee with a history of overtopping or breaching may have remaining deficiencies that require mitigation. The Levee Safety Action Classification (LSAC) ratings and qualitative descriptions of condition, and history were gathered from the NLD. Taking these factors into consideration, areas protected by levees with high risk levels were considered vulnerable and high risk levees with noted condition issues or a history of failure were classified as highly vulnerable. The Lumberton levee system was denoted as vulnerable based on this classification.

Detailed results of the vulnerability analysis can be found in **Appendix E**.

## Fluvial, Pluvial, Coastal, and Urban and Stormwater Vulnerability Analysis - Current Conditions

A cluster analysis was performed on the current conditions building risk results to delineate the regions with the highest risk density, denoting high vulnerability. Four concentrated areas of risk were identified as highly vulnerable within the Lumber River Basin: the City of Lumberton and surrounding areas, the Town of Fair Bluff, the City of Whiteville and surrounding areas, and the Coastal Areas.

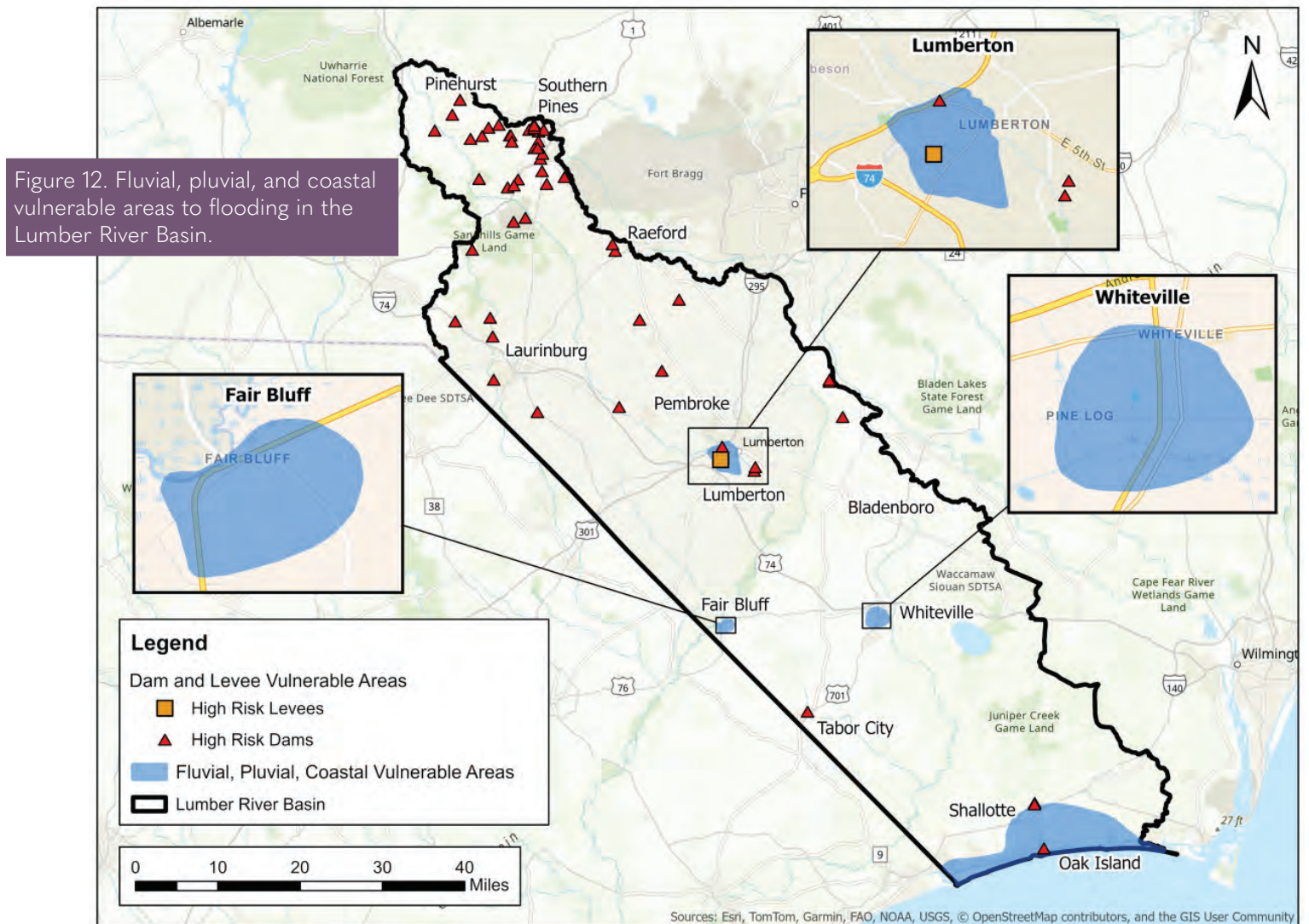


## Fluvial, Pluvial, Coastal, and Urban and Stormwater Vulnerability Analysis - Future Conditions

A cluster analysis was performed on the future conditions building risk results to delineate the areas with the highest risk density, indicating high vulnerability. The future conditions analysis indicates that the areas that are highly vulnerable under current conditions will be even more vulnerable in the future. These results are elaborated further in **Appendix E**.

## Lumber River Basin Flood Vulnerability Overview

The identified vulnerable areas for the Lumber River Basin can be seen in Figure 12. The figure depicts the regions within the basin that are currently vulnerable or will become vulnerable to flooding in the future.



# Identification of Regional Resiliency Actions

The vulnerability analysis identified the regions or areas within the Lumber River Basin that exhibit the highest flood risk for both future and current conditions. Regional actions were identified to mitigate flood risk within these vulnerable regions. If one action could not mitigate the flood risk within each vulnerable area, a group of actions was proposed that would mitigate the flood risk when implemented together. However, there were some areas where regional actions could not currently be identified to fully mitigate the identified flood risk. The proposed regional actions are:

- 1 Basin-wide Identified Dam Vulnerable Areas  
Regional Dam Inspections, Maintenance, and Modification or Removal

---

- 2 Basin-wide Identified Levee Vulnerable Areas  
Levee System Inspection, Maintenance, Repairs, and Upgrades

---

- 3 City of Lumberton and surrounding areas  
Permanent Pump Station and Floodgate Construction on Jacob Branch to be added to the ongoing construction of the west Lumberton floodgate.

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- 4 Town of Fair Bluff  
Town of Fair Bluff Acquisition and Park Creation and Levee Construction

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- 5 City of Whiteville and surrounding areas  
De-Pave Program and Mollie’s Branch Stream Restoration

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- 6 Coastal Areas  
No Identified Actions

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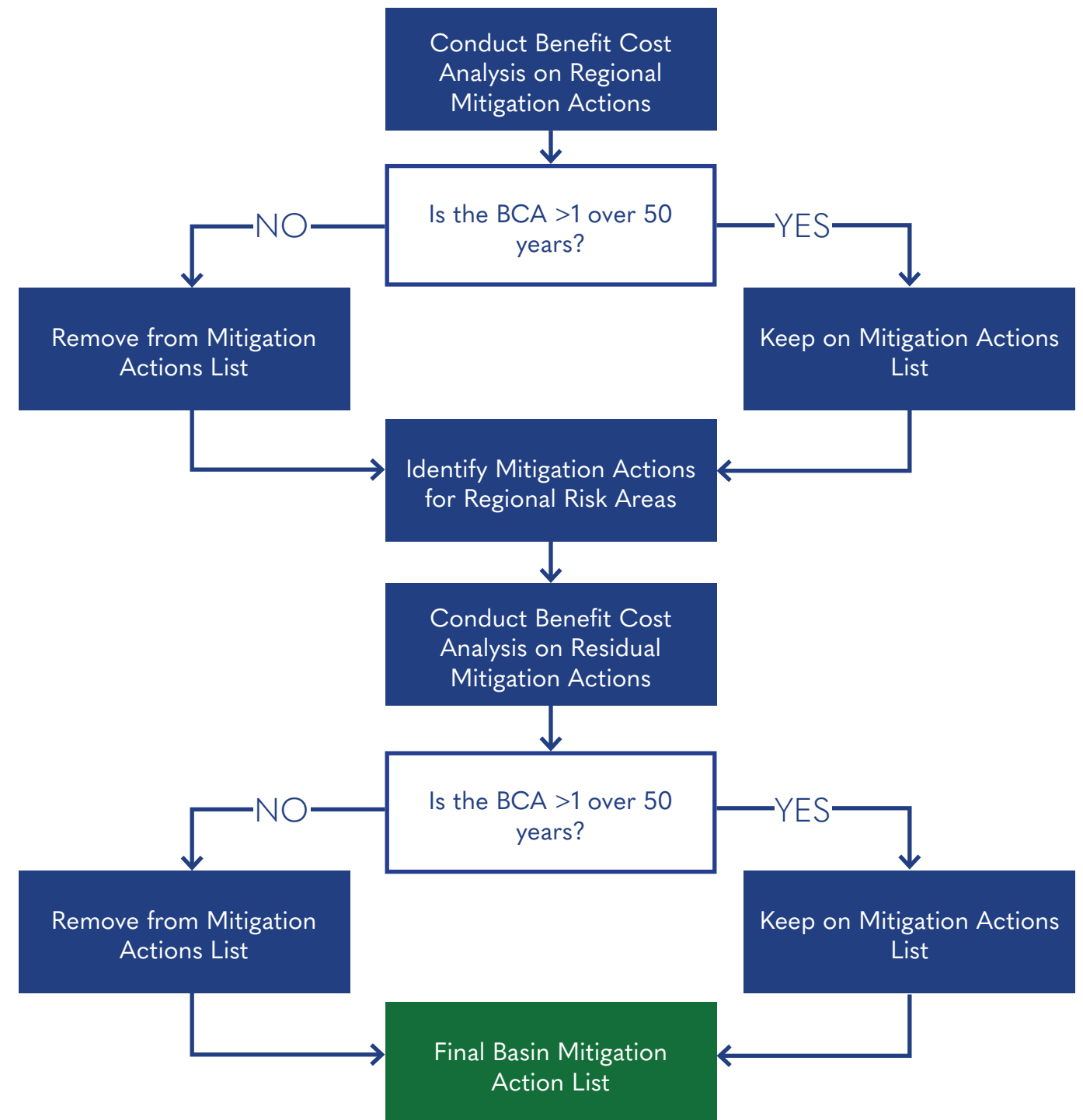
- 7 Residual Risk Areas  
Building Level Mitigation Program, Cleaning and Clearing Drainage Systems, and Roadway Upgrades

Specific details regarding all identified regional mitigation actions can be found in **Appendix E**.



# ACTION REVIEW & SELECTION

The flowchart below outlines the steps used in developing the prioritized mitigations actions list.



A factored BCA analysis was employed based on feedback from the River Basin Advisory Group. Factors were either considered as having a positive impact (Benefit) or a negative impact (Cost). The factors that were incorporated into the benefit cost analysis for the Lumber Basin are:

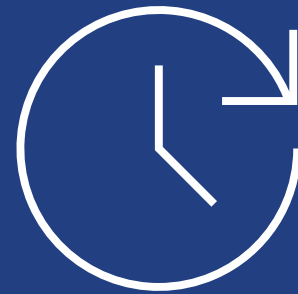
### Environmental Benefits (Benefit)

This factor considers the contributions of flood resiliency actions to the health of the environment, which can include improving water quality, increasing biodiversity and ecosystem health, and reducing erosion. Nature-based solutions received the highest weight of 20% due to the core design elements benefiting the environment. The middle tier, receiving a 10% weight, is for non-nature-based solutions that provide secondary environmental benefits. An example could include floodproofing at a wastewater plant that prevents pollutants from entering the environment during a flood event. Actions that do not have an environmental benefit beyond flood resilience are given a weight of 0%.



### Future Adaptability (Benefit)

Future adaptability is defined as the ability to build on or change an action once implemented to adapt to future conditions. Uncertainty in the severity of future storms and development patterns places importance on the flexibility of solutions. This factor applies a 20% weight for actions that can be modified or built upon in the future, while those that cannot be modified receive a weight of 0%. An example of an action that can be modified in the future is the creation of a floodplain park, since additional restoration or mitigation measures could be added in the future.



### Level of Protection (Benefit)

Level of protection is defined as the proportion of the flood risk mitigated by an action in the affected area. The most effective actions, mitigating 90-100% of the flood risk receive a weight of 30%. An example of a highly effective action would be levee construction. Less effective actions, like wet floodproofing, that mitigate approximately less than 90% of risk receive a 0% weight.



### Maintenance Requirements (Cost)

Maintenance requirements include the frequency and cost of the upkeep necessary to ensure the implemented projects mitigate flooding as intended. Projects with a significant level of requirements received a weight of 20%, like floodgate construction, due to the specialized expertise requirement to operate and maintain the structure. Actions with a standard or regular level of maintenance requirements, like roadway upgrades, receive a weight of 10%, because they require consistent maintenance activities that would be more common in a community. A weight of 0% is given to project types with insignificant or minor maintenance requirements, like riparian buffers, which should not need significant additional work following implementation.



