



Subtask 1.1: Literature Review and Data Collection Inventory

North Carolina Flood Resiliency Blueprint

Prepared for the North Carolina Department of Environmental Quality by AECOM

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Definitions

A comprehensive list of definitions applicable to multiple Flood Resiliency Blueprint documents is provided in a separate document.

Acronyms

AT&T – American Telephone and Telegraph

CEJST – Climate and Economic Justice Screening Tool

CHHP –

CHPP - Coastal Habitat Protection Plan

CRC – Coastal Resources Commission

CRS - Community Rating System

CSC - CHPP Steering Committee

DAV – Data Access Viewer

DCM – Division of Coastal Management within the Department of Environmental Quality

EJ – Environmental justice

EMC – Environmental Management Commission

EO – Executive Order

EPA – Environmental Protection Agency

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

FRA - Fisheries Reform Act

GHG – Greenhouse gas

GIS – Geographic information system

HES – Hurricane Evacuation Study

KMZ - Keyhole Markup language Zipped

LOE – Level of effort

MFC – Marine Fisheries Commission

NC – North Carolina

NCCF – North Carolina Coastal Federation

NCCMS – North Carolina Community Mapping System

NCCSR - North Carolina Climate Science Report

NCDEQ – North Carolina Department of Environmental Quality

NCDOT – North Carolina Department of Transportation

NCEM – North Carolina Emergency Management

NCORR – North Carolina Office of Resilience and Recovery

NFHL – National Flood Hazard Layer

NOAA – National Oceanic and Atmospheric Administration

NWL – Natural and working lands

RAPT - Resilience Analysis and Planning Tool

RCCP – Resilience Coastal Communities Program

RISE – Regions Innovating for Strong Economies and Environment

RPO – Rural Planning Organization

TAG – Technical Advisory Group

TNC – The Nature Conservancy

US – United States

US EPA – United States Environmental Protection Agency

USGS – United States Geological Survey

1 Introduction

1.1 Purpose and Intended Uses of Literature Review and Data Collection Inventory

The purpose of this document is to conduct a thorough literature review and data collection inventory of existing data, planning efforts, research projects, studies, and regional scale modeling that have been developed to provide a basis for understanding, to build upon existing efforts, and to help meet the intent of the North Carolina (NC) Flood Resiliency Blueprint. The inventory will result in a report that summarizes the efforts, the lessons learned, the key components of existing work, and an index with links to all resources reviewed.

Technical Advisory Group (TAG) representatives are subject matter experts who provide advisory input and feedback during the development of the NC Flood Resiliency Blueprint. Their expertise contributes to identifying key components of the existing work gathered in the inventory.

This inventory will enable all those involved to build upon existing efforts to help meet the intent of the NC Flood Resiliency Blueprint. Phase I is a statewide effort to create a basis of knowledge including an understanding of the vast amount of resiliency planning done throughout the state. Stakeholders from each basin will have the opportunity to add local and regional planning efforts to narrow the NC Flood Resiliency Blueprint consideration for regional and local needs.

1.2 Connections to Other NC Flood Resiliency Blueprint Tasks

There are various interconnections between this literature review (Task 1.1) and other tasks in the NC Flood Resiliency Blueprint, listed below.

- Task 1.7 identifies specific recommendations from planning efforts across the state that correspond with flood resilience strategies.
- Task 2.1 creates a statewide inventory of types and sources of flooding.
- Task 2.3 expands this literature review and data collection inventory to current flood resiliency efforts and sources of flooding within the Neuse River Basin, as well as identifying existing investments in flood resilience.

Reviewed materials are organized by purpose in the sections listed below.

- (3.1) Plans and Strategies
- (3.2) Technical Reports and Memos
- (3.3) State Laws and Policies
- (3.4) Research Projects and Studies
- (3.5) Programs
- (3.6) Data Tools

For each source, the report includes a brief background, summary of efforts, lessons learned where applicable, key components of existing work, primary and supporting TAG(s) related to the identified key components of existing work, and a link to the full document. Assessment parameters, including applicability to the NC Flood Resiliency Blueprint, community engagement level of effort (LOE), ease of use, year published, and update cycle are summarized in the Index. Additional information and

summary statistics related to stakeholder and community feedback are summarized in the Stakeholder and Community Feedback Summary Table.

1.3 Overview and Organization of Key Components of Existing Work

Many of the reviewed materials identify specific recommendations that correspond with flood resilience strategies listed in full in the Statewide Planning Efforts with Flood Resilience Strategies spreadsheet within Task 1.7 (i.e., identifying specific recommendations from existing statewide planning efforts). Presented in a spreadsheet format, users can navigate all listed actions for Task 1.7. The recommendation areas included in this report refer to how the Principal Advisory Group (Principal), Core Advisory Group, Technical Advisory Groups (TAGs), and other stakeholders may use key documents to enhance and complement their participation in NC Flood Resiliency Blueprint development. Key components of existing work included in this report are organized into key topic areas that emerged as common threads in the review process. These topic areas, and key components identified from the reviewed materials nested within these areas, may be particularly useful for NC Flood Resiliency Blueprint development and are listed and described below. The Parameter Assessment and Key Components of Existing Work Summary Table below lists a matrix of literature that contain these topic areas.

- **Stakeholder and/or Community Feedback.** Many materials included in this literature review and data inventory were informed by previous robust stakeholder engagement efforts from across the state. Engaged stakeholders include local government representatives, non-profits and faith-based organizations, technical and subject matter experts, community leaders, the public, and other relevant individuals on an as need basis. Feedback received through these planning efforts, particularly input provided from the public and community members who will not be engaged in NC Flood Resiliency Blueprint, can help establish a baseline for community perception of flood and resilience related challenges, successes, and ideas that have already been documented. The Stakeholder and Community Feedback Summary Table summarizes key statistics, topics addressed, the number of people involved in the community, and geographical spread of engagement for each source as applicable.
- **Data or Modeling.** When materials offer original datasets or indices, updated projections, or other data considerations, this key component of existing work is identified along with additional information about the dataset.
- **Environmental Justice.** As defined by US Environmental Protection Agency (EPA), environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, concerning the development, implementation, and enforcement of environmental laws, regulations, and policies.¹ A strategic goal of the NC Flood Resiliency Blueprint is to consider, consult, and meaningfully involve vulnerable and underserved communities in the decision-making process. Where materials outline efforts related to Environmental Justice (EJ), this key area is identified.
- **Decision Support Tool Example.** If the source is and/or references any decision support tools, these examples are included.
- Establishing how to use the robust efforts, findings, and information included in the many hundreds of pages of relevant documentation is a key part of setting a basis for understanding.

¹ US EPA. "Environmental Justice." U.S. Environmental Protection Agency. 2023. <https://www.epa.gov/environmentaljustice#:~:text=Environmental%20justice%20is%20the%20fair,laws%2C%20regulations%2C%20and%20policies.>

This process acknowledges the extensive efforts from diverse cross-sector stakeholders across North Carolina, while presenting key components of existing work when available, for how this content can strategically inform NC Flood Resiliency Blueprint development.

1.4 Inclusion Criteria

The inclusion criteria for resources within this literature review and data inventory are listed below. Resources identified that do not meet the inclusion criteria but are valuable for awareness and reference are listed in the Appendix.

- State-wide geographic scope. The geographic scope for this literature review and data collection inventory is the state of North Carolina. The materials included have state-wide considerations and/or local and regional applicability that can be implemented in other locations.
- Credible and vetted. Resources have state or agency support and/or have been reviewed by subject matter experts.
- Up-to-date, latest version. Generally, resources were published in 2019 or later, in response to Governor Roy Cooper's 2018 Executive Order 80. For resources updated annually, only the latest version was reviewed although earlier versions may be mentioned or linked in the document.

2 Index

2.1 Parameter Assessment Overview

Assessment parameters are described below along with included options.

- Community Engagement LOE. Community engagement refers to engagement with members of the public that provide valuable understanding of their communities and how flooding affects it, but who may or may be subject matter experts. The included community engagement was listed in the reviewed reports; however community engagement could have occurred that was not reported and therefore would not be included. As listed below, this parameter is based on information contained in each material.
 - **Low:** The material referenced no or little community engagement that was conducted to inform the development of the material; the material does not specify or include engagement strategies.
 - **Medium:** The material referenced some community engagement and mentioned community engagement plans or strategies that were conducted to inform the development of the material. Feedback received and included in the material is not representative of the entire state.
 - **High:** The material referenced robust community engagement conducted with a thoughtful and intentional community engagement plan that informed the development of the material. Feedback received and included in the material is relatively representative of the entire state.
- Applicability to NC Flood Resiliency Blueprint
 - **Low:** Somewhat relevant sources but missing foundational context.
 - **Medium:** Highly relevant sources; often secondary (i.e., found within highly relevant documents).
 - **High:** Highly relevant documents; foundational in content or function.
- Ease of Use
 - **Low:** Long and/or highly technical document.
 - **Medium:** Possibly technical but well-organized and clear.
 - **High:** Effectively summarized and easily understandable.
- Age and Update Cycle: Narrative form that includes the year it was published or released along with any known information on the update cycle.

Table 2-1: Parameter Assessment and Key Components of Existing Work Summary Table

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
Plans and Strategies									
North Carolina Climate Risk Assessment and Resilience Plan https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf	2020	The state will support and update	Medium	High	Medium	✓		✓	
State of North Carolina 2023 Hazard Mitigation Plan² https://www.ncdps.gov/our-organization/emergency-management/hazard-mitigation/enhanced-hazard-mitigation-plan	2023	Every 5 years	Low	High	Medium	✓			
NCDOT Resiliency Strategy Report https://files.nc.gov/ncdeq/climate-change/resilience-	2021; 2022	Annual	Low	High	High	✓	✓		

² Component of the North Carolina Risk Assessment and Resilience Plan.

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
plan/agency-reports/Department-of-Transportation-2021-Resilient-Strategy-Report.pdf NCDOT 2022 Resiliency Strategy Report https://www.ncdot.gov/initiatives-policies/Transportation/transportation-resilience/Documents/ncdot-resilience-report.pdf									
North Carolina Natural and Working Lands Action Plan³ https://files.nc.gov/ncdeq/climate-change/natural-working-lands/NWL-Action-Plan-FINAL---Copy.pdf	2020	A living document with no prescribed update schedule	Low	High	High		✓		
North Carolina Coastal Habitat Protection Plan: Source Document 2016 https://deq.nc.gov/marine-fisheries/coastal-habitat-protection-plan/2016-	2016	Every 5 years	High	High	High				

³ Component of the North Carolina Risk Assessment and Resilience Plan.