### Number of Entities Involved (Cost)

This factor considers the increased complexity that comes with coordination between multiple stakeholders at that could negatively affect the implementation due to competing priorities and breakdowns in communication. The first tier includes actions with one or two owners listed and receives a 0% cost weight, since two organizations are more likely to be able to work together and resolve conflicts. Actions with three or more owners receive a 20% cost weight due to the increased chances of collaborative issues.



### Permitting Requirements (Cost)

Permitting requirements include the application, completion, and approval of any level of permit needed to construct the project. Projects with a significant level of requirements, like levee or floodgate construction, receive a weight of 20% because of the time, cost, and expertise required to obtain necessary permits. Actions with a standard or regular level of permitting requirements, such as roadway upgrades, receive a weight of 10%, since most communities would have experience with the processes. A weight of 0% is given to project types with insignificant or minor permitting requirements, like routine dam inspections and maintenance, which do not require specific permits.



To ensure that multiple actions that protect the same location were not selected, regional actions were analyzed first, followed by local actions. Refer to **Appendix F** for details about the action prioritization process.

# LUMBER RIVER BASIN PRIORITIZED ACTIONS



# What is an Action?

An action is a proactive flood mitigation or resilience measure implemented to minimize an area’s vulnerability and risk of flooding and associated disruptions and damages. NCDEQ has six action type categories: Building Level Mitigation, Channel Modification, Infrastructure & Control Structures, Nature Based Solutions, Policy & Planning, and Other. A selected action may be implemented on a local, regional, or basin-wide scale. The action type will determine the level of coordination required.

## Building Level Mitigation

A building level mitigation action focuses on the physical changes that can be implemented on an individual structure to reduce flood risk. Action types within this category include Acquisition/Demolition (purchasing and/or removing flood-prone structures), Dry Floodproofing (making structure watertight to prevent floodwaters from entering), Mitigation Reconstruction (rebuilding or updating a structure to improved standards and codes), Relocation (moving a structure out of flood-prone areas), Structural Elevation (raising the structure first-floor elevation above predicted flood levels), Utility Elevation (raising critical mechanical, electrical, and plumbing systems), and Wet Floodproofing (designing a structure to allow water to enter certain areas while minimizing damage and protecting critical infrastructure).

Building level mitigation allows for small-scale targeted resiliency from an individual property to a neighborhood-scale based on specific needs. While implementation only impacts the specific residents and structure, these actions serve to protect property and life. Since these actions operate at the individual structure scale, they can sometimes be faster to implement but may face funding and property ownership challenges. The acquisition of at-risk properties shall be undertaken exclusively on a voluntary, property-by-property basis. Participation by property owners is entirely optional and the State does not intend to pursue involuntary acquisition or the use of eminent domain for these properties.

### Action Types

- **Acquisition/Demolition**
- **Dry Floodproofing**
- **Mitigation Reconstruction**
- **Relocation**
- **Structural Elevation**
- **Utility Elevation**
- **Wet Floodproofing**

## Channel Modification

Channel modification actions involve natural or engineered solutions to alter waterways and improve the water storage capacity and functionality. Action types within this category include Channel Dredging, Widening, and Diversion which entails deepening, expanding, or changing the flow path of the channel to increase capacity or Debris Removal where any natural or artificial debris blockages in the channel

are removed such that the channel can more closely perform as normal during flooding events. These actions target improving the flow of water through channels which can minimize the risk of flooding to surrounding buildings, roadways, and critical infrastructure. Depending on the waterway and flooding event intensity these actions may need to be repeated to maintain optimal channel performance.

### Action Types

- **Channel Dredging**
- **Widening**
- **Diversion**
- **Debris Removal**



# Infrastructure & Control Structures

Infrastructure and control structure actions focus on structure implementation to divert water from vulnerable areas. Action types for this category include Critical Infrastructure (planning and implementation of infrastructure to improve runoff, reducing flood risk and impacts), Levee/Dike/Berm (modifying or constructing new barriers to contain, divert, or control water flow), New and Existing Dam Structures (adding or improving wet or dry dams to contain flood waters), Quarries (repurposed to

serve as temporary flood water storage), Roadway Elevation/Road Crossing Modification (raising or modifying roadways to improve accessibility during floods), and Storm Water Management Activities (planning, design, and implementation of stormwater infrastructure to reduce flood risk). These actions are generally implemented within communities and are key to protecting the residents, structures, and critical infrastructure during flooding events and minimizing disruptions to communities.

### Action Types

- **Critical Infrastructure**
- **Levee/Dike/Berm**
- **New and Existing Dam Structures**
- **Quarries**
- **Roadway Elevation/Road Crossing Modification**
- **Storm Water Management Activities**

## Nature Based Solutions

Nature based solutions (NBS) actions utilize sustainable planning, design, environmental management, and engineering practices that focus on natural processes and features to reduce flood risk. Action types include Afforestation (planting forest vegetation to reduce flow velocity), Bioretention (uses soil and vegetation to promote infiltration and storage of flood waters), Flood Storage Wetlands (engineered or restored wetlands designed to capture, store, and gradually release flood waters), Floodplain Preservation (protecting floodplains to maintain natural ability to absorb and reduce flood waters and mitigate erosion), Floodplain Restoration (rehabilitating degraded floodplains to enhance their ability to perform as intended), Green Roofs (incorporates vegetation

on rooftops to intercept rainfall and reduce runoff), Living Shorelines (use of native materials to stabilize a shoreline and enhance wildlife habitat), Permeable Pavement (infiltrate runoff to reduce flood risk in the implemented traffic areas), Raingardens/Sand Filters/Bioswales (engineered green infrastructure to capture runoff and promote infiltration), and Riparian Buffers (areas of healthy vegetation from grasses to woody shrubs that reduce runoff speed and promote infiltration). Implementing an NBS action can assist in flood risk mitigation while also offering additional benefits of promoting biodiversity and wildlife habitat, improved aesthetic value, and public green space.

### Action Types

- **Afforestation**
- **Bioretention**
- **Flood Storage Wetlands**
- **Floodplain Preservation**
- **Floodplain Restoration**
- **Green Roofs**
- **Living Shorelines**
- **Permeable Pavement**
- **Raingardens/Sand Filters/Bioswales**
- **Riparian Buffers**



## Policy & Planning

Policy and planning actions focus on regulations that will impact land use, management, and future development to manage and mitigate flood risk. Action types include Advanced Regulations, focusing on GIS capacity building, land use and impervious surface restrictions, and enhanced zoning (adopts stricter standards such as higher freeboard requirements, not allowing certain construction, and stricter rules for critical facilities), Multi-use Floodplains (restored or managed floodplains that

provide flood storage and infiltration along with secondary benefits such as community green space or wildlife habitats), and Stormwater, Water Quality, and Floodplain Regulations (polices and regulations to control stormwater volume and flow, reduce pollutants in waterways, and preserve or restore floodplains). The policies and planning will build more long-term flood resilient communities and infrastructure.

### Action Types

- **Advanced Regulations (GIS Capacity Building)**
- **Advanced Regulations (Land Use and Impervious Surface Restrictions)**
- **Advanced Regulations (Enhanced Zoning)**
- **Multi-use Floodplains, and Stormwater, Water Quality, and Floodplain Regulations**

## Other

There are some actions that do not fit into the defined categories and designated as 'Other'. These include Beaver Management (allows for the restoration of waterways to remove flood risk from artificial dams), Coastal-Building Mitigation (building level mitigation actions focused on structures impacted by coastal flooding including tidal flooding,

storm surge, and sea level rise), and Coastal-Road Elevation/Modification (infrastructure improvements to raise or modify roadways to endure coastal and tidal conditions and sustain transportation). These actions are more individualized, but also provide critical flood resilience to communities.

### Action Types

- **Beaver Management**
- **Coastal – Building Mitigation**
- **Coastal – Road Elevation/Modification**

## Why are these Actions Needed?

Resiliency actions are needed to mitigate flooding risk within the basin and to build more long-term resilient communities. Without these actions, the basin and its population will continue to be vulnerable to flood risk. The identified flood hazard type and vulnerability and risk of an identified area along with the area's characteristics including population, properties at risk, geographical limitations, and infrastructure will determine which action category and type is most applicable.

### Flood Hazard Types

Location within the basin impacts flooding type, such as riverine, rainfall, urban stormwater, or coastal flooding, and severity which will play a critical role in the appropriate action selection. For example, inland communities will face different flood risk concerns than coastal communities and will impact which action is deemed most effective.

### Vulnerability

Vulnerability refers to the populations, infrastructure, and areas susceptible to flood risk and the adverse impacts. Assessing vulnerability helps identify the higher at-risk areas and develop prioritized actions to ensure the greatest impacts across the basin are mitigated.

Ocean Isle Beach, North Carolina, USA



# PRIORITIZED RESILIENCY ACTIONS

The prioritized or selected resiliency actions for the Lumber River basin are the regional/multi-jurisdictional and local actions with calculated benefit cost ratios (BCR) of at least one over a 50-year project life period. The local actions complement the regional actions by mitigating the flood risk in areas that are not protected by regional actions.

As previously discussed, resiliency actions were proposed for all identified vulnerable areas within the Lumber River Basin. The identified actions for the vulnerable areas ranged in scale from local to basin-wide and went through a prioritization process to determine which would be most effective for the basin.

Additionally, communities within the basin provided NCDEQ with a list of actions which are important to their stakeholders. These actions, which were developed as part of the RBAS process, are listed as “locally prioritized actions”. Locally prioritized actions have not undergone the factored benefit cost analysis described in this report as most of them are not yet “shovel ready”, and hence their cost and benefits cannot be estimated with a reasonable level of confidence.

## RBAS Process Prioritized Basin Action

The factored BCA process identified four regional resilience actions, no local actions, and multiple building level mitigation actions that met the criteria of the 50-year BCA equaling at least 1.0 (Table 2). Further details regarding each prioritized action can be found below.

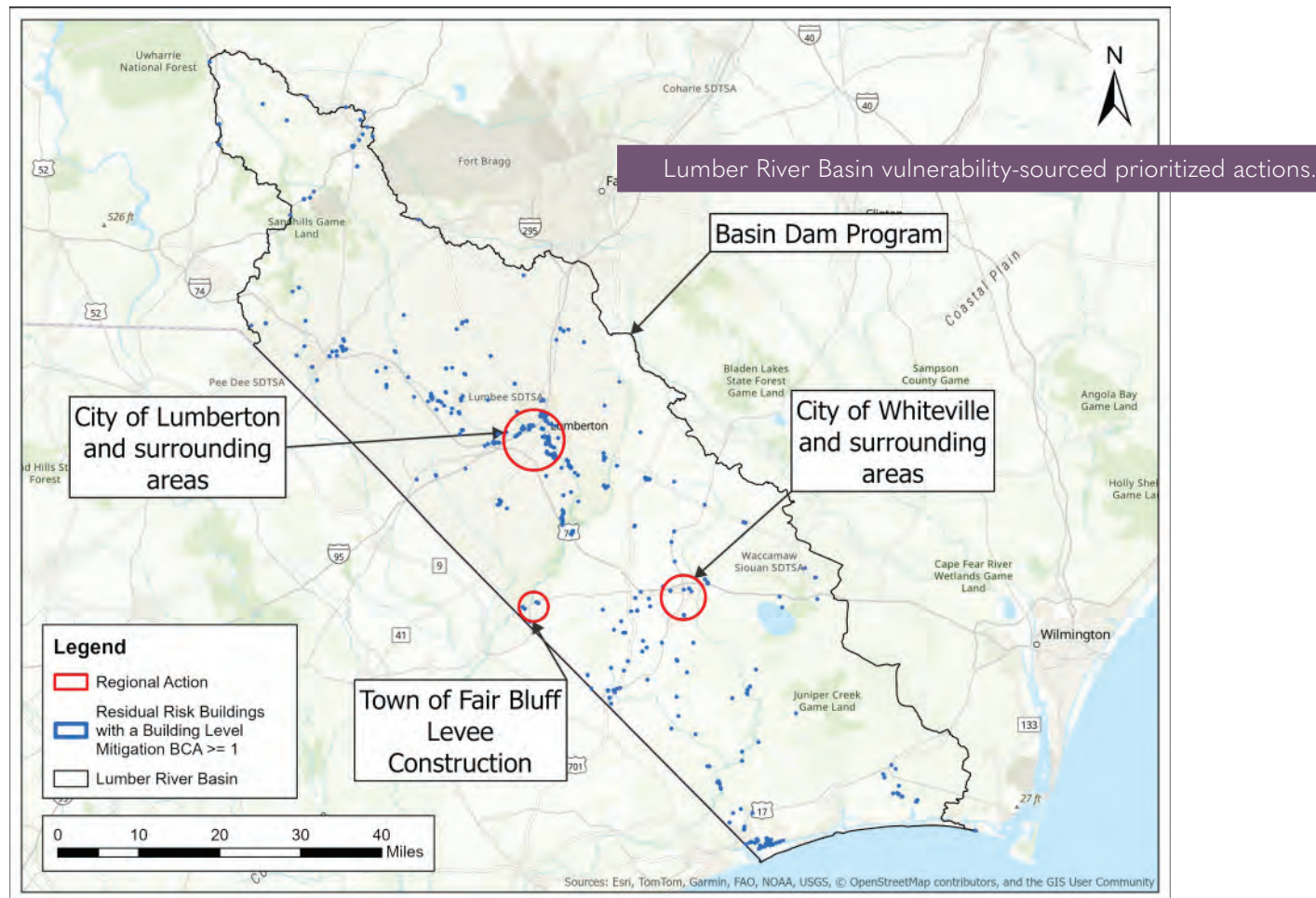


Table 2. Vulnerability-sourced prioritized actions list for the Lumber-River Basin