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
chpp-source-document/open									
North Carolina Coastal Habitat Protection Plan: 2021 Amendment		Every 5 years	High	High	High	✓			
2022 Climate Strategy Reports (for 11 State Agencies) https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-strategy-reports#2022-11687	2022	Annual	Varies	High	High	✓		✓	
Hurricane Matthew Resilient Redevelopment Plans https://www.rebuild.nc.gov/resiliency/hurricane-matthew-resilient-redevelopment-plans	2017	N/A	Medium	High	Medium		✓		
Technical Reports and Memos									
North Carolina Climate Science Report ⁴ https://ncics.org/wp-content/uploads/2020/10/	2020	Updated as needed to incorporate new decision-relevant information	Low	High	Medium		✓		

⁴ Component of the North Carolina Risk Assessment and Resilience Plan.

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
NC Climate Science Report FullReport Final revised September2020.pdf									
State Laws and Policies									
Executive Order 80: North Carolina’s Commitment to Address Climate Change and Transition to a Clean Energy Economy https://governor.nc.gov/media/967/open	2018	N/A	N/A	Low	High				
Executive Order 246: North Carolina’s Transformation to a Clean, Equitable Economy https://governor.nc.gov/media/2907/open	2022	N/A	N/A	Low	High			✓	
2021 NCDOT Resilience Policy https://www.ncdot.gov/initiatives-policies/Transportation/transportation-resilience/Documents/ncdot-resilience-policy.pdf	2021	Next review date: 9/27/2025	N/A	Medium	High				
Research Projects and Studies									

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
Collaboratory Flood Resilience Study 2.1.1.1 https://collaboratory.unc.edu/wp-content/uploads/sites/476/2021/06/flood-resiliency-report.pdf	2021	N/A	Low	High	High		✓		✓
Growing Safely or Building Risk? Floodplain Management in North Carolina https://www.tandfonline.com/doi/full/10.1080/01944363.2022.2141821	2023	N/A	Low	High	Medium		✓	✓	
Programs									
Regions Innovating for Strong Economies and Environment Program 2.1.1.2 RISE and Environment Program ReBuild NC	2021	N/A	Medium	High	Medium	✓		✓	
North Carolina Resilient Coastal Communities Program	2020	N/A	Medium	High	Medium	✓			

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
2.1.1.3 NC Resilient Coastal Communities Program NC DEQ									
Data Tools									
North Carolina Resilience Clearinghouse https://www.usmangroup.com/experience/north-carolina/	Not Listed	Unknown	Low	High	TBD		✓		✓
Resilience Analysis and Planning Tool (RAPT) https://www.fema.gov/northeast/resilience-analysis-and-planning-tool-rapt	2020	Not specified	Low	High	Medium		✓	✓	
Environmental Justice Screening and Mapping Tool (EJScreen) https://www.epa.gov/ejscreen	2015 (public release)	Annually, with new and best available data	Low	High	High		✓	✓	✓
NOAA Coastal Flood Exposure Mapper https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html	Not listed	Not specified	Low	Medium	High		✓		

			Parameter Assessment			Key Components of Existing Work			
Title and Link	Year	Update Cycle	Community Engagement LOE	Applicability	Ease of Use	S/CF	Data	EJ	DST
NOAA Digital Coast Data Access Viewer (DAV) https://coast.noaa.gov/dataviewer/#/	Not listed	Not specified	Low	Medium	Medium		✓		
National Flood Hazard Layer https://www.fema.gov/flood-maps/national-flood-hazard-layer	2013	Continuously	Low	High	Medium		✓		✓
Climate and Economic Justice Screening Tool (CEJST) https://screeningtool.geoplatform.gov/en/about	2022	Annually, based on public feedback, research, and the availability of new data	Medium	High	High	✓	✓	✓	✓
NCDEQ North Carolina Community Mapping System https://deq.nc.gov/outreach-education/environmental-justice/deq-north-carolina-community-mapping-system	2019	Not specified	Low	Medium	Low	✓		✓	

3 Review and Inventory

3.1 Plans and Strategies

3.1.1 North Carolina Climate Risk Assessment and Resilience Plan

(<https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf>)

3.1.1.1 Background

The North Carolina Climate Risk Assessment and Resilience Plan (“2020 Resilience Plan”) was released in June 2020. The development of the 2020 Resilience Plan, led by the Department of Environmental Quality (NCDEQ) with interagency collaboration and stakeholder support, was a key action directed by Governor Cooper’s Executive Order 80 (EO 80), signed in October 2018. The plan’s purpose is to guide state action, engage policymakers and stakeholders, and facilitate collaboration among many partners to protect the state against high-impact, low-frequency weather events. The plan states “Heavy precipitation accompanying hurricanes and other weather systems is likely to increase, thus increasing the potential for flooding in inland and coastal areas.” This is one example of how the Climate Risk Assessment and Resilience Plan could be pertinent to the Blueprint.

3.1.1.2 Summary of Efforts

The 2020 Resilience Plan also establishes the North Carolina Resilience Strategy, formed by four component documents: (1) The North Carolina Science Report, (2) State Agency Resilience Strategies, (3) Statewide Vulnerability Assessment and Resilience Strategies, and (4) the state of North Carolina Enhanced Hazard Mitigation. Task 1.7 provides a comprehensive understanding of the recommendations in the 2020 Resilience Plan. This plan offers the following results:

- Our best understanding of the projected change in the climate.
- Climate justice considerations.
- State infrastructure, assets, programs, and services that are vulnerable and at risk to climate and non-climate stressors within the following 11 critical sectors:
 - Agriculture and Forestry
 - Coastal Resources and Infrastructure
 - Commerce and Business
 - Cultural Resources
 - Ecosystems
 - Health and Human Services
 - Housing, Buildings, and Support Services
 - Public Safety
 - Transportation
 - Water and Land Resources
 - Energy
- Preliminary actions currently underway or which could be taken to reduce the risk for at least three example vulnerability areas.

- Recommendations for nature-based solutions to enhance ecosystem resiliency and sequester carbon in the state’s natural and working lands (NWL).

The 2020 Resilience Plan also establishes the following Cross-Cutting Resilience Strategies:

- Consider resilience criteria in making state investments.
- Update plans, standards, and design values.
- Increase resilience capacity in state agencies.
- Identify sustainable funding sources for resilience.
- Increase communication and outreach on climate change.

3.1.1.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact, Hazard Identification

Stakeholder and/or Community Feedback: To support the implementation of Governor Roy Cooper’s Executive Order 80, Section 9, the North Carolina Division of Coastal Management (DCM) and North Carolina Coastal Federation (NCCF) held two regional coastal resilience workshops and one coastal resilience summit. NCDEQ and key stakeholders throughout the Piedmont and Mountain regions of the state replicated these engagements in five dispersed locations. Over the eight workshops, more than 300 participants representing 82 of the 100 counties offered input. Key outcomes and thematically organized feedback can be found in the reports listed below and included in the North Carolina Climate Risk Assessment and Resilience Plan appendices.

- Appendix D: [North Carolina Coastal Regional Workshops Report](#)
- Appendix C: [North Carolina Mountain and Piedmont Regional Workshops Report](#)

Environmental Justice: Chapter 4 of the 2020 Resilience Plan, titled “Climate and Environmental Justice” is a valuable resource to inform statewide efforts. Chapter 4 establishes a shared understanding of inequity in climate vulnerability and resilience born from centuries of structural racism resulting in compounding vulnerabilities.

The Climate and Environmental Justice spotlight issues include:

- Energy cost burden and higher heat,
- Workers, small businesses, and family businesses in vulnerable industries,
- African American property ownership, and
- Insurance inequalities.

3.1.2 North Carolina Department of Transportation Resiliency Strategy Report

(2021: <https://files.nc.gov/ncdeq/climate-change/resilience-plan/agency-reports/Department-of-Transportation-2021-Resilient-Strategy-Report.pdf>)

(2022: <https://www.ncdot.gov/initiatives-policies/Transportation/transportation-resilience/Documents/ncdot-resilience-report.pdf>)

3.1.2.1 Background

The first North Carolina Department of Transportation (NCDOT) Resilience Strategy Report published in 2021 aligns agency goals and objectives and will serve as the guiding document for agency activities, policy and practice improvements, and decision-making moving forward. Flooding is highlighted as a risk in both the 2021 and 2022 Resilience Strategy Reports; namely, as observed highway and railroad bridge washouts and closings in Western North Carolina in 2021. Various flood resilience activities including flood inundation analyses and other research projects are identified in the 2021 Report with status updates in the 2022 Report.

3.1.2.2 Summary of Efforts

The NCDOT Strategy includes a review of completed and ongoing agency activities, studies, plans, and state and national tools for use in contextualizing the recommended strategies. A peer review of three other state departments of transportation has found relevant practices that help to inform NCDOT as it pursues future resilience-related actions, such as vulnerability assessments or pilot studies. The NCDOT 2022 Resilience Strategy Report supplies a status update and progress report on agency actions.

3.1.2.3 Key Components of Existing Work

Primary TAG: Hazard Identification

Supporting TAG(s): Vulnerability/Risk/Impact, Resilience/Mitigation/Reduction

Stakeholder and/or Community Feedback: NCDOT held a series of virtual meetings with key stakeholders including those across NCDOT, Metropolitan Planning Organizations (MPOs), Rural Planning Organizations (RPOs) and state partners. Results are presented in a summary table on page 16 with focus areas and key themes.

Data or Modeling: Various research projects, studies, tools, and other efforts are identified and a sampling of these are listed below.

- Application for Site-Specific Information Storage and Tracking (ASSIST)
- BridgeWatch Pilot Project
- Flood Inundation Mapping and Alert Network for Transportation (FIMAN-T)

3.1.3 2022 Climate Strategy Reports

(<https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-strategy-reports#2022-11687>)

3.1.3.1 Background

As of October 2022, Cabinet agencies have combined the annual reporting on Executive Order 80, Executive Order 246, and the Climate Risk Assessment and Resilience Plan actions into Climate Strategy Reports, sent to the Climate Change Interagency Council. The eleven state agencies that released 2022 Climate Strategy Reports are listed below.