Action Name	Components	Regional, Local, or Building Level?	BCA	Location
Town of Fair Bluff Levee Construction	<ul style="list-style-type: none"> <li>Levee Construction</li> </ul>	Regional	18.22	Town of Fair Bluff
City of Lumberton and surrounding areas Regional Action	<ul style="list-style-type: none"> <li>Lumberton Levee System Inspection, Maintenance, Repair, Upgrades, and Accreditation</li> <li>Permanent Pump Station</li> <li>Floodgate Construction on Jacob Branch</li> </ul>	Regional	7.73	City of Lumberton and surrounding areas
City of Whiteville and surrounding areas Regional Action	<ul style="list-style-type: none"> <li>De-Pave Program</li> <li>Mollie’s Branch Stream Restoration</li> </ul>	Regional	3.71	City of Whiteville and surrounding areas
Regional Dam Program	<ul style="list-style-type: none"> <li>Basin-Wide Prioritized Dam Inspections</li> <li>Regular Dam Maintenance</li> <li>Rehabilitate, Repair, Retrofit, Remove Dams</li> </ul>	Regional	1.05	Lumber River Basin
Building Level Mitigation	<ul style="list-style-type: none"> <li>Residual Risk Building Level Mitigation by Community Jurisdiction</li> </ul>	Building Level	-	Lumber River Basin Residual Risk Areas

The Blueprint tool reports of these locally prioritized actions are included in **Appendix H**.

Above inlet between Holden Beach and Oak Island

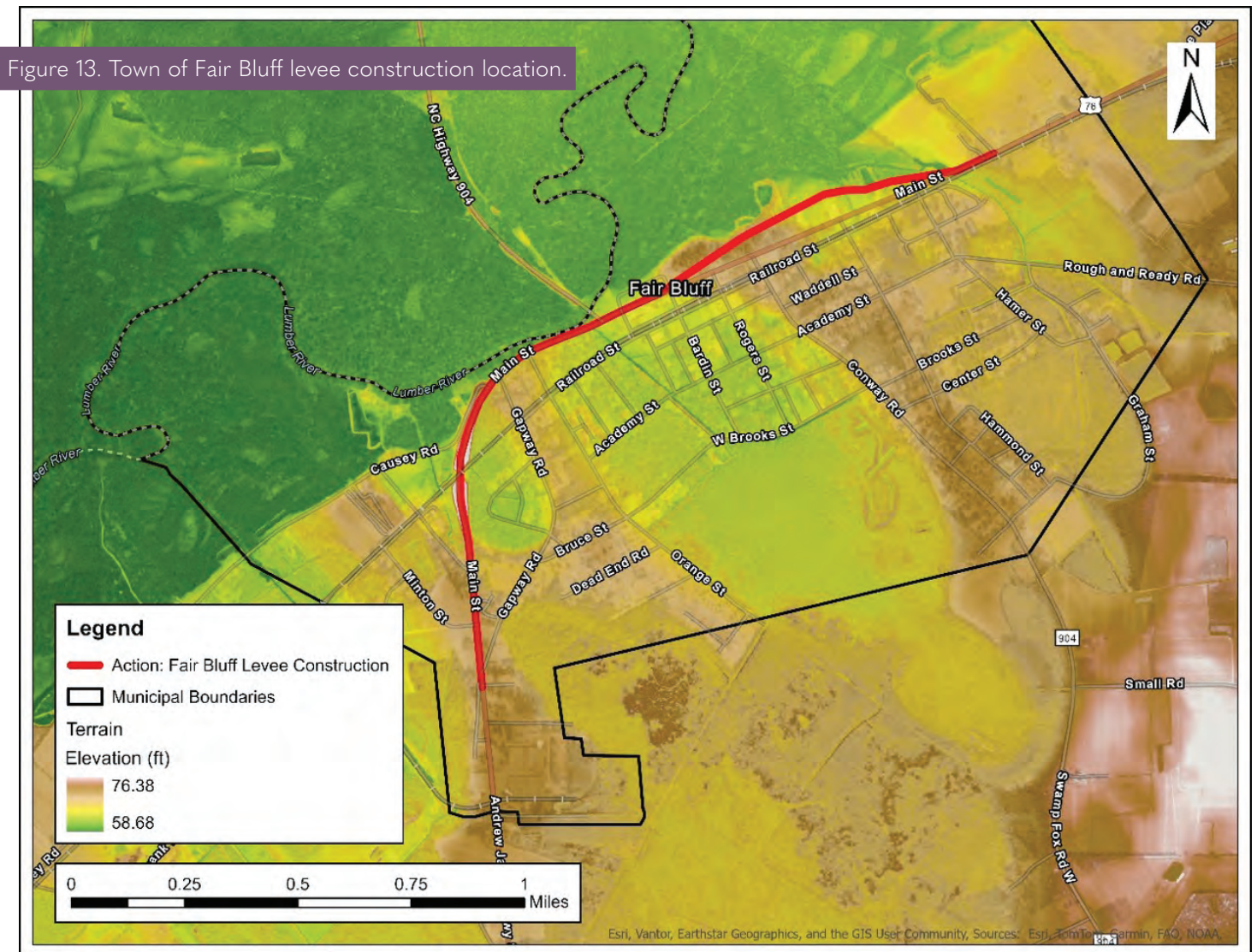


## Town of Fair Bluff Levee Construction

Location:	Town of Fair Bluff
Owner:	Town of Fair Bluff
Cost:	\$2,931,790
Status:	Proposed

Town of Fair Bluff Levee Construction: The construction of a levee along the Lumber River would prevent severe fluvial flooding from inundating the Town of Fair Bluff (Figure 13). The levee system would run along the Lumber riverbank, tying into Main Street near Glastron Road and east of Hamer Street. This alternative was originally proposed in both the USACE Lumber River Basin Flood Risk Management Study and the NCEM and NCDOT Lumber River Basin Flood Analysis and Mitigation Strategies Study.

Figure 13. Town of Fair Bluff levee construction location.



# City of Lumberton and surrounding areas Regional Action

Location:	The City of Lumberton and surrounding areas	<b>Lumberton Levee System Inspection, Maintenance, Repair, Upgrades, and Accreditation:</b>  This action involves improvements including raising the height of the levee to protect from future flooding conditions. The functioning of the Lumberton Levee system is key to protecting the southwestern part
Owner:	City of Lumberton	
Cost:	\$27,094,427	
Status:	Conceptual	

of the City of Lumberton. This action proposes that the levee should have ongoing support for inspections, maintenance, repairs, and accreditation to ensure that the levee system operates at a high level (Figure 14). Regular and routine maintenance should be done on these systems to extend the life cycle. Additionally, attention should be paid particularly after severe flood-loading events to ensure potential overtopping or breaching or any structural deficiencies are identified and addressed early. This could include standard repairs and upgrades and adaptations to the system to evolve protection with future flooding conditions and community needs. Finally, as proposed in the 2018 Lumberton Recovery Plan future levee improvements should ensure that the system meets FEMA requirements for accreditation under the NFIP (Hurricane Matthew Disaster Recovery and Resilience Initiative, 2018). This would verify that the entire system has at least 3 feet of freeboard above the 100-year flood, O&M, emergency, and interior drainage plans, and have the added benefit of reducing the flood insurance cost burden on the community within the protected area.

## Permanent Pump Station:

The ongoing Lumberton Flood Gate Project (as of May 2026) will protect residents from fluvial flooding from the Lumber River. However, this structure limits the flow of water out from behind the floodgate. The construction of a permanent pump station within the protected area on the south side of I-95 near Hester Drive would create the ability convey flow across the levee during a pluvial event while the floodgate is closed (Figure 15). A feasibility study has identified specific pump locations.

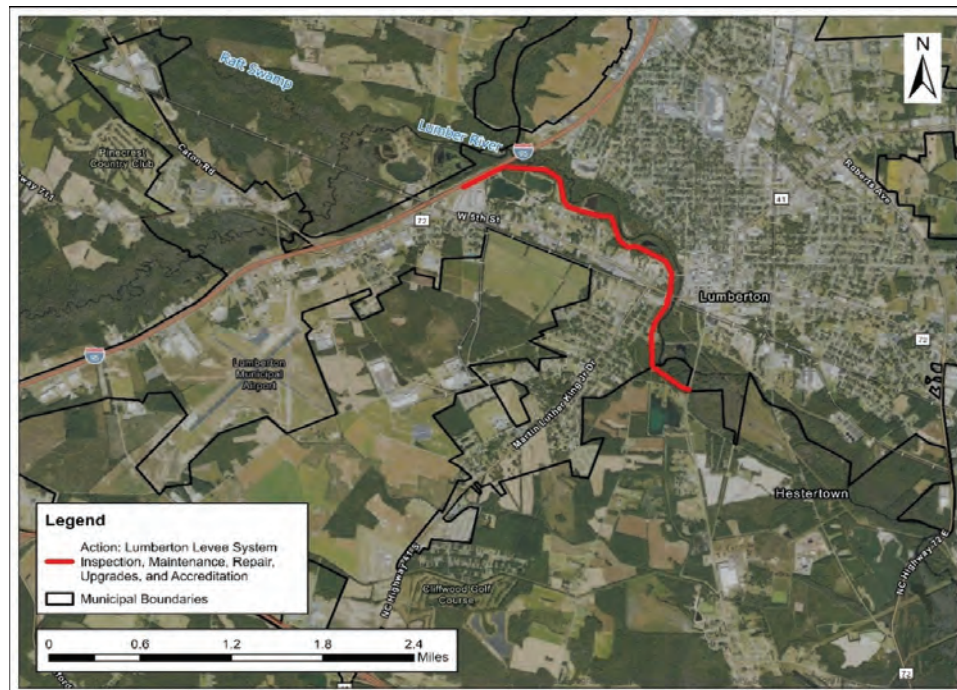


Figure 14. Lumberton Levee System location.

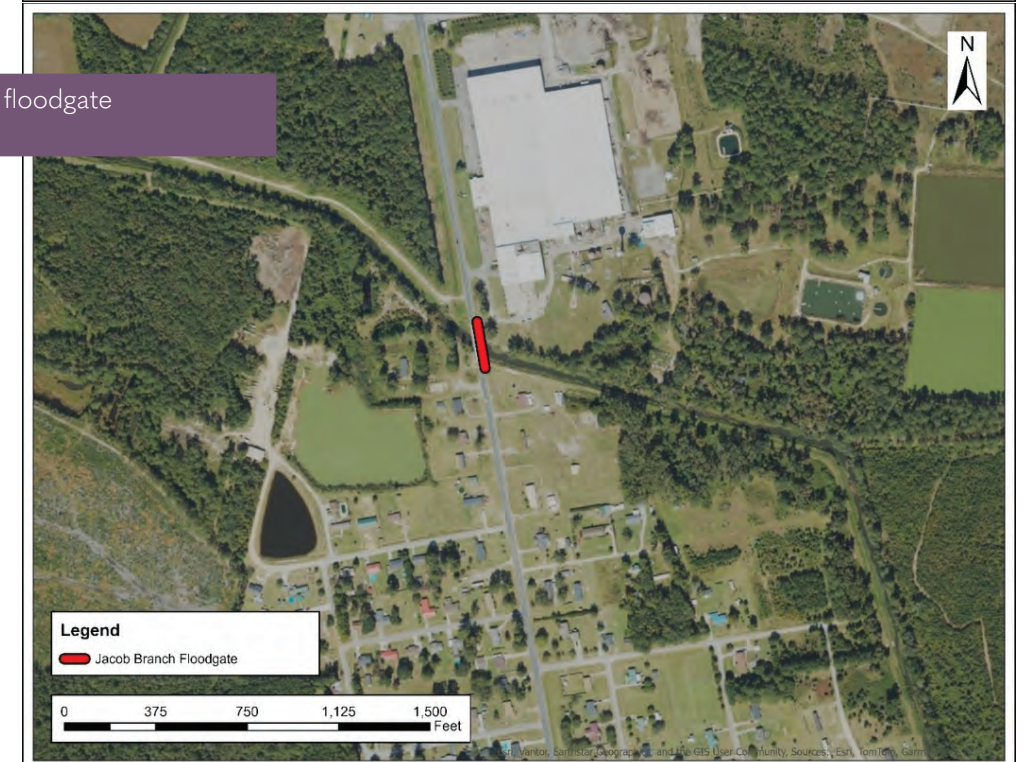
## Floodgate Construction on Jacob Branch:

The ongoing flood gate project was designed to mitigate fluvial flooding from entering the city through a railway bridge opening on the west side of the city. Through future flood risk analysis, it was determined that flooding from the Lumber River will also impact the area by backing up Jacob Branch through the crossing at Alamac Road on the southeast side of Lumberton (Figure 16). This location can benefit from the implementation of a similar flood gate to what is being constructed on the west side of Lumberton to protect the residents from flooding.

Figure 15. Lumberton permanent pump station locations.



Figure 16. Jacob Branch floodgate construction location.



# City of Whiteville and surrounding areas Regional Action

Location:	The City of Whiteville and surrounding Areas	De-Pave Program:	Proposed through the Whiteville Community Floodprint, the De-Pave Program creates green stormwater infrastructure where there are underutilized impervious areas of downtown Whiteville such as sidewalks or parking lots (Figure 17). Examples of the green infrastructure include planting strips, bulb outs along streets, or floating islands in existing parking lots (Coastal Dynamics Design Lab, 2023).
Owner:	City of Whiteville		
Cost:	\$10,223,645		
Status:	Proposed		

Creating these areas of green infrastructure can allow for increased stormwater absorption and less runoff, further protecting the residents and businesses from current and future flood damage.

## Mollie's Branch Stream Restoration:

Proposed through the Whiteville Community Floodprint and city communications, Mollie's Branch Stream Restoration is a nature-based stream restoration project that strives to return the waterway back to its natural state between the confluence with Soules Swamp to US-74 BUS (Figure 18). The channel had been straightened to allow for development in the area surrounding it. In addition, the area easily gets blocked with debris during a storm event. The current conditions modeling shows some at-risk buildings due to pluvial and fluvial flooding along Mollie's Branch, with risk increasing for the future conditions. Planned implementation was delayed due to developments related to FEMA's BRIC grant, the primary source of funding for this project (Coastal Dynamics Design Lab, 2023). Continuing with this project would protect the residences and development around Mollie's Branch.



Figure 17. De-Pave Program location.

Figure 18. Mollie's Branch stream restoration location.

# Regional Dam Program

Location:	Lumber River Basin High Risk Dams
Owner:	NCDEQ
Cost:	\$127,111,895
Status:	Conceptual

Dam risk and vulnerability analysis highlights the importance of continued investment in the North Carolina Dam Safety Program since dam failure is a key source of flooding within the basin. The Blueprint would work in close coordination with the Dam Safety Program on any dam or levee action. The following are three actions to address vulnerability to dam breach flooding in the basin. Each of the three components could be implemented

individually or jointly, as deemed necessary. Figure 19 shows the locations of high risk dams that would be prioritized under this program.

## Basin-wide Prioritized Dam Inspections:

Identified dams within the basin that have a high risk level should be prioritized for additional inspections to monitor for declining conditions. Dams which are high risk and also have poor or unsatisfactory conditions or are more than 50 years old may be at an elevated risk for failure and should have the highest priority to ensure that corrective actions can be taken as soon as possible. This would allow for quicker interventions on dams deemed to be no longer safe. Inspections and reviews are needed for dams where information is missing or outdated to ensure the identification of high risk dams is accurate. This includes the 12 high risk dams within the Lumber without a recorded condition. Additionally, 14 of the identified high risk dams are classified by DEQ as either low or intermediate hazard dams. These dams should be reviewed to confirm or update the hazard classification. Without this knowledge there could be other areas and populations with increased risk not currently identified. These inspections would assist in determining if there are additional vulnerable areas that need to be addressed.

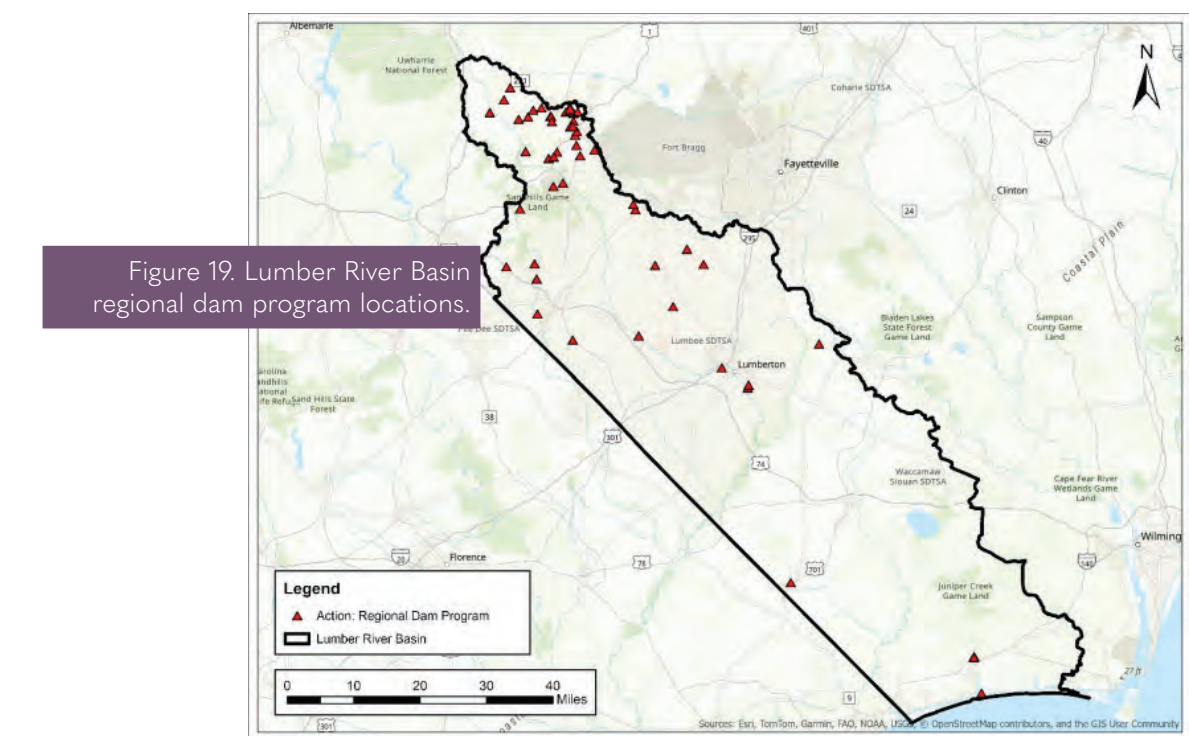


Figure 19. Lumber River Basin regional dam program locations.

## Basin-wide Regular Dam Maintenance:

Another component is conducting regular dam maintenance and minor repairs, which addresses vulnerability by consistently taking small measures to keep dams in good condition. Maintenance activities, as defined by DEQ, include but are not limited to mowing, control of small trees, debris removal, and replacement of gates and riprap. This is necessary for all dams to prevent common issues like embankment stability, erosion, seepage, and cracks that can increase failure risk if unaddressed. While many dam owners may have and follow an operations and maintenance (O&M) plan, dams without these practices are more likely to fall into poor condition and require larger scale action to protect downstream communities.

## Basin-wide Rehabilitate, Repair, Retrofit, Remove Dams:

Finally, physical updates, through modification (repair, retrofit, and rehabilitations) or removal, should be completed on dams that have been identified to need such repair or removal based on findings from the regular inspections. The longer these dams go without improvements or removal, the greater the continued chances of failure. The actual repair, retrofit, or rehabilitation action will depend on the deficiency identified at a particular dam and may range from patching a structural issue, to increasing the spillway or outfall capacity, to increasing the dam height. Removal could be utilized in cases where there are benefits to restoring natural hydrologic processes.

Bridge in Aberdeen Lake Park, North Carolina, USA



## Building Level Mitigation

**Location:** Residual Risk areas of the Lumber River Basin  
**Owner:** NCDEQ  
**Cost:** \$17,329,544  
**Status:** Proposed

### Residual Risk Building Level Mitigation:

At-risk buildings outside the areas of impact of the regional mitigation actions were analyzed to determine the cost effectiveness of implementing building level mitigation techniques to combat against pluvial and fluvial flooding. The NCEM building BCA methods were used to calculate

the building level mitigation technique with the highest BCA between acquisition, relocation, elevation, dry floodproofing, and wet floodproofing. The residual risk buildings with mitigation options with a BCA of at least 1.0 are shown in Figure 20.

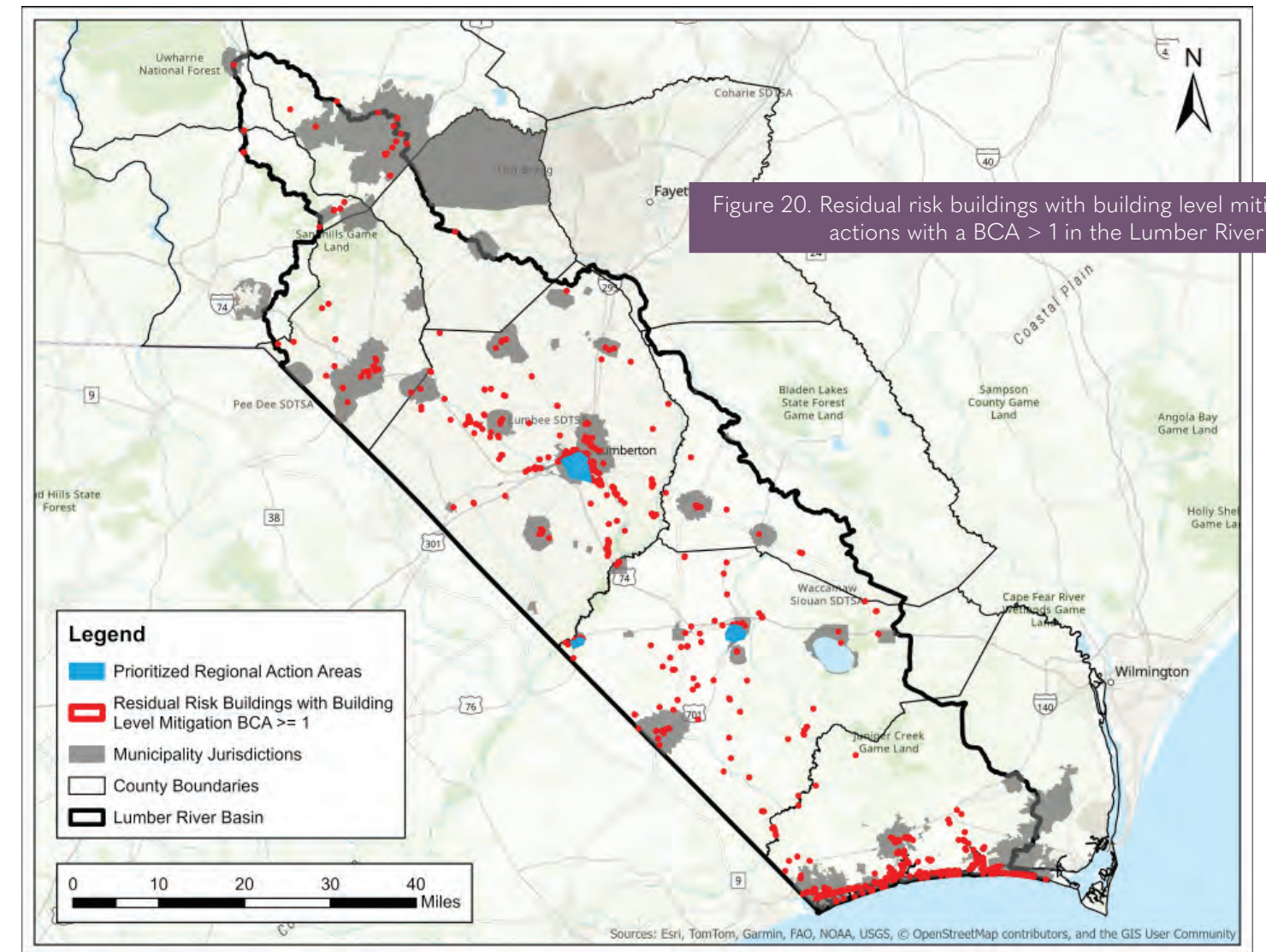


Figure 20. Residual risk buildings with building level mitigation actions with a BCA > 1 in the Lumber River Basin.