- Department of Administration
- Department of Agriculture and Consumer Affairs
- Department of Commerce
- Department of Environmental Quality
- Department of Health and Human Services

- Department of Information Technology
- Department of Military and Veteran Affairs
- Department of Natural and Cultural Resources
- Department of Public Safety
- Department of Revenue
- Department of Transportation

While the Cabinet agency Climate Strategy Reports have a much broader focus than flood resilience alone, statewide climate impacts include significant flood-related impacts, such as increased total annual precipitation, extreme precipitation and frequency, sea level rise along the coast, frequency and intensity of storms, storm surge flooding in the coastal region, and inland flooding. Accordingly, many agency reports outline strategies and actions to reduce flood impacts that are specifically nested within Section 2 included in the section below.

3.1.3.2 Summary of Efforts

In the 2022 Climate Strategy Reports, each state agency shows their vulnerabilities to climate change and describes the agency approach to completing the strategies outlined in the NC Climate Risk Assessment and Resilience Plan. All Climate Strategy Reports include agency-specific actions and progress (including expected completion dates) for the statewide interagency goals and objectives listed below.

1. Reduce greenhouse gas emissions.
 - 1.1. Reduce energy consumption per square foot in state-owned buildings by at least 40% from the fiscal year 2002-2003 levels.
 - 1.2. Support the use and expansion of energy-efficient and clean energy resources.
 - 1.3. Increase the number of registered Zero Emission Vehicles to at least 1,250,000 by 2030 so that 50% of in-state sales of new vehicles are zero-emission by 2030.
 - 1.4. Prioritize Zero Emission Vehicles (ZEVs) in the purchase or lease of new vehicles and for agency business travel.
 - 1.5. Initiate other initiatives to decarbonize the transportation sector.
 - 1.6. Initiate other projects aimed at reducing statewide greenhouse emissions.
2. Increase statewide resilience to the impacts of climate change.
 - 2.1. Evaluate the impacts of climate change on cabinet agencies' programs and operations.
 - 2.2. Integrate climate change adaptation practices and resiliency planning into cabinet agencies' policies and operations.
 - 2.3. Assist the communities served by each cabinet agency to implement climate change adaptation practices and resiliency planning.
3. Address the public health impacts of climate change.
 - 3.1. Increase understanding and awareness of the health impacts of climate change.
 - 3.2. Advance health equity.
 - 3.3. Initiate other projects aimed at addressing the public health impacts of climate change.

4. Invest in historically underserved communities.
 - 4.1. Increase affordability for low- and moderate-income households.
 - 4.2. Create jobs and economic growth.
 - 4.3. Alert residents and businesses, particularly those in underserved communities, of state and federal grant opportunities.
 - 4.4. Initiate other projects aimed at investing in underserved communities.

3.1.3.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact

Stakeholder and/or Community Feedback: Each Climate Strategy Report addresses the agency's public participation plan, often including a hyperlink to an agency-specific public participation plan.

Environmental Justice: Each Climate Strategy Report describes the agency's approach and path forward to address environmental injustices and inequities. Each agency's status and intended actions for meeting all objectives listed in Goal 4: Invest in Historically Underserved Communities, are other valuable reference points.

3.1.4 State of North Carolina 2023 Enhanced Hazard Mitigation Plan

(<https://www.ncdps.gov/our-organization/emergency-management/hazard-mitigation/enhanced-hazard-mitigation-plan>)

3.1.4.1 Background

The Federal Emergency Management Agency (FEMA) requires state and local governments to develop and adopt hazard mitigation plans to receive certain types of non-emergency disaster funds. North Carolina's Enhanced Hazard Mitigation Plan (322 Plan) makes the state eligible for more funds to prevent future damage. Due to the enhanced plan status, North Carolina qualifies for 20 percent (as opposed to 15 percent) of the total federal recovery assistance funds (i.e., what has been paid out through the individual and public assistance programs combined). These funds can now be used on projects that minimize the impact of future storms. The State of North Carolina Enhanced Hazard Mitigation Plan is referenced in the 2020 Climate Risk Assessment and Resilience Plan and is considered a component of the North Carolina Resilience Strategy. It is listed as a standalone source for this literature review.

Flooding is a natural hazard identified in the Risk and Vulnerability Assessment portion of the NC Enhanced Hazard Mitigation Plan. Specifically, the plan highlights the two major categories, flash floods and general floods, and identifies further flood types including riverine flooding, coastal flooding, sea level rise (as a factor of coastal flooding), urban flooding, and inflow and infiltration (as a factor of urban flooding).

3.1.4.2 Summary of Efforts

The Enhanced Hazard Mitigation Plan includes a Risk Identification and Vulnerability Assessment considering natural and technological hazards, corresponding vulnerabilities, and critical asset inventory. Statewide mitigation capabilities, including North Carolina Emergency Management (NCEM) functions, state agency roles, mitigation programs and funding, local and tribal capabilities,

mitigation planning, and mitigation grants management are identified and summarized. The mitigation strategy section identifies goals, objectives, and actions.

In Task 2.3, a detailed review of relevant Regional Hazard Mitigation Plans is completed to address and identify efforts done on a local scale.

3.1.4.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact; Hazard Identification; Partnership/Funding

Stakeholder and/or Community Feedback: The Risk Management Coordinating Council is the coordinating body for 322 Plan updates and holds annual meetings concerning the content and status of the plan. The Council includes state agencies that are key stakeholders and solicits feedback, provides updated data and specific recommendations relevant to the plan. The public was invited to comment at the beginning of the plan update process and invited again to comment on the draft update prior to submission to FEMA for review.

3.1.5 North Carolina Natural and Working Lands Action Plan

(<https://files.nc.gov/ncdeq/climate-change/natural-working-lands/NWL-Action-Plan-FINAL---Copy.pdf>)

3.1.5.1 Background

The North Carolina Natural and Working Lands Action Plan (“NWL Action Plan”) was released in June 2020. The plan was a summary of the North Carolina Natural and Working Lands Action Plan included in the 2020 Climate Risk Assessment and Resilience Plan and the plan in its entirety is considered a part of the North Carolina Resilience Strategy. It is listed as a standalone source for this literature review. Overall, the efforts and recommendations in the NWL Action Plan demonstrate the opportunity for nature-based solutions to advance flood resilience. Various priority recommendations within the NWL Action Plan relate to flooding, for example, the transformative recommendation to “protect and restore forests and wetlands within flood prone areas” and priority recommendations for floodplains, wetlands, and coastal habitats broadly.

3.1.5.2 Summary of Efforts

The purpose of the NWL Action Plan is to find and create opportunities and outline specific projects for North Carolina’s natural and working lands that sequester carbon, build ecosystem and community resilience, provide ecosystem benefits, and enhance our economy. The plan is intended for various stakeholders including public and private landowners; universities; NGOs (non-government organizations); federal, state, and local planners; and policymakers to collectively work towards the presented goals. The NWL Action Plan addresses the following issues:

- Define the stakeholders’ shared goals developed for the NWL Action Plan.
- Present the current state of our NWL.
- Quantify the potential impact of various actions.
- Recommend specific actions that facilitate meeting the shared goals.
- Identify implementation pathways, partners, and funding to facilitate taking action.
- Discuss roadblocks currently preventing the use of certain action pathways, and
- Encourage working on broad policy initiatives that would greatly enhance meeting our goals.

The NWL Action Plan shows some long-term, high-impact and short-term and cost-effective actions. The recommendations presented are clustered in the following areas: Transformative Recommendations and Recommendations for Forest Lands, Floodplains and Wetlands, Pocosins, Coastal Habitats, Urban Lands, and Agriculture. The Plan is intended to be a living document with periodic changes and status updates.

3.1.5.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact

Data or Modeling. One transformative recommendation listed in the NWL Action Plan is to “build a natural and working lands solutions toolbox (p. 26).” To contextualize this recommendation, the NWL Action Plan lists tools, datasets, and models that currently exist or are underway (as of the publish date in 2020); many are relevant for NC Flood Resiliency Blueprint as included below.

- [Green Growth Toolbox](#) developed by built by the North Carolina Wildlife Resources Commission and partners.
- The DCM produced the [NC Coastal Community Resiliency Guide](#).
- The US EPA contacted North Carolina about developing a state-specific version of its [Adaptation Resource Center \(ARC-X\)](#) interactive resource. Arc-X currently offers a regional scale.
- The [Coastal Resilience Evaluation and Siting Tool](#) and [Regional Coastal Resilience Assessments](#) were developed by the National Fish and Wildlife Foundation, in partnership with the National Oceanic and Atmospheric Administration (NOAA), the US Army Corps of Engineers, University of North Carolina Asheville’s National Environmental Modeling and Analysis Center, and NatureServe.
- Duke University’s Nicholas Institute for Environmental Policy Solutions launched two new tools in 2023: the [Conservation Prioritization Tool](#) and the [Benefits Calculator](#). These join a growing suite of tools, including three dashboards launched in 2022: the [Overview Dashboard](#), [Conservation Dashboard](#), and [Carbon Dashboard](#).
- Duke University’s Nicholas Institute for Environmental Policy Solutions also completed spatial modeling. More information can be found here, and the dataset is accessible at [Data from: Coastal protection and blue carbon mapping for six mid-Atlantic states](#).⁵
- Datasets accessible at [Data from: Opportunity assessment for carbon and resilience benefits on natural and working lands in North Carolina](#)⁶ were used to estimate potential recommendations featured in the NWL Action Plan.
- The Nature Conservancy (TNC) developed a [Coastal Resilience decision-support tool](#) to make best available local data on coastal hazards more accessible and a [Natural Solutions Toolkit](#) made up of spatial decision-making tools and web apps to support and drive conservation.
- United States Geological Survey (USGS) South Atlantic Water Science Center has completed a 3-year study called the [Coastal Carolinas Focus Area Study](#).
- The [North Carolina Wildlife Habitat Threat Data Viewer and Analysis Tool](#) is a decision-making that combines threat projections and allows the user to explore various scenarios.

⁵ Warnell, K., & Olander, L. (2020). Data from: Coastal protection and blue carbon mapping for six mid-Atlantic states. Duke Research Data Repository. <https://doi.org/10.7924/r4pg1qw8p>.

⁶ Warnell, K., & Olander, L. (2020). Data from: Opportunity assessment for carbon and resilience benefits on natural and working lands in North. Carolina. Duke Research Data Repository. <https://doi.org/10.7924/r4ww7cd91>.

- The American Farmland Trust developed the [Carbon Reduction Potential Evaluation \(CaRPE\) Tool](#) and has offered to collaborate with North Carolina to create “spatially explicit data” at state and county scales using the CaRPE Tool™.
- The [Tool for Environmental, Agricultural and Military reporting](#) developed by the North Carolina Department of Agriculture and Consumer Services is an example of a toolkit that ultimately provides actionable and concrete implementation measures paired with funding sources and technical assistance.

Decision Support Tool Example: TNC’s [Coastal Resilience decision-support tool](#) has an international scope with a North Carolina scale option.

3.1.6 North Carolina Coastal Habitat Protection Plan: 2016 Source Document

(<https://deq.nc.gov/marine-fisheries/coastal-habitat-protection-plan/2016-chpp-source-document/open>)

3.1.6.1 Background

The North Carolina Coastal Habitat Protection Plan (CHPP) was developed in response to the Fisheries Reform Act (FRA) that the Governor signed into law in 1997. With pressures from coastal development, North Carolina’s estuaries had suffered from water quality degradation, major fish kills, and habitat loss. The Department of Environment and Natural Resources, now the Department of Environmental Quality (NCDEQ), was tasked with developing the CHPP to identify threats to North Carolina’s coastal fishery habitats and to provide implementable management actions to protect and restore these critical resources. The first CHPP plan was drafted in 2004 and approved by the Coastal Resources (CRC), the Environmental Management Commission (EMC), and the Marine Fisheries (MFC) regulatory commissions. Implementation was a key desired outcome of the CHPP, and following its adoption, each division and department also established a bi-annual implementation plan for components within their purview. The CHPP provides a critical ecosystem perspective to be incorporated in flood resilience efforts, particularly pertinent for nature-based solution approaches and efforts.

3.1.6.2 Summary of Efforts

The 2016 CHPP is an update to the 2015 plan and maintains the same four overarching goals to protect coastal habitats in North Carolina: (1) Improve effectiveness of existing rules and programs protecting coastal habitats, (2) Identify and delineate strategic coastal habitats, (3) Enhance coastal habitat and protect it from physical impacts, and (4) Enhance and protect water quality. The CHPP has three parts.

1. Part 1: Provides information on coastal habitats, including their description, distribution, ecological role, status, and trends.
2. Part 2: Discusses the existing and potential threats to habitats, including those related to physical disturbances, hydrological alterations, water quality degradation, and other stressors.
3. Part 3: Outlines existing habitat protection, restoration, and enhancement efforts. The section also discusses ecosystem management and habitat area assessments.

3.1.6.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact

Stakeholder and/or Community Feedback: The 2016 CHPP was developed with robust input from the public. Outreach and engagement efforts included an online survey that garnered 817 responses from residents in 55 counties. Several public meetings were held, and public comments were also received at MFC, CRC, EMC, and CSC (CHPP Steering Committee) meetings.

3.1.7 North Carolina Coastal Habitat Protection Plan: 2021 Amendment

(<https://deq.nc.gov/media/26810/open>)

3.1.7.1 Background

The need for a coastwide habitat plan(s) originated in the 1990s when fish populations, habitat, and water quality concerns were becoming increasingly clear. Developing Coastal Habitat Protection Plans (CHPPs) were required in the Fisheries Reform Act of 1997 (FRA; G.S. 143B-279.8). The legislative goal of the CHPP is the long-term enhancement of coastal fisheries associated with coastal habitats. The law specifies that the CHPP finds threats and recommends management actions to protect and restore coastal habitats critical to NC's coastal fishery resources. Building on the 2016 CHPP Source Document, the 2021 Amendment further emphasizes nature-based solution implementation to protect and restore wetlands, acknowledging flood control benefits.

3.1.7.2 Summary of Efforts

The CHPP has four fundamental goals to protect coastal habitats in North Carolina: (1) Improve effectiveness of existing rules and programs protecting coastal habitats, (2) Identify and delineate strategic coastal habitats, (3) Enhance coastal habitat and protect it from physical impacts, and (4) Enhance and protect water quality. The CHPP was previously updated in 2016. To simplify the CHPP process in 2021, the CSC chose to develop an amendment to the 2016 CHPP Source Document and selected five priority issues to pursue:

1. Submerged Aquatic Vegetation protection and restoration through water quality improvements.
2. Wetland protection and restoration through Nature-based Solutions.
3. Environmental rule compliance to protect coastal habitats.
4. Wastewater infrastructure solutions for water quality improvement.
5. Coastal habitat mapping and monitoring to assess status and trends.

For each priority issue area, the CHPP supplies background information, proposed strategies, and details recommended actions. The CHPP also outlines implementation progress on the earlier priority habitat issues found in the 2016 CHPP: Oyster Reef Habitat Restoration, Encourage Use of Living Shorelines, Sedimentation in Estuarine Creeks, and Generating Metrics on Management Success and Habitat Trends, along with progress on other coastal habitat protection plan recommendations.

3.1.7.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact

Stakeholder and/or Community Feedback: Appendix A of the CHPP is the North Carolina Coastal Federation and the Pew Charitable Trusts Stakeholder Workgroup Report, which summarizes Findings, Conclusions, and Recommendations by the independent stakeholder workgroup met by the

North Carolina Coastal Federation and The Pew Charitable Trusts during development of the 2021 amendment to the NC CHPP. Additionally, a public comment period on the draft plan occurred from September 21 to October 21, 2021. Comments were received at five MFC Advisory Committee meetings held virtually in October, an online survey, and mailed and emailed comments. Additionally, the draft NC CHPP Amendment Public Comment survey asked for feedback from 93 individuals. NCDEQ also received two petitions in staunch support of the CHPP amendment and action implementation from NC Audubon (461 signatures) and NC Conservation Network (796 signatures), in addition to 40 letters via email about the amendment. Of these, 33 were letters of support. Appendix B of the CHPP summarizes public comments.

3.1.8 Hurricane Matthew Resilient Redevelopment Plans

(<https://www.rebuild.nc.gov/resiliency/hurricane-matthew-resilient-redevelopment-plans>)

3.1.8.1 Background

Following Hurricane Matthew in 2016, the Disaster Recovery Act of 2016 directed NCEM to lead efforts resulting in a resilient redevelopment plan for all fifty counties included in the Presidential Disaster Declaration. Counties included in the Presidential Disaster Declaration and direct links to associated county plans are included in the list below.

- [Anson County](#)
- [Beaufort County](#)
- [Bertie County](#)
- [Bladen County](#)
- [Brunswick County](#)
- [Camden County](#)
- [Carteret County](#)
- [Chatham County](#)
- [Chowan County](#)
- [Columbus County](#)
- [Craven County](#)
- [Cumberland County](#)
- [Currituck County](#)
- [Dare County](#)
- [Duplin County](#)
- [Edgecombe County](#)
- [Franklin County](#)
- [Gates County](#)
- [Greene County](#)
- [Halifax County](#)
- [Harnett County](#)
- [Hertford County](#)
- [Hoke County](#)
- [Hyde County](#)
- [Johnston County](#)
- [Jones County](#)
- [Lee County](#)
- [Lenoir County](#)
- [Martin County](#)
- [Montgomery County](#)
- [Moore County](#)
- [Nash County](#)
- [New Hanover County](#)
- [Northampton County](#)
- [Onslow County](#)
- [Pamlico County](#)
- [Pasquotank County](#)
- [Pender County](#)
- [Perquimans County](#)
- [Pitt County](#)
- [Richmond County](#)
- [Robeson County](#)
- [Sampson County](#)
- [Scotland County](#)
- [Tyrrell County](#)
- [Wake County](#)
- [Warren County](#)
- [Washington County](#)
- [Wayne County](#)
- [Wilson County](#)

In 2017, NCEM also facilitated the development of regional resilient redevelopment plans for four "prosperity zones" as identified by the North Carolina Department of Commerce. The four regional plans are listed below.

- [Hurricane Matthew Resilient Redevelopment Plan – North Central Region](#)
- [Hurricane Matthew Resilient Redevelopment Plan – Northeast Region](#)
- [Hurricane Matthew Resilient Redevelopment Plan – Southeast Region](#)
- [Hurricane Matthew Resilient Redevelopment Plan – Sandhills Region](#)

Each County and Regional Resilient Redevelopment Plan provides a summary of Hurricane Matthew Storm Damage for the jurisdiction caused by extensive rainfall and subsequent flooding from the slow-moving, Category 3 hurricane.

3.1.8.2 Summary of Efforts

These summary documents supply a snapshot of the current needs of the counties found in these regions on holistic recovery and redevelopment.

The four regional plans supply a profile of the region; overview of impact from Hurricane Matthew; and list possible regionally scaled strategies for resilience related to economic development, infrastructure, and the environment.

3.1.8.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact; Hazard Identification

Data or Modeling: Data profiles and storm impact data included in the regional and county plans may be helpful starting points for data considerations in NC Flood Resiliency Blueprint for previous storm events. Datasets and sources referenced in the storm impact sections include total rainfall depth, documented stream gage data from the USGS, coastal/tidal station records from USGS and NOAA, and Individual Assistance claims and Public Assistance claims from FEMA.

3.1.9 Action Plan for Nature-Based Stormwater Strategies: Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina (March 2021)

(<https://www.nccoast.org/project/nbss/>)

3.1.9.1 Background

The Action Plan for Nature-Based Stormwater Strategies, published in March of 2021, was created by the North Carolina Coastal Federation and funded through The Pew Charitable Trust to determine nature-based solutions that would assist in the mitigation of flooding caused by stormwater.

3.1.9.2 Summary of Efforts

The Action Plan breaks efforts down across four work groups made up of individuals serving North Carolina through various governmental and contractor positions. These work groups were tasked with determining a set of recommendations for mitigating flooding caused by stormwater, that served across all groups. The works groups were also tasked with creating a set of individual recommendations for mitigating stormwater flooding that centered on the focus of the work group. These work groups were titled the New Development Work Group, Roadways Work Group, Stormwater Retrofit of Existing Land Use Work Group, and the Working Lands Work Group. Each work groups decision frame was guided by six principles that served as base agreements and understandings to build nature-based solution suggestions from. Using these principles, a list of major impediments was discovered, and were used to determine a set of recommendations that could serve on a state, local, and project-specific level. Critical first steps were identified and shared alongside the recommendations as action items for the North Carolina Coastal Federation to encourage the Pew Charitable Trust and the stakeholders to work on and encourage.

3.1.9.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact; Hazard Identification

Stakeholder and/or Community Feedback: In May 2023, the North Carolina Coastal Federation, Pew Charitable Trusts, the N.C. Office of Recovery and Resiliency, N.C. Department of Administration, Governor Roy Cooper’s office, and 50 members of the Work Groups came together to discuss and understand how nature-based solution application functioned under Executive Order 266.