# Locally Prioritized Actions

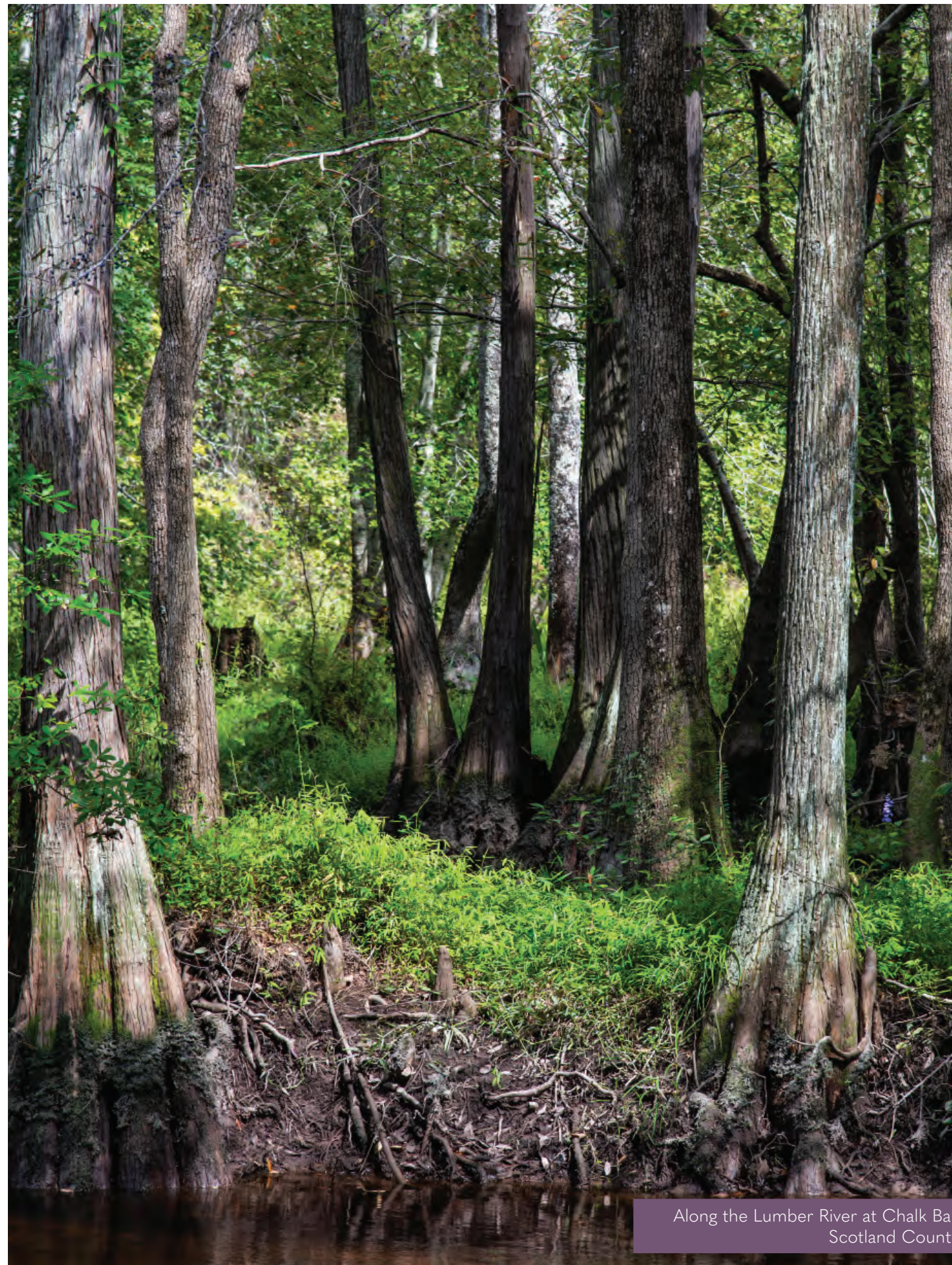
Locally prioritized actions were developed by communities and deemed important to their stakeholders (Table 3). The communities worked with NCDEQ to add these actions to the Blueprint Tool with the best available data. Further information is likely needed to complete a full analysis, but should still be considered for increased flood resiliency within the basin. Blueprint Tool reports for each action are provided in Appendix H.

Table 3. Lumber River Basin Locally Prioritized Actions

Resiliency Action Name	Jurisdictions	Counties	Description
Town of Chadbourn Stormwater System Improvements for Flood Mitigation	Town of Chadbourn	Columbus	Priority Area 1 and 3 Stormwater System Improvements: Proposed project will implement findings from a Stormwater Asset Inventory & Assessment project completed in 2021 to include the replacement of piping in two areas ranging from 12" to 18", and five associated stormwater structures.
Town of Fairmont Pump Station Relocation	Town of Fairmont	Columbus	This project involves relocation of the North Walnut and Happy Hill pump stations to outside the 100-year floodplain. The new stations will have submersible pumps, wet wells, valve vaults, emergency bypass connections, generators, new computer systems and security fencing.
Town of Holden Beach Ocean Boulevard Stormwater Project	Town of Holden Beach	Brunswick	4 Priority Areas for Stormwater Improvements along Ocean Boulevard. Projects include New HPPPs, RCPs, Swales, Pipe Upgrades, Tide Gate. Part of 2024 Holden Beach Stormwater Master Plan
Town of Ocean Isle Beach Elevate & Empower: Resilient Infrastructure Project (Elevate Lift Stations and Transformer Pedestals, Generators for Lift Stations)	Town of Ocean Isle Beach	Brunswick	This project supports the Town of Ocean Isle Beach's infrastructure resilience in three key ways: 1) Elevating sewer lift station control panels in flood-prone areas; 2) Elevating transformer pedestals in flood prone areas, and 3) Purchasing 3 portable generators to operate lift stations during emergency situations with power outages. The Town frequently experiences flooding at multiple sites where lift station control panels and transformers are affected.
Town of Pembroke Stormwater/ Flooding Improvements	Town of Pembroke	Robeson	This strategy will focus on cleaning and reshaping channels and culverts that carry stormwater away from the campus and town to the larger tributary areas of Watering Hole and Bear Swamp.

Action Category	Action Type	Potential Funding Sources
Infrastructure & Control Structures	Storm Water Management Activities	Hazard Mitigation Grant Program (HMGP); Disaster Relief and Mitigation Fund (DRMF) Grants; Local Assistance for Stormwater Infrastructure Investments (LASII)
Infrastructure & Control Structures	Critical Infrastructure	Hazard Mitigation Grant Program (HMGP)
Infrastructure & Control Structures	Storm Water Management Activities	Hazard Mitigation Grant Program (HMGP); Disaster Relief and Mitigation Fund (DRMF) Grants; Local Assistance for Stormwater Infrastructure Investments (LASII)
Infrastructure & Control Structures	Storm Water Management Activities	Hazard Mitigation Grant Program (HMGP)
Infrastructure & Control Structures	Storm Water Management Activities	Hazard Mitigation Grant Program (HMGP); Disaster Relief and Mitigation Fund (DRMF) Grants; Local Assistance for Stormwater Infrastructure Investments (LASII)





Along the Lumber River at Chalk Banks in Scotland County, NC



# REVIEW OF FUNDING SOURCES

North Carolina communities face growing challenges from flooding, aging infrastructure, rapid development, and climate driven extreme weather. To address these risks, a wide ecosystem of federal, state, regional, and private funding sources exists—but navigating this landscape is complex. **Appendix G** provides a comprehensive catalog of the programs available to support resilient infrastructure, watershed restoration, nature based solutions, disaster recovery, stormwater improvements, and long-range community planning.

This summary synthesizes the full document into three pages, highlighting the major categories of funding, core features of key programs, and strategic considerations for project selection, eligibility, and implementation. It is intended to support staff, local governments, and partners in identifying viable funding pathways and aligning resilience needs with the strongest opportunities.

## Federal Funding Programs

Federal agencies administer a wide range of programs that support flood mitigation, disaster recovery, transportation resilience, water/wastewater infrastructure, land conservation, and ecosystem restoration. Many of these programs are competitive, require detailed benefit cost analysis, and operate on recurring annual cycles or disaster specific funding streams.

### FEMA Programs

FEMA funds are among the most significant sources for hazard mitigation and flood resilience.

# 25%

Across all FEMA programs, eligible applicants in North Carolina include local governments, tribes, and state agencies. Projects generally require a 25% local match unless the community qualifies for disadvantaged or severe repetitive loss adjustments.

- **Building Resilient Infrastructure and Communities (BRIC)**

provides competitive funding for mitigation projects, with strong emphasis on shovel-ready infrastructure protection solutions, improved codes and code enforcement and long-term resilience in the face of changing conditions.

- **Flood Mitigation Assistance (FMA)**

supports repetitive loss and severe repetitive loss properties through elevation, acquisition, and floodproofing, floodplain restoration and flood mitigation planning.

- **Hazard Mitigation Grant Program (HMGP)**

is available after major disasters and supports a wide range of projects such as buyouts, structural mitigation, and infrastructure retrofits.



## HUD Community Development Block Grants

HUD administers **CDBG Disaster Recovery (CDBG DR)** and **CDBG Mitigation (CDBG MIT)** programs following major disasters. These funds support:



Housing Reconstruction



Long-term Recovery



Mitigation



Infrastructure Upgrades



Planning

States manage allocation plans that define eligible activities and target low and moderate income communities.

## USDA Programs

The U.S. Department of Agriculture supports agriculture focused and rural community water infrastructure:

- NRCS Watershed and Flood Prevention Operations (WFPO)
- Emergency Watershed Protection (EWP)
- Rural Development Water & Waste Disposal Loans and Grants

These programs fund watershed improvements, streambank restoration, emergency stabilization, and water/sewer infrastructure in rural communities.

## EPA and Water Infrastructure Programs

EPA's major programs include:

- Clean Water State Revolving Fund (CWSRF)
- Drinking Water State Revolving Fund (DWSRF)
- WIFIA Loans for large scale water infrastructure

These sources offer low interest loans and forgivable principal for eligible communities.

## Department of Transportation (DOT) Resilience Programs

DOT's resilience programs—including **PROTECT**, **RAISE**, and other discretionary grants—support projects that improve resilience of transportation systems, culverts, roadways, and multimodal networks.

## NOAA and Interior Programs

Environmental agencies support conservation, floodplain restoration, and nature based solutions. NOAA's funding for habitat restoration and coastal resilience and the U.S. Fish & Wildlife Service's programs for wetlands, rivers, and wildlife corridors offer opportunities for ecosystem based flood mitigation.

## Congressional Spending

Legislative Pre-Disaster Mitigation (L-PDM) and Community Project Funding (CPF) are Congressionally directed spending programs that can be used to mitigate against flooding. These funds are accessed directly through the local Congressional representative.

## State of North Carolina Funding Programs

North Carolina has one of the most diverse state level funding environments for water, land, flood, and resilience related projects. Many state sources provide match flexibility, technical assistance, or planning support not available from federal programs.

### North Carolina Land & Water Fund (NCLWF)

NCLWF supports land acquisition, stream and floodplain restoration, innovative stormwater management, and planning for water quality and flood resilience. Programs include:

- Acquisition Grants for riparian buffers, wetlands, and floodplain conservation
- Restoration Grants for streams, wetlands, and natural infrastructure
- Innovative Stormwater Projects
- Planning Grants for long-range watershed and restoration strategies

### NC Division of Water Resources (DWR)

DWR administers several programs including:

- Water Resources Development Grant Program (WRDG)
- State cost share support for flood mitigation and water-based recreation
- Planning assistance for hydrologic and watershed studies

These programs support construction and planning for flood reduction projects, stormwater controls, and water supply solutions.