3.2 Technical Reports and Memos

3.2.1 North Carolina Climate Science Report

(https://ncics.org/wp-content/uploads/2020/06/NC_Climate_Science_Report_FullReport_Final_revised_May2020.pdf)

3.2.1.1 Background

The 2020 North Carolina Climate Science Report (NCCSR) supplies a rigorous, comprehensive, peer reviewed assessment of the weather and climate future of North Carolina. The NCCSR was developed by North Carolina-based climate experts with review by an expert panel from state and federal research and science positions along with a rigorous peer review process. It is informed by the latest climate science produced at the federal and international level, including the U.S. Fourth National Climate Assessment, the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, and details included in the North Carolina State Summary. The 2020 North Carolina Climate Science Report summary and findings are included within the 2020 Climate Risk Assessment and Resilience Plan and is considered a part of the North Carolina Resilience Strategy. It is listed as a standalone source for this literature review. The NCCSR outlines the likelihood of various flood-related climate patterns and conditions in North Carolina due to climate change.

3.2.1.2 Summary of Efforts

The NCCSR presents key findings of observed changes in the past climate of North Carolina and projected changes and associated likelihood for the states’ climate future through the end of the century. Analyses included are informed on vetted, well-established observational and modeling datasets, climate assessments at the nationwide and global scale, and peer-reviewed scientific literature, among others. Key findings for observed and projected changes are presented for and organized into the following categories: temperature, precipitation, sea level, hurricanes, storms, floods, droughts, and wildfire, other compound events, and engineering design standards. The NCCSR offers findings for the state and regionally specific findings for the Western Mountains, the Piedmont, and the Coastal Plain. An overview of findings can be found in the NCCSR [Report Findings and Executive Summary](#).

3.2.1.3 Key Components of Existing Work

Primary TAG: Hazard Identification

Supporting TAG(s): Vulnerability/Risk/Impact

Data or Modeling: Data and projections included in NCCSR are the most recent and robust climate science for the state of North Carolina. This science should ground all materials and be included in NC

Flood Resiliency Blueprint. Findings that will result in more frequent or intense flooding and impacts are highly relevant and are listed below.

- It is **likely** that annual total precipitation for North Carolina will increase.
- It is **very likely** that extreme precipitation frequency and intensity in North Carolina will increase due to increases in atmospheric water vapor content.
- It is **virtually certain** that sea level along the North Carolina coast will continue to rise due to expansion of ocean water from warming and melting of ice on land, such as the Greenland and Antarctic ice sheets.
- Heavy precipitation accompanying hurricanes that pass near or over North Carolina is **very likely** to increase, which would in turn increase the potential for freshwater flooding in the state.
- It is **likely** that the frequency of severe thunderstorms in North Carolina will increase.
- It is **likely** that total snowfall and the number of heavy snowstorms in North Carolina will decrease due to increasing winter temperatures.
- It is **virtually certain** that rising sea level and increasing intensity of coastal storms, especially hurricanes, will lead to an increase in storm surge flooding in coastal North Carolina.
- It is **likely** that increases in extreme precipitation will lead to increases in inland flooding in North Carolina.

Finally, the need for enhanced engineering design standards for buildings and infrastructure statewide to keep pace with the changing climate and expected impacts will grow by mid-century.

3.3 State Laws and Policies

3.3.1 North Carolina Executive Order 80: North Carolina’s Commitment to Address Climate Change and Transition to a Clean Energy Economy

(<https://governor.nc.gov/media/967/open>)

3.3.1.1 Background

Signed by Governor Roy Cooper on October 29, Executive Order 80 (EO80) drives statewide action for collective, interagency efforts to address and enact climate change adaptation and mitigation. Adaptation to flooding and flood-related impacts are a key facet of climate change adaptation within North Carolina.

3.3.1.2 Summary of Efforts

EO80 directs the creation of the North Carolina Climate Change Interagency Council and the North Carolina Climate Risk Assessment and Resilience Plan. EO 80 directs the state to carry out the following goals by 2025 : (1) reduce statewide greenhouse gas emissions to 40% below 2005 levels, (2) increase the number of registered, zero-emission vehicles (ZEVs) to at least 80,000, and (3) reduce energy consumption per square foot in state-owned buildings by at least 40% from fiscal year 2002-2003 levels. Several agencies received specific charges and all cabinet agencies received general directives related to the goals.

3.3.1.3 Key Components of Existing Work

Primary TAG: Governance

Supporting TAG(s): Partnerships/Funding

EO 80 is a foundational source to understand the state landscape for climate action and framework for annual agency progress reports submitted to the Governor. Statewide progress made towards achieving the goals in EO80 as of February 2022 are detailed in [Executive Order 80: 2022 Status Report](#).

3.3.2 North Carolina Executive Order 246: North Carolina’s Transformation to a Clean, Equitable Economy

(<https://governor.nc.gov/media/2907/open>)

3.3.2.1 Background

Signed by Governor Roy Cooper on January 7, 2022, Executive Order 246 (EO246) builds on EO80 to advance the state’s pathway towards greenhouse gas (GHG) reductions, with an emphasis on environmental justice and job creation. Environmental justice is a critical component of building statewide flood resilience.

3.3.2.2 Summary of Efforts

EO246 outlines the following goals that North Carolina will strive to carry out: (1) reduce statewide GHG emissions to at least 50 percent below 2005 levels by 2030 and achieve net-zero emissions as soon as possible, no later than 2050; and (2) increase the total number of registered, zero-emission vehicles (ZEVs) to at least 1,250,000 by 2030 and increase the sale of ZEVs so that 50 percent of in-state sales of new vehicles are zero-emission by 2030. EO246 stipulates more specific directives.

3.3.2.3 Key Components of Existing Work

Primary TAG: Governance

Supporting TAG(s): Partnerships/Funding

Environmental Justice: “Section 2. Environmental Justice and Equity” encourages all agencies, departments, and other entities to consider equity and environmental justice. “Section 9. Community Input on Environmental Justice” describes the process by which the state will request public input on furthering executive action related to equity and environmental justice.

3.3.3 NCDOT Resilience Policy (NCDOT Policy F.35.0102)

(<https://www.ncdot.gov/initiatives-policies/Transportation/transportation-resilience/Documents/ncdot-resilience-policy.pdf>)

3.3.3.1 Background

The NCDOT Resilience Policy is a formalized outcome of directives included in state and federal guidance (including Governor Cooper’s EO80) to incorporate resilience into all agency functions and operations, cultivating “organization-wide resilience.” NCDOT adopted the policy in 2021. The Policy references the Department’s goal to “manage risks and strengthen transportation resilience, considering both natural and man-made hazards.” The NCDOT Resiliency Strategy Report identifies flooding as one key hazard.

3.3.3.2 Summary of Efforts

NCDOT will enhance state-wide transportation system resilience in the following ways (1) act based on the most up-to-date science, (2) implement risk-based asset management and design approaches to identify threats and assess vulnerabilities, (3) incorporate better planning to reduce disaster losses,

and (4) include processes to avoid or minimize consequences to transportation assets and the people of North Carolina Strategy. The policy will be implemented through plans, programs, and project development with progress reported annually through the NCDOT Resilience Strategy Report.

3.3.3.3 Key Components of Existing Work

Primary TAG: Governance

NCDOT Resilience Policy is a foundational source driving resiliency action in NCDOT efforts.

3.4 Research Projects and Studies

3.4.1 Collaboratory Flood Resiliency Study

(<https://collaboratory.unc.edu/wp-content/uploads/sites/476/2021/06/flood-resiliency-report.pdf>)

3.4.1.1 Background

In September 2019, the North Carolina General Assembly passed Senate Bill 429, the “Disaster Recovery Act,” (Session Law 2019- 224) into law. Among its many provisions the bill appropriated \$2,000,000 to the North Carolina Policy Collaboratory to conduct research related to flood resiliency in eastern North Carolina. The legislation called for submittal of the final report by December of 2020.

3.4.1.2 Summary of Efforts

A research team formed of experts in a wide range of fields was developed to evaluate flood resiliency from a comprehensive perspective. The flood resiliency study focused on five specific focal topics:

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

The study was a collaboration of many projects and researchers from the University of North Carolina at Chapel Hill and North Carolina State University as partner universities. The various lenses through which inland flood resiliency was analyzed coalesced into the shared goals of keeping North Carolinians healthy and safe, and improving the state’s planning for, and response to, flood and storm events. Using research designed by leading experts, the study’s goal was to generate the latest information to inform decisions around flooding and storms. Identified information users included governments, non-governmental organizations, private organizations, and individuals.

Buyouts: State and local governments have adopted various mechanisms to fund buyouts, including bonds, stormwater management fees, grants, and sales taxes. The study found 34 total funding programs, nationwide. Many of these funding tools aim to promote autonomy from federal mitigation programs, and ultimately, faster buyout processes. Local governments seldom keep any accounting of their total expenditures on buyouts costs beyond the direct cost of acquiring homes. The absence of cost data inhibits targeted policy reform and adoption of best practices. More detailed and standardized data collection and reporting can inform more impactful and equitable buyout policy, as well as more efficient use of public resources. Continued private sector involvement, e.g., in the financing or management of buyouts, could lead to cost savings and a more efficient buyout process. By distributing investment risks outside the public sector, it may be possible to re-structure programs

in a manner that achieves hazard mitigation goals and better aligns stakeholder interests. Attention must be paid to oversight and equity implications. Many communities that have implemented buyouts concurrently allow (or even facilitate) more development in their floodplains, thus countering any reduction in vulnerability to flooding stemming from the buyout. Historical data on buyouts are unreliable and difficult to use. New data management structures need to be developed to accurately keep buyout records for any policy analysis or evaluation purposes.

3.4.1.3 Key Components of Existing Work

Primary TAG: Resilience/Mitigation/Reduction

Supporting TAG(s): Vulnerability/Risk/Impact

Data or Modeling: Key data findings can supply important context. For example, high level findings include: 100 electric generators and hundreds of electrical substations in the aerial footprint of severe flooding, up to 1.5 feet water level reduction is possible with natural infrastructure implementation, and there is a 12-14% potential reduction in structural damage by using natural infrastructure measures. Understanding the geospatial components of these findings and more will help to understand more nuances of flood risk and opportunities for enhancing flood resilience.

Decision Support Tool Example: The Collaboratory Flood Resiliency Study names a suite of actions within the Implementation Plan. Additionally, findings throughout the flood resiliency studies may be instrumental in shaping assumptions to be included in the Decision Support Tool.

3.4.2 Growing Safely or Building Risk? Floodplain Management in North Carolina

(<https://www.tandfonline.com/doi/full/10.1080/01944363.2022.2141821>)

3.4.2.1 Background

This study was conducted out of the University of North Carolina at Chapel Hill and published in *The Journal of the American Planning Association* in 2023. The goal of the study was to determine whether communities that allowed or did not have restrictions against building new structure in floodplains had more severe costs of damages following a flooding event compared to communities that had less development in their floodplains. The study investigates if “communities with the most advanced floodplain management programs also experienced the most floodplain development.” The researchers looked to compare the effectiveness of putting restrictions on developing in a floodplain versus waiting to buy the land back after catastrophic events have rendered the structures useless. There is information showing that less development in floodplains leads to less cost of damages in the future, however the number of populations exposed to flood risk has increased over time, even with preventative measures. Findings also show that many flood risk mitigation techniques disproportionately benefit white and or/ wealthier communities through the Community Rating System (CRS) point program and federal buyouts programs. These same programs are also theorized to have adverse reactions compared to their intended use, where communities can use the benefits created by these plans to build more structures in their floodplains.

3.4.2.2 Summary of Efforts

The three research questions driving this study include:

1. How much development has occurred in North Carolina’s floodplains in the past two decades?

2. How does floodplain development relate to number of buyouts, participation in the CRS, and other community socioeconomic and geographic characteristics?
3. Based on current zoning, what is the potential for future floodplain development across the state?

The study found that on average, for every property that was bought out between 1996 and 2017, over 10 new residential structures were built in floodplains. Communities that experience lower levels of buyouts also had statistically higher numbers of new properties built, with a good portion of these properties being \$200,000 or higher value homes. It was also found that the percentages of properties being sold in floodplains also increased over the same year period, regardless of other resiliency planning communities have for floodplain management. The study did not find a statistically significant relationship between communities with high involvement with the CRS program and an increase in structures in their floodplain, which goes against their hypothesis. Overall, this was a study done to try and determine the amount of floodplain development that is currently occurring in North Carolina, or has occurred in the last 20 years, and whether or not there is a statistically significant relationship between floodplain development and other flood mitigation techniques and their positive or negative effects on aid.

3.4.2.3 Key Components of Existing Work

Primary TAG: Vulnerability/Risk/Impact

Supporting TAG(s): Resilience/Mitigation/Reduction

Data or Modeling: Use existing data from this study and other public data locations listed in the article, to help determine effective plans of action when creating or editing community mitigation plans. Review the CRS program and determine if there is a way the NC Flood Resiliency Blueprint can supplement the action items that the CRS point program tries to attain, while also working to fill any gaps.

Environmental Justice: Findings related to the study's second research question, focused on the relationship between floodplain development and number of buyouts, CRS participation, and other community socioeconomic and geographic characteristics can help inform and shape nuanced understandings of socioeconomic underpinnings of mitigation strategy offerings. For example, as stated in the article, "nationwide, buyouts are more common among wealthier and whiter communities" (Elliot et. al., 2020; Mach et al., 2019). Understanding who may be more likely to be offered a buyout, for example, or who may be disproportionately less likely to be approached for mitigation strategies is important as the NC Flood Resiliency Blueprint Decision Support Tool is developed. With this information, decision-making prompts and tools can be designed with fair and equitable access to mitigation strategies. For example, North Carolina buyouts are more broadly equitable than other states partly because the state has typically picked up the non-Federal match (25%) on Hazard Mitigation Grant Program-funded acquisitions.

3.5 Programs

3.5.1 Regions Innovating for Strong Economies and Environment Program

([RISE and Environment Program](#) | [ReBuild NC](#))

3.5.1.1 Background

Regions Innovating for Strong Economies and Environment (RISE) is developed by a partnership between NCORR (North Carolina Office of Resilience and Recovery) and the NC Rural Center. RISE aims to support resilience primarily in the storm-impacted regions of North Carolina. RISE is promoting Statewide Resiliency by supplying support and tools to regional partners. RISE supports resilience efforts in eastern North Carolina regions that have been affected by recent storms, including those that have experienced flood impacts.

3.5.1.2 Summary of Efforts

RISE is a multi-phase effort that includes a forward-looking vulnerability assessment, the identification of 5 to 10 high-priority projects and a list of the actions needed to implement each proposed project. A diverse stakeholder partnership is guiding the project to ensure that the scope of work reflects local priorities. RISE Project aims to support resilience primarily in the storm-impacted regions of Eastern North Carolina in three primary ways:

1. RISE will be supplying coaching and technical assistance to regional partners to support community vulnerability assessments, find priority actions to reduce risk and enhance resilience in their region, and develop paths to implementation.
2. Developing the North Carolina Resilient Communities Guide, as a statewide resource that supplies tools, guidance and opportunities for building community resiliency.
3. Hosting regional leadership training workshops that emphasize resilience as a tool for community economic development.

3.5.1.2.1 Phase 1: Community Engagement & Risk/Vulnerability Assessment

The first phase of the project includes performing a risk and vulnerability assessment, developing a community action team, and engaging with the public. This analysis brings together science and local knowledge to paint a picture of hazards in the region and how they may change in the future.

3.5.1.2.2 Phase 2: Planning, Project Identification, & Prioritization

Phase 2 of the program involves a community- and data-driven process to find priority actions that can be taken to adapt to short- and long-term hazards. This phase of the project includes the development of a portfolio of several projects that have regional benefits for resilience. Proposed projects could include construction projects, nature-based solutions, outreach and capacity building activities, or planning and policy developments. The regional benefit could come in many forms, such as reducing downstream flooding, offering a resource to multiple local governments, or crafting a pilot project that may be replicated in other places. A critical part of developing the portfolio is finding achievable paths to implementation, including funding sources and capacity considerations. The region will have the opportunity to select a project for seed funding from the Duke Energy Foundation RISE Accelerator Grant Program.

3.5.1.2.3 Phase 3: Engineering & Design

Phase 3 is the engineering, design, and permitting of the prioritized projects. A critical part of developing the portfolio is finding achievable paths to implementation, including funding sources and capacity considerations. Grants will be available for communities who successfully completed Phases 1 and 2 to develop projects that are shovel ready.

3.5.1.2.4 Phase 4: Project Implementation

Phase 4 grants will be available for communities who successfully completed Phases 1, 2, and 3 for implementation of a shovel-ready project(s) and must include a natural or nature-based part.

There will be two final products: A vulnerability assessment that stands alone but is also right for integration into regional and local plans, grant applications, public presentations, and other planning tools; and the regional resilience portfolio, which will include goals, a summary of the vulnerability assessment, selected priority projects, and the implementation plans for the priority projects.

RISE is building a foundation for a more resilient future in North Carolina. At the end of the program, 200 emergent leaders in Eastern North Carolina will have the tools to incorporate resilience in community and economic development. Communities statewide will be able to use the North Carolina Resilient Communities Guide to enhance their resilience, and storm-impacted regions will be prepared to implement priority resilience activities. These activities will support existing efforts such as regional hazard mitigation planning and strategizing for comprehensive economic development. Over time, and as ability increases with staff and funding, the NC Resilient Communities Program expects to supply opportunities across North Carolina.

The Duke Energy Foundation has committed \$600,000 in grant funding to support the RISE Regional Resilience Portfolio Program through accelerator grants. The grants are being made available to support the implementation of priority projects found in each RISE region's portfolio.

The grant program will allow each region to kick-start all or part of a project. The project and applicant eligibility will be evaluated by a committee of representatives from the Duke Energy Foundation and NCORR. The goal is to fund at least one project in each RISE region, but funding isn't guaranteed in each region. The state is helping to fund the RISE program.

RISE is funded by a \$1.1 million U.S. Economic Development Administration grant, with support from both NCORR and the NC Rural Center.

3.5.1.3 Key Components of Existing Work

Primary TAG: Partnerships/Funding

Supporting TAG(s): Resilience/Mitigation/Reduction

Stakeholder and/or Community Feedback: Input from stakeholders is a critical part of the development of the North Carolina Resilient Communities Guide and Regional Resilience Portfolio Program. Project teams will use a breadth of stakeholder engagement methods to understand the pressing issues. These include a steering committee, focus groups by invitation, effective inclusion of other representatives, surveys, and open feedback on specific items to a wider audience.

Environmental Justice: The program illustrates the importance of educating communities about historical racial inequity and its impact on equitable economic development. Achieving equity is an issue for urban, suburban and rural areas. Both economic development and equity are interconnected and necessary to achieve meaningful and effective communitywide resilience. RISE strives to center environmental justice and all kinds of diversity as integral components in leadership training, guidebook development, and regional portfolio creation.

RISE looks to ensure that rural communities, communities of color, and low-income communities equitably share the benefits of the program and projects that are developed because of RISE. A fundamental principle that guides RISE's work is that everyone should have the same degree of environmental protection and equal access to the decision-making process of this program.

3.5.2 North Carolina Resilient Coastal Communities Program

([NC Resilient Coastal Communities Program | NC DEQ](#))

3.5.2.1 Background

The NC Resilient Coastal Communities Program (RCCP) supplies financial grants and technical assistance to support a proactive, locally driven, and equitable approach to coastal resilience planning and project implementation. RCCP was developed to address the devastating impacts that flooding and other coastal hazards have on economies and livelihoods in eastern North Carolina, exacerbated by climate change and development pressures.

3.5.2.2 Summary of Efforts

The NC Resilient Coastal Communities Program aims to facilitate a community-driven process for setting coastal resilience goals, assessing existing and needed local capacity, and identifying and prioritizing projects to enhance community resilience to coastal hazards. Participating communities will walk through a framework leading to the development of “shovel-ready” projects. Local governments throughout the 20 coastal counties will be eligible to apply for direct technical help to complete a community engagement process, risk, and vulnerability assessment, and develop a resilience project portfolio.

The four phases of the program include:

- Phase 1: Community Engagement and Risk & Vulnerability Assessment
- Phase 2: Planning, Project Selection, and Prioritization
- Phase 3: Engineering and Design
- Phase 4: Implementation

This initiative, funded through the NC State Legislature and the National Fish and Wildlife Foundation, will supply funding to local governments to help overcome barriers in coastal resilience and adaptation planning, boost local government ability, and support a proactive, sustainable, and equitable approach to coastal resilience planning and project implementation.