### State Revolving Funds (SRF)

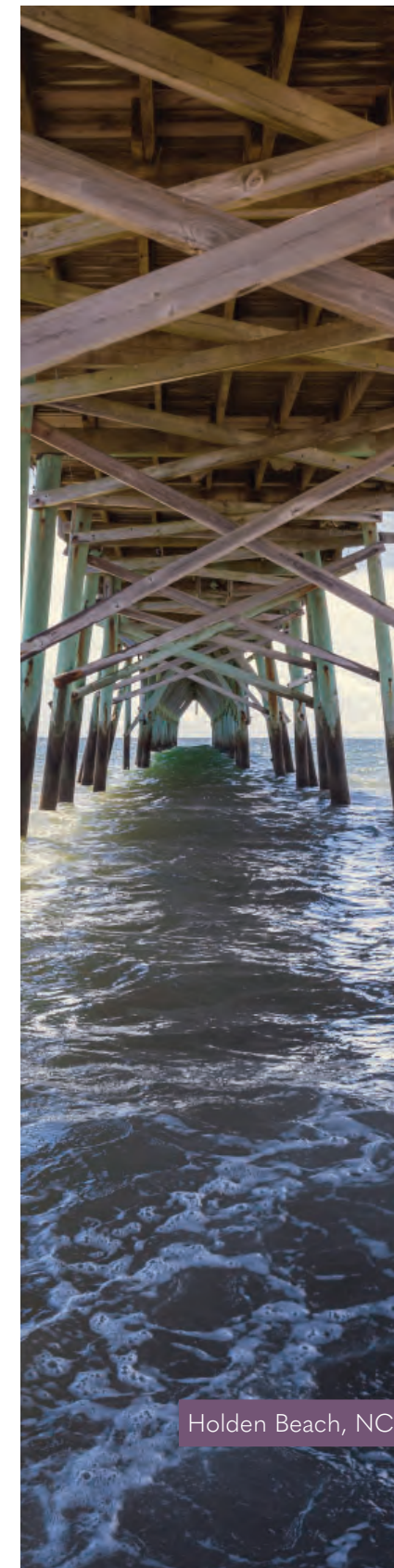
North Carolina administers CWSRF and DWSRF with added benefits for disadvantaged communities. Funds include loan forgiveness, match assistance, and priority scoring for resilience and green infrastructure.

### Coastal and Environmental Programs

For coastal communities, the state offers:

- Coastal Storm Damage Mitigation Fund
- Resilient Coastal Communities Program (RCCP)
- CAMA grants for shoreline, planning, and hazard mitigation

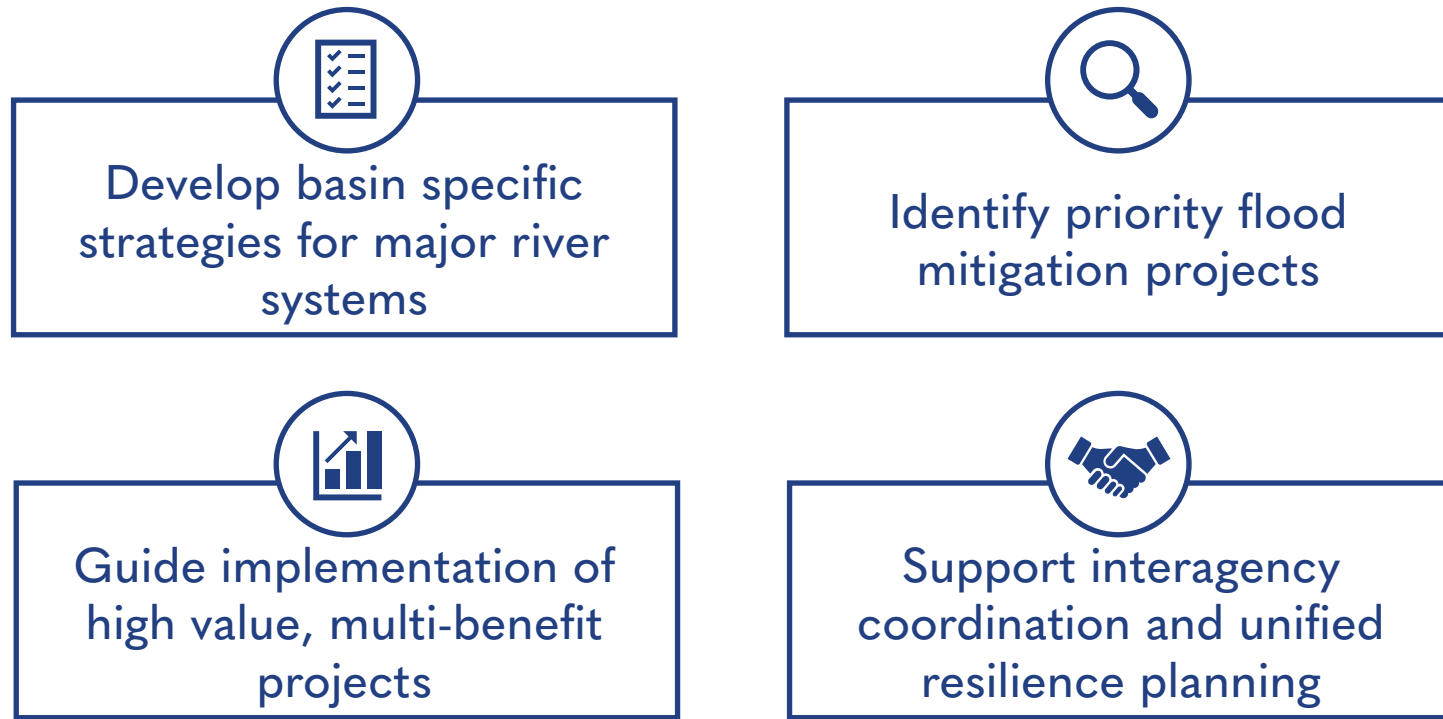
Other programs, such as the Environmental Enhancement Grant (EEG) and agricultural conservation programs, support habitat restoration, water quality enhancements, and preservation of natural lands.



Holden Beach, NC - USA

# Blueprint Project Implementation Funding

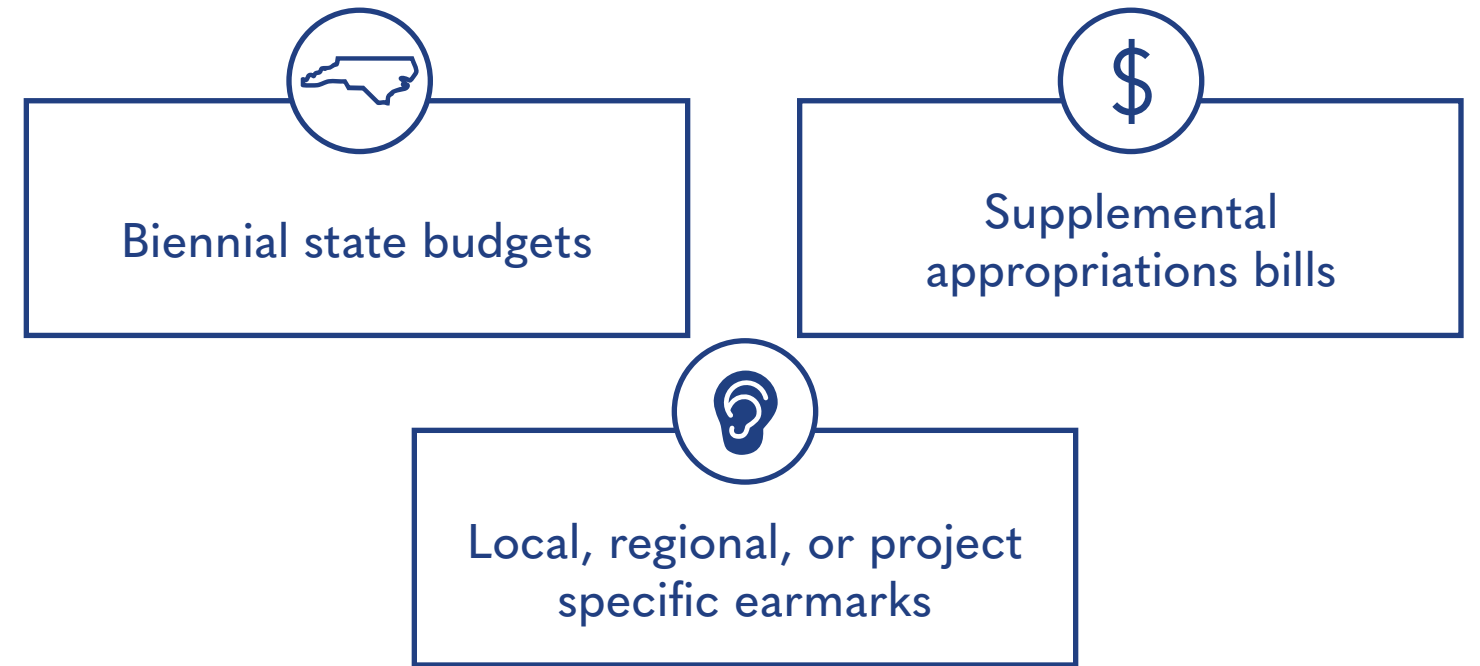
The North Carolina Flood Resiliency Blueprint represents one of the largest state investments in long term flood mitigation planning. Funded initially with \$96 million and now operating with \$76 million, the Blueprint aims to:



Blueprint implementation funds are designed to move high priority projects from concept to construction, particularly where solutions reduce community flood risks, restore natural systems, and provide durable watershed benefits. As strategies are finalized for each basin, these funds will act as a state-level catalyst for projects that align with Blueprint priorities.

# Legislative Appropriations from the NC General Assembly

The North Carolina General Assembly (NCGA) can allocate funding for resilience and infrastructure through:



Recent budgets have included substantial statewide investments in water, sewer, and stormwater infrastructure, as well as direct allocations to counties, municipalities, and utilities. Legislative appropriations are often strategic tools for addressing urgent needs or advancing major projects that do not fit traditional grant programs. Local governments can work with legislators to elevate priority projects for potential inclusion in budget cycles, especially when projects align with statewide resilience, infrastructure, and economic development objectives.

Fishing Pier at Holden Beach, North Carolina



# Local, Regional, and Nonprofit Funding Programs

Local governments, regional planning organizations, and nonprofit partners provide essential complementary resources that can fill match requirements, support early-stage planning, or implement smaller scale resilience solutions.

## Local and Utility Funding

Local sources include:



These funds can be used as match for federal or state programs or to advance preliminary engineering.

- **General funds**
- **Stormwater utility fees**
- **Water & sewer enterprise funds**
- **Local capital improvement plans (CIPs)**

## Regional Transportation Planning Funds

Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs) can incorporate resilience components into transportation improvement programs, often unlocking federal dollars for culverts, bridges, greenways, and road related stormwater improvements.

## Nongovernmental Organizations (NGOs) and Philanthropy

Nonprofit organizations can serve as applicants, co applicants, match partners, land stewards, or technical supporters. Key partners include:

- North Carolina Community Foundation
- National Fish & Wildlife Foundation (NFWF)
- The Nature Conservancy
- Conservation Trust for NC
- Local land trusts and conservation groups

These partners often bring additional capacity, volunteer support, specialized expertise, and access to philanthropic funding streams.



Dam at Lake Waccamaw



# Strategic Considerations for Project Success

The document highlights several cross cutting considerations:

## Eligibility and Governance

Eligibility differs across programs:

- Some require the applicant to be a unit of local government
- Others accept nonprofit organizations or special districts
- Utility authorities may be eligible for water infrastructure funds
- FEMA programs require state sponsorship and hazard mitigation planning compliance

Understanding institutional eligibility early in project development is critical.

## Matching, Cost Share, and Funding Stacking

Most major programs require local match contributions, typically ranging from 0% to 25%, though disadvantaged community provisions may reduce this requirement. Many projects are financed through braided funding, combining:

- Federal grants
- State grants or loans
- Local funds
- Philanthropic contributions

## Planning and Readiness

Competitive programs prioritize:

- Strong benefit cost analysis
- Permitting readiness
- Engineering feasibility
- Multi benefit outcomes (e.g., water quality + flood reduction + recreation)
- Community engagement and social impact outcomes

## Nature-Based Solutions

Many programs strongly encourage or explicitly prioritize nature based approaches such as:

- Floodplain reconnection
- Wetland restoration
- Stream restoration and buffer enhancement
- Green stormwater infrastructure

These solutions typically score well in competitive evaluations and provide durable long term benefits.

North Carolina has access to one of the most diverse and strategically aligned funding environments for flood mitigation, watershed restoration, and resilience in the United States. The programs cataloged in the Funding Sources Writeup provide a broad spectrum of opportunities for planning, engineering, land conservation, stormwater improvements, resilient infrastructure, and long-term community capacity building.

Aligning local project needs with the right funding source—while leveraging multi agency partnerships and taking full advantage of the Flood Resiliency Blueprint—positions communities to make transformative progress in reducing flood risks and improving watershed health.



## Funding Sources for RBAS Process Prioritized Actions

As a final step in developing the RBAS, federal, state, regional, and local funding programs were evaluated for possible fit with the identified Blueprint projects so that these projects can move toward implementation. Information about these programs were gathered- in an organized manner and is available in **Appendix G**.

Many of the regional priority projects identified for their impact in mitigating risk, were large projects with substantial cost estimates that would need success in large federal grant programs to complete the work. In many instances, the non-federal cost share that would be required of the community was prohibitively high for the small communities in which the action is proposed. To address this need, when the community is under-resourced and the project is large, the strategy also considers sources of cost-match from non-federal sources. For some actions, partnerships with state or federal agencies would likely aid in the success of the project, and these partnerships are identified.

Several factors were considered in making funding program matches, including routing projects to a variety of programs so that basin projects were not in competition for the same funding resources. Other factors included the purpose of the program, award size, previously funded projects, and eligibility. Two funding subject matter experts developed independent funding strategies for the priority basin actions, then met to discuss results to determine the best fit for each project component, the needs for cost-match assistance and the necessary partnerships to implement each project. An overview is available in Table 4 and discussed below.



Lumber River at Chalk Banks in Scotland County, NC



Table 4. Funding Strategy Overview

Project Name	Program Match	Cost Matching Source	Partnerships
Fair Bluff: Levee Construction	FEMA Flood Mitigation Assistance	Blueprint or Appropriations, NC Community Foundation	NCEM Floodplain Mapping Program, Charleston USACE
Lumberton Levee System Improvements: Lumberton Levee System Inspection, Maintenance, Repair, Upgrades and Accreditation	Community Projects Funding	Stormwater Utility Fees	NCEM Floodplain Mapping Program, Charleston USACE
Lumberton Levee System Improvements: Permanent Pump Station	FEMA Building Resilient Infrastructure and Communities	Stormwater Utility Fees	-
Lumberton Levee System Improvements: Floodgate Construction on Jacobs Branch	FEMA Pre-Disaster Mitigation	-	-
Whiteville Stream Restoration and Stormwater Solutions: De-Pave Program	North Carolina Water Resource Development Grant Program: State and Local Projects	-	-
Whiteville Stream Restoration and Stormwater Solutions: Mollie's Branch Stream Restoration	USDA Watershed and Flood Prevention Operations Program	EPA Clean Water State Revolving Fund, NRCS-EQIP Water Resources Development Grant: Stream Restoration Projects	-
Lumber Basin Regional Dam Program: Basin-wide Prioritized Dam Inspections	National Dam Safety Program	Direct Legislative Spending	North Carolina Dam Safety Program
Lumber Basin Regional Dam Program: Regular Dam Maintenance	FEMA High Hazard Potential Dam Program	Rural Infrastructure Program	North Carolina Dam Safety Program
Lumber Basin Regional Dam Program: Rehabilitate, Repair, Retrofit Dams	FEMA BRIC, FEMA Public Assistance Mitigation	National Rural Water Association Revolving Loan Fund	-



## Fair Bluff Levee Construction:

The levee construction project is in a community of fewer than 1,000 residents, and was first proposed in a U.S. Army Corps of Engineers Charleston District, where they determined that the levee project would not pass the Benefit-Cost Analysis methodology used by the USACE, and therefore was dropped from consideration for USACE funding. This eliminated traditional levee programs out of the USACE. However, when considering the loss of life and property as the primary drivers of benefits, this project scores well. It protects a number of likely NFIP-insured properties, making the project a good fit for FEMA's Flood Mitigation Assistance (FMA) Program, which has a purpose of reducing claims on NFIP-insured properties.

As the community is small, it will likely need cost-match assistance to access this federal program. However, if the properties protected have had numerous claims, there is the possibility of reducing cost-match requirements down to nothing. Assuming that there is a need for cost match, there are limited programs for accessing levee funding among non-federal programs. Blueprint, Appropriations and/or the North Carolina Community Foundation are possible sources for match funding.

Since the USACE Charleston District has scoped the project, outreach to the agency for partnership is recommended. The NCEM Floodplain Mapping Program would also serve as a partner that would assist the community and/or alternative grant application development team to identify the legislative obstacles and processes to getting the levee accredited. Given the size of the community,

Fair Bluff may consider reaching out to the county government or local COG to assist in application development. The North Carolina Water Resources Development Grant: Flood Resiliency Grants is identified as an alternative funding program match for this project. This program was deemed the alternative rather than the best match due to its relatively high 67/33 cost-share and lack of history of levee project funded by the program. FMA requires that the project be identified in an adopted and approved Hazard Mitigation Plan. If the project is not identified in the existing plan, it should be added in the next update.

## Lumberton Levee System Improvements: Lumberton Levee System Inspection, Maintenance, Repair, Upgrades, and Accreditation:

This is a high-cost project that protects more than 400 likely-NFIP properties, and several critical facilities and infrastructure assets. The high cost, limits program fits as many place caps at the higher end. This levee system already received funding from the EDA and NCDOT, complicating the match. The best funding match for levee upgrades was determined to be Community Projects Funding, which is a federal direct spending program on a wide range of projects with a nexus to existing federal programs. This project can support a nexus to existing FEMA programs to qualify for this program. To access this program, Lumberton should reach out to its elected federal Representative in the project area, who can place the project for funding consideration with Congress.

As this project has also been deemed not in the economic interest of the USACE, it is unlikely to find funding through this additional route. While FEMA programs such as FMA, BRIC, Pre-Disaster Mitigation (PDM), and HMGP may find that this project would qualify, award caps make them funding alternatives for this project.

Similarly to Fair Bluff, partnerships with the NCEM Floodplain Mapping Program and the USACE Charleston District should be sought for guidance in developing the scope, budget and timeline to ensure appropriate time and steps are taken to accredit the levee.



## Lumberton Levee System Improvements: Permanent Pump Station:

Adding a suitably sized pump to the Lumberton Levee system would protect transportation, wastewater, potable water, and other assets from stormwater flooding by pumping it over the protective levee and into the Lumber River. Given the density of infrastructure protected, FEMA's Building Resilient Infrastructure and Communities (BRIC) program is deemed to be the best fit for this project. The pump fits well below the \$20 million cap for the program, and depending on the needed size, may be eligible for state set-aside funding. Similar pumps have been funded through this program.

Other FEMA programs such as HMGP, PDM and FMA may also be alternative programs to construct the pumping system. The USDA Watershed and Flood Prevention Operations Program is another alternative. Lumberton has an existing Stormwater Utility fee that could be used for cost-match. BRIC and other FEMA programs requires that the project be identified in an adopted and approved Hazard Mitigation Plan. If the project is not identified in the existing plan, it should be added in the next update.

## Lumberton Levee System Improvements: Floodgate Construction on Jacobs Branch:

The floodgate is designed to protect several properties and roadways from flooding. The best program fit for this project is the FEMA Pre-Disaster Mitigation program which is accessed through elected Representatives at the project location. This program was selected because it appears likely to pass a FEMA BCA. FMA requires that the project be identified in an adopted and approved Hazard Mitigation Plan. If the project is not identified in the existing plan, it should be added in the next update.

The project was not deemed to need a source of match funding. Alternative program identified for this project are FEMA's FMA program and the DOT's Better Utilizing Investments to Leverage Development (BUILD) and Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) programs that are designed to invest in improvements that protect transportation assets.

## Whiteville Stream Restoration and Stormwater Solutions: De-Pave Program:

With benefits for stormwater flooding and water quality and a more affordable cost estimate, there are more alternatives for funding. The project also already has several partners on board. The funding match identified for this program is the North Carolina Water Resource Development Grant Program: State and Local Projects. This state-level program identifies green infrastructure as an eligible activity.

It is a relatively low-cost project, so cost-match assistance was not considered, however, alternative programs may be considered if there is a need. Alternative programs include the Five Star Urban Waters Restoration Grant Program, which could include community implementation activities and is named for its need for five partners. Additionally, the North Carolina Land and Water Fund: Innovative Stormwater Program, which awards innovative projects in the state.



## Whiteville Stream Restoration and Stormwater Solutions: Mollies Branch Stream Restoration:

This project entails the restoration of a stream to a more natural flow adjacent to a wetland, creating water quality benefits along with flood mitigation. It includes culvert upgrades to better pass the restored stream. The project was previously funded through FEMA's BRIC program in the program year that was canceled. Due to recent court rulings, there is the possibility of restoring funding through BRIC to the project, and the project team should reach out to NCEM to pursue this possibility. The best fit for the project is the USDA's Watershed Protection and Flood Prevention Operations Program. Its purpose is to protect and restore watersheds for flood prevention or other purposes. It is accessed through local Natural Resources and Conservation Service offices.

Federal program alternatives include pursuing the culverts through the USDOT PROTECT program and seeking stream restoration funding through the North Carolina Water Resources Development Grant Program: Flood Resiliency. PROTECT focuses on coastal surface transportation assets, and the Flood Resiliency program focuses on nature-based mitigation alternatives in the Lumber River basin among a select few others.

The project was deemed likely to need cost-match assistance. Two programs were identified for this purpose: The EPA Clean Water State Revolving Fund, which provides low- or no-interest loans for projects that support clean water; and the NRCS-EQIP Water Resources Development Grant: Stream Restoration Projects, which provides cost-share support for stream restoration projects.

## Lumber Basin Regional Dam Program: Basin-wide: Prioritized Dam Inspections:

Dam inspections are part of the state's Dam Safety Program responsibilities, making the state the best applicant for this project. The best funding source for increased and emergency inspections would be the National Dam Safety Program, for which increased inspections are an eligible activity. The state program should contact the national program about funding options. Appropriations would be the best source of cost-match or alternative funding source for this project.

## Lumber Basin Regional Dam Program: Regular Dam Maintenance:

Identification of dam deficiencies is a likely outcome from success in increased inspections. Each deficient dam is likely to become its own project best directed to the FEMA High Hazard Dam Program, which is designed to address dam deficiencies likely to lead to a loss of life or property in the event of failure. Alternatives include other less-specific FEMA programs such as BRIC, where infrastructure is protected, FMA where NFIP properties are protected, and HMGP and PDM. Where maintenance of dams has the possibility of creating jobs, the Rural Infrastructure Program can provide an alternative. FEMA programs require that the project be identified in an adopted and approved Hazard Mitigation Plan. If the project is not identified in the existing plan, it should be added in the next update.

The State Dam Safety Program should be contacted as a partner for this program, as they are the organization responsible for identifying qualified dams and interfacing with FEMA on this program

## Lumber Basin Regional Dam Program: Rehabilitate, Repair, Retrofit Dams:

This is another action that is likely to be both an outcome of success of the inspection program, and likely to become multiple stand-alone projects as deficiencies are identified. Funds for dams can be restrictive, and difficult to access. All of the above-mentioned FEMA Programs: BRIC, FMA, HMGP, PDM, HHPD and Public Assistance Mitigation should be considered to the resulting projects. There are other alternatives as well, including the National Rural Water Association Revolving Loan Fund, where water utilities are protected, and the Fish & Wildlife Service's National Fish Passage Program, where the project can benefit fisheries, and an EPA Water Infrastructure and Innovation Act (WIFIA) loan may be a viable alternative for cost-match assistance. FEMA programs require that the project be identified in an adopted and approved Hazard Mitigation Plan. If the project is not identified in the existing plan, it should be added in the next update.

Lumber River, Fair Bluff, North Carolina



# ACTION STRATEGY TAKE-AWAYS

The Lumber River Basin Action Strategy is intended to support local governments, regional partners, state agencies, and other organizations in identifying and advancing flood resilience actions that are appropriate to different conditions across the basin. The vulnerability assessment shows that flood risk is increasing under future conditions, with more people, homes, critical facilities, and essential systems exposed to flooding over time. These and other findings support the need for an action strategy that can guide both near-term risk reduction and longer-term flood resilience planning across the basin.

This Action Strategy includes a mix of actions that were identified through steps 1 through 5 of the flood resiliency blueprint tool and planning process (Figure 1), and locally prioritized actions by the communities. The actions identified through the flood resiliency blueprint tool and planning process are the regional/multi-jurisdictional and local actions with calculated benefit cost ratios (BCR) of at least one

over a 50-year project life period. The local actions complement the regional actions by mitigating the flood risk in areas that are not protected by regional actions. Locally prioritized actions are actions that were provided by the various communities. Benefit cost ratios have not been calculated for locally prioritized actions.

The resiliency actions included in this strategy reflect differences in flood risk, vulnerability, and implementation context across the Lumber River Basin. Some actions are intended to mitigate or reduce concentrated flood losses in more developed areas, some are intended to protect infrastructure and maintain access to essential services, and others are intended to support adaptation in places where flooding is widespread or persistent. Taken together, the Action Strategy provides a basin-wide framework for the Blueprint to understand flood resilience needs and to advance actions through continued coordination, funding, technical assistance, and project development.