3.5.2.3 Key Components of Existing Work

Primary TAG: Partnerships/Funding

Supporting TAG(s): Resilience/Mitigation/Reduction

Stakeholder and/or Community Feedback: RCCP is a potential avenue for NC Flood Resiliency Blueprint introduction to support coastal communities in creating and developing project applications for submission to the program. NC Flood Resiliency Blueprint usage may also be incorporated into technical assistance that DCM provides to coastal communities as requested.

3.6 Data Tools

3.6.1 North Carolina Resilience Clearinghouse

([Climate Resilience Toolkit & Clearinghouse User Research \(usmangroup.com\)](#))

3.6.1.1 Background

In the wake of 2018's devastating Hurricane Florence, North Carolina Governor Roy Cooper set up the (NCORR to lead the state's efforts in rebuilding smarter and stronger. At that time, many eastern North Carolina counties had yet to recover from two storms in two years, which brought flooding and extensive damage to many of the same communities. NCORR, in partnership with the Department of Environmental Quality and several North Carolina environmental nonprofits and universities, has begun a project to develop an online climate resilience clearinghouse for local governments and community leaders.

3.6.1.2 Summary of Efforts

NCORR plans to launch an online Climate Resilience Clearinghouse to address climate-related risks in all communities across the state, especially those that are most vulnerable, as well as provide local governments and community leaders with solutions that mitigate and safeguard against the hazardous effects of climate change.

3.6.1.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Data or Modeling: Leveraging simple, geospatial climate-change resilience maps specific to North Carolina that live on the Clearinghouse site rather than third-party platforms could help curate hyperlocal data specific to North Carolina.

Decision Support Tool Example: When completed, the Clearinghouse will supply key information to inform equitable resilience building.

3.6.2 Resilience Analysis and Planning Tool

(<https://www.fema.gov/node/resilience-analysis-and-planning-tool-rapt>)

3.6.2.1 Background

Developed by FEMA, the Resilience Analysis and Planning Tool (RAPT) is a free geographic information system (GIS) web map that allows federal, state, local, tribal and territorial emergency managers and other community leaders to examine the interplay of census data, infrastructure locations, and hazards, including real-time weather forecasts, historic disasters and estimated annualized frequency of hazard risk.

Flood hazard-specific data includes layers of real-time radar and watch and warning notifications from the National Weather Service (severe weather, excessive rainfall, river flood outlooks etc.), live stream gauges, historical hazard data for hurricanes, flood risk, and future forecast layers of 4 to 6 ft. sea-level rise.

3.6.2.2 Summary of Efforts

RAPT is a combination of over 20 community resilience indicators with correlation analysis. Users can combine layers for analysis and to inform decision making.

3.6.2.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Hazard Identification; Vulnerability/Risk/impact

Data or Modeling: Data included in RAPT, and the RAPT user experience may inform NC Flood Resiliency Blueprint development. RAPT has been linked to other data tools; interconnections and analyses are listed below as added reference materials.

- More information is accessible in the [Resilience Analysis and Planning Tool User Guide \(2022\)](#), [RAPT Resource Center](#), and RAPT Overview and Quick Start.
- RAPT references the Community Resilience Indicator Analysis as its foundational indicator. the [Community Resilience Indicator Analysis: Commonly Used Indicators from Peer-Reviewed research: Updated for Research Published 2003-2021](#). Appendix A of the report compiles more than 90 methodologies FEMA reviewed for the analysis.
- [Integrating DSS-WISE™ Lite Results into RAPT](#) is a 2022 report produced by FEMA that could inform data integration guidance. Decision Support System for Water Infrastructural Security Web, or [DSS-WISE™ Lite](#) is a web-based, automated two-dimensional modeling and mapping capability developed by the National Center for Computational Hydroscience and Engineering, the University of Mississippi. DSS-WISE™ Lite allows users to quickly set up dam-break/ levee-breach flood inundation simulations with minimum user input data.
- [The Climate Risk & Resilience Portal \(ClimRR\)](#) was created by the Center for Climate Resilience and Decision Science at Argonne National Laboratory in partnership with AT&T (American Telephone & Telegraph) and FEMA.

Decision Support Tool Example: RAPT and the incorporation of DSS-WISE™ are examples of decision support tools.

Environmental Justice: RAPT incorporates layers related to equity, including the National Flood Insurance Program policy penetration rates and broadband description.

3.6.3 Environmental Justice Screening and Mapping Tool (EJScreen)

(<https://www.epa.gov/ejscreen>)

3.6.3.1 Background

The Environmental Justice Screening and Mapping Tool (EJScreen) was developed by the EPA. The EPA began to develop the tool in 2010 and it was peer-reviewed in 2014. EJScreen was released publicly in 2015. EJScreen is intended to better meet the Agency's responsibilities related to the protection of public health and the environment in a way consistent with EO 12898 and the goals of EJ 2020, EPA's environmental justice strategic plan. EJScreen includes flood-related data such as Coastal Flood Hazard, 100 Year Floodplain, Sea Level Rise (NOAA), and Flood Risk. The critical value that EJScreen offers is centering environmental justice in flood risk areas to better understand which communities have greatest need.

3.6.3.2 Summary of Efforts

EJScreen uses maps and reports to present various kinds of information: environmental indicators and socioeconomic indicators, which combine to form EJ/supplemental indexes. The 13 EJ and supplemental indexes summarize how an environmental indicator and socioeconomic factors come together in the same location. EJScreen displays data at the census block group scale and makes state-wide, EPA regional, and national comparisons available.

3.6.3.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Vulnerability/Risk/impact; Hazard Identification

Environmental Justice: Designed with environmental justice at the center, EJScreen can be used to identify areas with people of color and/or low-income populations, potential environmental quality issues, a combination of environmental and demographic indicators that is greater than usual, and other factors that may be of interest.

Data or Modeling: The development and technical components of EJScreen may be helpful for NC Flood Resiliency Blueprint and can be found detailed in the [EJScreen Technical Documentation](#) published in October 2022.

Decision Support Tool example: The EPA data displayed, and indices included in EJScreen can be used to support development and decisions related to “educational programs, grant writing, community awareness efforts, and other purposes.”

3.6.4 NOAA Coastal Flood Exposure Mapper

(<https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html>)

3.6.4.1 Background

The Coastal Flood Exposure Mapper was released and continues to be hosted and supported by the NOAA Office for Coastal Management. It was designed in response to feedback expressing the need for visualization tools that display coastal flood hazards, sea level rise, and community assets.

3.6.4.2 Summary of Efforts

This online visualization tool supports communities that are assessing their coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the people, places, and natural resources exposed to coastal flooding. The maps can be saved, downloaded, or shared to communicate flood exposure and potential impacts. In addition, the tool supplies guidance for using these maps to engage community members and stakeholders. A user can “visualize people, places, and natural resources exposed to coastal flood hazards and share online maps to communicate with and engage stakeholders.”

3.6.4.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Vulnerability/Risk/Impact; Hazard Identification

Data or Modeling: Aggregation method for the coastal flooding composite hazard layer may be considered for the NC Flood Resiliency Blueprint Decision Support Tool. The map layer aggregates risk information for multiple coastal flood hazards and shows the gradient of coastal flood risk that ranges from areas outside the FEMA 1% annual chance floodplain that are still at risk from high magnitude, low frequency events like major landfalling hurricanes and tsunamis, to areas nearer the coast that are also at risk from higher frequency flood events, wave impacts, and long-term sea level change. At any given location, the user can query which coastal flood hazards may impact that spot.

3.6.5 NOAA Digital Coast Data Access Viewer

(<https://coast.noaa.gov/dataviewer/#/>)

3.6.5.1 Background

The Data Access Viewer (DAV) was released and continues to be hosted and supported by the NOAA Office for Coastal Management. The layers provided by NOAA's DAV including land cover, elevation, and imagery layers are important components to understand the movement of water during a flood event.

3.6.5.2 Summary of Efforts

The DAV allows a user to search for and download elevation (lidar), imagery, and land cover data for the coastal U.S. and its territories. The data can be customized, requested, and downloaded for free through a checkout interface. An email supplies a link to the customized data, while the original data set is available through a link within the viewer. A user can view image services for each data set, view technical specifications and metadata for each data set, and access data in several projections and datums.

3.6.5.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Hazard Identification

Data or Modeling: Downloadable data layers available through DAV for North Carolina may be considered for the NC Flood Resiliency Blueprint Decision Support Tool.

3.6.6 National Flood Hazard Layer

(<https://www.fema.gov/flood-maps/national-flood-hazard-layer>)

3.6.6.1 Background

The National Flood Hazard Layer (NFHL) is a geospatial database that has current effective flood hazard data. FEMA supplies flood hazard data to support the National Flood Insurance Program. The NFHL is designed to enable individuals and communities to better understand their level of flood risk and type of flooding.

3.6.6.2 Summary of Efforts

The NFHL is formed of effective flood maps and [Letters of Map Change](#) provided to communities. Users can search by address or using the map to find a specific location and print a full Flood Insurance Rate Map (FIRM) or FIRMette where applicable. Users can also download data layers directly from the FEMA Flood Map Service Center for county or state in a GIS file format.

3.6.6.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Hazard Identification; Vulnerability/Risk/Impact

Data or Modeling: As stated above, data layers may be downloaded. Other data and information that may be relevant is included below:

- [Technical References for Flood Risk Analysis and Mapping](#): A collection of technical references considered specifications of a technical nature essential to the success of the program but too granular to be considered standards. These are database, product and documentation

requirements where consistency is needed. There are several standards mandated compliance with Technical References.

- [Draft National Flood Hazard Layer](#): This ArcGIS data viewer displays potential future changes to regulatory flood map information that is not yet effective (and therefore not yet included in the National Flood Hazard Layer).
- [Using the National Flood Hazard Layer Web Map Service in Google Earth](#): Offers information on how to use the KMZ (Keyhole Markup language Zipped) shapefile within Google Earth™.

Decision Support Tool Example: GIS web services are available to integrate the NFHL database into other websites and GIS applications. More information can be found in the [NFHL GIS Services User Guide](#). Information detailed in the Data or Modeling recommendation area may be considered for NC Flood Resiliency Blueprint Decision Support Tool development.

3.6.7 Climate and Economic Justice Screening Tool

(<https://screeningtool.geoplatform.gov/en/about>)

3.6.7.1 Background

The White House Council on Environmental Quality developed and launched the Climate and Economic Justice Screening Tool (CEJST) Version 1.0 in as directed by President Biden’s Executive Order 14008. Federal agencies will use the tool to help show disadvantaged communities that will receive help from programs included in the Justice40 Initiative. The Justice40 Initiative seeks to deliver 40% of the overall benefits of investments in climate, clean energy, and related areas to disadvantaged communities.

Various explicitly flood-related or adjacent datasets are considered within the CEJST methodology, most significantly within the climate change burden category. This burden category includes projected flood risk (sourced from Climate Risk Data Access produced by the First Street Foundation), expected agriculture loss rate, expected building loss rate, and expected population loss rate (the latter three are sourced from the National Risk Index produced by FEMA). Furthermore, a critical value that CEJST offers is, like EJScreen, centering climate and economic justice in viewing flood risk areas to better understand which communities have greatest need.

3.6.7.2 Summary of Efforts

CEJST has an interactive map and uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool uses this information to find disadvantaged communities that are overburdened and underserved. It shows the data at the census tract scale using 2010 census tract boundaries.

3.6.7.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Vulnerability/Risk/Impact; Hazard Identification

Stakeholder and/or Community Feedback: As a federally developed tool, CEJST was widely socialized and highly vetted. CEJST continues to support a Site Satisfaction Survey for public feedback and submissions to improve the Tool in future iterations.

Environmental Justice: Awareness of federal efforts related to equity and environmental justice, such as the CEJST tool and the Justice40 Initiative broadly, is valuable for multiple reasons. The CEJST tool and/or method can inform understanding and identification of overburdened and underserved communities to advance equitable application of mitigation strategies and benefits to areas of highest need. Second, CEJST could inform funding opportunities available for mitigation activities in connection to the Justice40 Initiative and the Biden Administration’s commitment to deliver funds to disadvantaged communities.

Data or Modeling: Data layers included within CEJST are broad ranging in key categories of burden that communities experience. Burdens are ranked using percentiles or have a binary yes/no rank. The data method used in CEJST may be useful in the development of the NC Flood Resiliency Blueprint Decision Support Tool.

Decision Support Tool Example: CEJST determination of “disadvantaged” or “not disadvantaged” at the community scale could help ensure that underserved communities are centrally considered in all stages of state, local, tribal and territorial project design and development and receive the ultimate benefits and outcomes of the project when implemented.

3.6.8 NCDEQ North Carolina Community Mapping System

<https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=1eb0fbe2bcfb4cccb3cc212af8a0b8c8>

3.6.8.1 Background

The Department of Environmental Quality (NCDEQ) developed the NCDEQ North Carolina Community Mapping System (NCCMS) to inform its own decision-making and to increase transparency, knowledge, understanding, and local on issues related to permitting and other environmental information. The NCCMS satisfies two primary goals: (1) to present program information (including permitting and incident tracking), and (2) to provide an environmental justice tool (EJ Tool) that allows all users to understand the sociodemographic and health characteristics of communities across North Carolina. Although no flood data is included in the tool, like CEJST and EJScreen, the NCDEQ NCCMS can be used to understand the geospatial components of other hazards that flooding may further exacerbate in addition to identifying communities with the greatest need.

3.6.8.2 Summary of Efforts

The NCDEQ North Carolina Community Mapping System consolidates various existing datasets into one map for streamlined access to information and for a depiction of the spatial distribution of the data. Examples of the incorporated data include air quality permit sites, animal feed operation permits, contaminated dry-cleaning sites, National Pollutant Discharge Elimination System stormwater permits, and Brownfields Program sites, and Potentially Underserved Block Groups.

3.6.8.3 Key Components of Existing Work

Primary TAG: Tool Development/Acceptance

Supporting TAG: Vulnerability/Risk/Impact; Hazard Identification

Stakeholder and/or Community Feedback: A beta version of the mapping tool was released for testing and community feedback. Community members, academics, advocates, and industry representatives engaged with the beta version and provided more than 100 comments that were incorporated to

improve the NCCMS. The development process also included interviews, focus groups, and meetings with communities and non-governmental organizations. The NCCMS Version 1.0 background document outlines how feedback was addressed and used to improve specific aspects of the tool.

Environmental Justice: The NCCMS includes the Environmental Justice Tool, which incorporates demographic and health data to highlight how the spatial distribution of these factors interact with permitting and other environmental information.

3.7 Concluding Remarks

The first draft of this literature review and data collection inventory was prepared in March 2023. This living document may be updated as reports, plans, studies, and other relevant resources are published and with input from the TAGs. An index with links to all resources reviewed in the literature review are included in the next section and an appendix follows with more adjacent resources for awareness and reference.

4 Appendix

The sources included in the Literature Review and Data Inventory met the resource inclusion criteria and were reviewed and considered against key assessment parameters to focus efforts on resources of highest applicability, relevance, ease of use, and foundational nature to NC Flood Resiliency Blueprint. However, there are many other resources that may be valuable for awareness and reference.

This appendix displays more adjacent resources (organized in analogous categories, with the addition of “webpages” that may hold a collection of other nested materials, tools, studies, etc.).

Title and Link	Year	Lead Agency	Notes (if applicable)
Plans and Strategies			
2019 NC ZEV Plan: A Strategic Plan for Accelerating Electric Vehicle Adoption in North Carolina https://www.ncdot.gov/initiatives-policies/environmental/climate-change/Documents/nc-zev-plan.pdf	2019	NCDOT	N/A
NCDEQ Public Participation Plan https://deq.nc.gov/media/29825/download?attachment	2022	NCDEQ	N/A
NC Statewide Public Involvement Plan https://www.ncdot.gov/projects/public-involvement/Documents/statewide-public-involvement-plan.pdf	2022	NCDOT	N/A
NC Moves 2050 Plan https://www.ncdot.gov/initiatives-policies/Transportation/nc-2050-plan/Documents/nc-moves-final-plan.pdf	2021	NCDOT	N/A
NCDOT Transportation Asset Management Plan https://connect.ncdot.gov/resources/Asset-Management/TAMP/Final%20TAMP%20-%20June%202021.pdf	2019	NCDOT	N/A
North Carolina Statewide Multimodal Freight Plan https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Documents/NCDOT_SWFrTPln_FinalReport_05182022.pdf	2022	NCDOT	N/A

Title and Link	Year	Lead Agency	Notes (if applicable)
Comprehensive State Rail Plan https://connect.ncdot.gov/resources/Rail-Division-Resources/Documents/2015%20Comprehensive%20State%20Rail%20Plan-%20Full%20Report.pdf	2015	NCDOT	N/A
Connecting North Carolinians to Opportunities https://www.ncdot.gov/divisions/integrated-mobility/public-transit-services/statewide-strategic-plan/Documents/december-2018-strategic-plan.pdf	2018	NCDOT	N/A
Statewide Transportation Demand Management (TDM) Strategic Plan Update https://connect.ncdot.gov/business/Transit/Documents/North%20Carolina%20Statewide%20Transportation%20Demand%20Management%20(TDM)%20Strategic%20plan%20Update%20-%20January%202018.pdf	2018	NCDOT	N/A
North Carolina Transportation Network Update https://connect.ncdot.gov/projects/planning/STC%20Documents/StratCorrFramework_NCDOT_Final_150831.pdf	2015	NCDOT	N/A
State Laws and Policies			
Executive Order 266: Updating the North Carolina Uniform Floodplain Management Policy for State Construction https://governor.nc.gov/executive-order-no-266	2022	Gov. Cooper	N/A
Executive Order 271: Growing North Carolina's Zero-Emission Vehicle Market https://governor.nc.gov/executive-order-no-271	2022	Gov. Cooper	N/A
2020 Water/Wastewater Public Enterprise Reform Act (House Bill 1087) https://www.ncleg.gov/BillLookup/2019/H1087	2020	NC General Assembly	N/A

Title and Link	Year	Lead Agency	Notes (if applicable)
Disaster Recovery Act of 2016 https://www.ncleg.net/enactedlegislation/sessionlaws/html/2015-2016/sl2016-124.html	2016	NC General Assembly	N/A
North Carolina Strategic Transportation Corridor Policy https://www.ncdot.gov/initiatives-policies/Transportation/strategic-corridors/Documents/strategic-corridors-prioritization-policy.pdf	2015	NCDOT	N/A
Research Projects and Studies			
Flood Extent Mapping: An Integrated Method Using Deep Learning and Region Growing Using UAV Optical Data https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9324919	2021	Hashemi-Beni & Gebrehiwot (NC A&T)	N/A
The Power of Place in Disaster Recovery: Heritage-based Practice in the Post-Matthew Landscape of Princeville, North Carolina https://escholarship.org/uc/item/5sq9z4n9	2020	Naylor et al. (NCSU)	N/A
Hurricane Flooding and Gastrointestinal Illness in North Carolina https://ehp.niehs.nih.gov/doi/abs/10.1289/isee.2020.virtual.O-OS-650	2020	Quist et al. (UNC-Chapel Hill)	N/A
Assessing the full costs of floodplain buyouts https://link.springer.com/article/10.1007/s10584-021-03178-x	2021	Curran-Groome et al. (UNC-Chapel Hill)	N/A
Natural Infrastructure Practices as Potential Flood Storage and Reduction for Farms and Rural Communities in the North Carolina Coastal Plain https://www.mdpi.com/2071-1050/13/16/9309	2021	Hovis et al. (NCSU)	N/A

Title and Link	Year	Lead Agency	Notes (if applicable)
Uncovering climate (in)justice with an adaptive capacity assessment: A multiple case study in rural coastal North Carolina https://www.sciencedirect.com/science/article/abs/pii/S0264837718313309	2020	Jurjonas et al. (NCSU)	N/A
Assessing the Vulnerability of Coastal Plain Groundwater to Flood Water Intrusion Using High Resolution Mass Spectrometry https://repository.lib.ncsu.edu/bitstream/handle/1840.20/38926/etd.pdf?sequence=1	2021	Hayden Rudd (NCSU)	N/A
Community Resilience-Focused Technical Investigation of the 2016 Lumberton, North Carolina Flood: An Interdisciplinary Approach https://www.nist.gov/publications/community-resilience-focused-technical-investigation-2016-lumberton-north-carolina	2020	van de Lindt et al. (Texas A&M)	N/A
Enhanced Hydrologic Monitoring using Fiber Optics- Implementing Distributed Temperature Sensing to Uncover Flow Paths and Groundwater Interactions in Stormwater Conveyance Structures https://ui.adsabs.harvard.edu/abs/2020AGUFMH202...01D/abstract	2020	DeBell et al. (NCSU)	N/A
A Hidden Markov Tree Model for Flood Extent Mapping in