City of Lumberton's earthen levee system



## Current Limitations

The analysis, results, and recommendations in this report are subject to the following limitations:

- 1 Utilizing existing Base Level Engineering (BLE) data as the main source of fluvial and pluvial flooding data provides a strong baseline for fluvial and pluvial flood extents within the Lumber River Basin. However, the BLE modeling does not incorporate detailed terrain or detailed survey data in the analysis, which can provide refined results. Creating updated hydraulic modeling for the highly vulnerable areas can provide more detailed and accurate data to develop more specific mitigation options per area.
- 2 The updated BLE modeling data does account for sea level rise (SLR), which gives further insight into coastal flooding, which can be used for mitigation action selection. However, there are many other dynamics involved with coastal modeling including storm surge, wave run-up, overtopping, propagation, storm-induced erosion, and tides, all of which can change the coastal landscape. Currently there are datasets available for only storm surge and overland wave modeling, however these were as early as 2012. Using these potentially out of date datasets can limit the level of actions selected and the potential success of these actions, so updated coastal modeling data is needed for all coastal dynamics.
- 3 Fluvial and pluvial flood risk was only conducted on a building-level. The data used was developed in recent modeling efforts and provided building-level damage across the basin. However, there are many other components with associated risk including transportation infrastructure damage and limited access to critical infrastructure. Data on these systems across the basin could provide refined high risk and vulnerable areas and more detailed actions.
- 4 There was a lack of dam breach modeling through SERA or any other data source for most of the dams within the Lumber River Basin. 156 of the 186 total dams do not have existing breach modeling.
- 5 The NC Dam Inventory had information missing on the status of some dams about hazard level and structure condition or may not be up to date. It was observed in the data from the NC Dam Inventory that the listed inspection dates for certain dams went back to 1970, with some not having an inspection date listed. Over the period since that listed inspection, the condition and hazard class could have potentially changed based on downstream updates as well as natural degradation. However, without this information accurate risk categorization could not occur.
- 6 Simplifying assumptions were made for the urban and stormwater, and coastal flooding sources, and compound flooding due to lack of data.
- 7 Capacity challenges can prevent some local communities from developing local action plans and locally prioritized actions. Further engagement and capacity building are needed to meaningfully prioritize local actions and ensure all are able to participate.



# NEXT STEPS & IMPLEMENTATION

## DEQ Program and Project Accountability

Through the development of the River Basin Action Strategies, local governments, Councils of Government, and other partners have used the Blueprint Tool and staff support to develop local resilience plans. River Basin Advisory Groups and Blueprint Teams have further evaluated and prioritized actions for inclusion in the RBAS. These planning efforts are a critical part of building a more resilient state, but they must be matched with funding and implementation.

The completion of the River Basin Action Strategies is not an endpoint. The Blueprint team will continue working with local governments and other partners to support flood resilience planning and will collaborate with basin partners to help identify funding for prioritized mitigation actions. As of April 2026, NCDEQ has received funding for RBAS development in six basins, as well as an additional \$96 million for project implementation in those basins. To implement projects, NCDEQ has used a range of funding mechanisms, including direct partnerships with local governments, funding private firms for full-delivery flood mitigation projects, and collaboration with fellow state agencies and programs, including North Carolina Emergency Management (NCEM), the North Carolina Land and Water Fund (NCLWF), the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), the Division of Water Resources (DWR), and the North Carolina Department of Transportation (NCDOT). These partnerships support the efficient implementation of priority projects and help address gaps in current mitigation efforts. The RBAS process has also identified a need for funding to support engineering and design, in addition to construction. Moving forward, this is an area where the Blueprint can be especially impactful.

Additional funding is needed to complete RBAS development, identify projects, and support project implementation in the remaining eleven river basins. In addition, the RBAS process will identify areas where data improvements are needed, allowing those needs to be prioritized to ensure that the most accurate data is used to inform these critical decisions.

Overall, NCDEQ is committed to making the state more flood resilient by providing local governments, state agencies, and other partners with the data, tools, and support needed to guide investments that reduce the cost and disruption of future flooding.



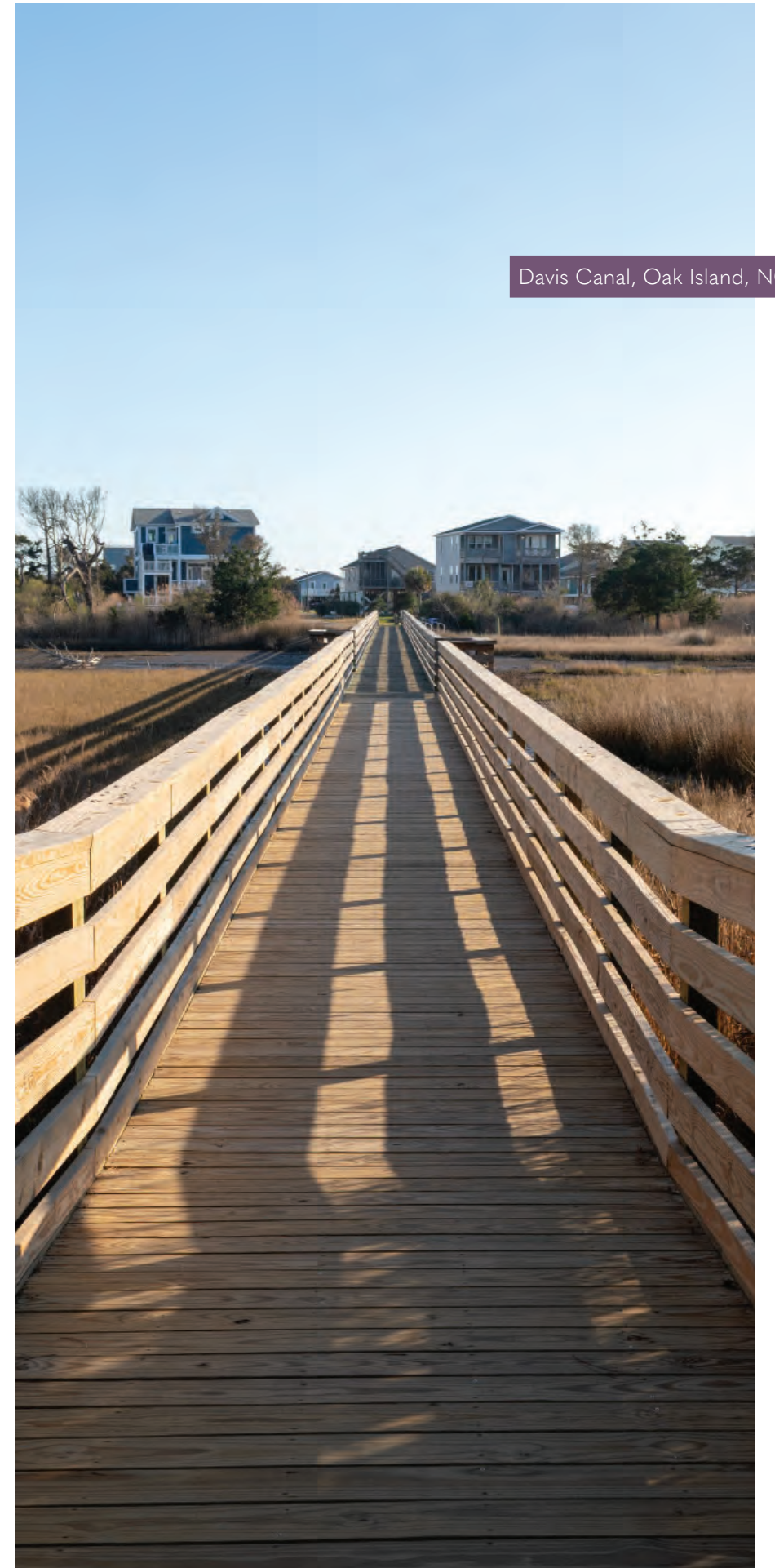
Ocean Isle and Shallotte Inlet



## Blueprint Tool

The Blueprint Tool is available statewide, but its functionality is limited outside the initial six basins. With additional funding, improved flood mapping and expanded data development will be completed for the rest of the state, allowing the Blueprint Tool to effectively support all communities across North Carolina. Continued investments to improve and refine the Blueprint Tool will better serve North Carolina's residents and ensure the state remains a leader in data-driven flood resilience planning.

In the basins currently engaged, Blueprint staff will continue providing support and resources to build local capacity to use the Tool from project conception through completion. This approach will enable local entities and basins to continue applying the Blueprint Process beyond the initial RBAS effort.



Davis Canal, Oak Island, NC



# ACKNOWLEDGEMENTS

## RBAG Members

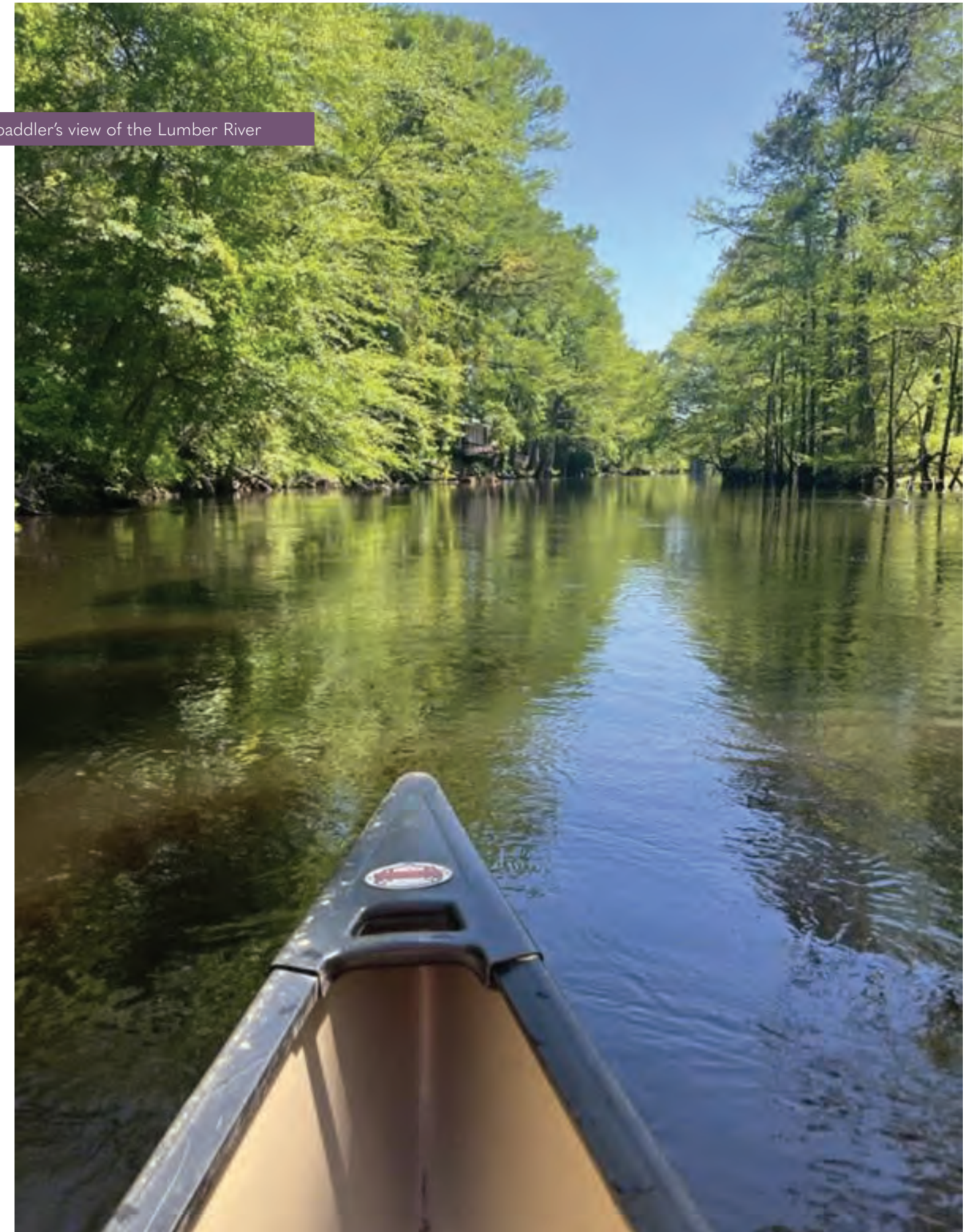
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## Contributing Entities

The Association of Mexicans in North Carolina (AMEXCAN)  
 North Carolina Black Alliance (NCBA)  
 NC Statewide Independent Living Council (SILC)  
 Southern Coalition for Social Justice (SCSJ)  
 The Conservation Fund (TCF)  
 North Carolina Budget & Tax Center (CB&TC)  
 North Carolina Conservation Network (NCCN)  
 North Carolina Inclusive Disaster Recovery Network (NCIDR)  
 Carolina Wetlands Association (CWA)  
 Lumber River Council of Governments  
 Lumber River Conservancy (LRC)  
 South Carolina Office of Resilience  
 North Carolina Department of Environmental Quality Division of Coastal Management

A paddler's view of the Lumber River



This report was developed by AtkinsRéalis for NCDEQ.

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# APPENDICES



Sunset beach sunrise North Carolina

# APPENDIX A: Data Inventory Report



# APPENDIX B: Public Engagement Plan



# APPENDIX C: Blueprint Capacity Results



# APPENDIX D: Gap Analysis Report



# APPENDIX E: Flood Risk and Vulnerability Analysis Report



# APPENDIX F: Actions Prioritization Report



# APPENDIX G: Funding Data Sheets



# APPENDIX H: NC Resiliency Blueprint Tool Reports for Locally Prioritized Actions

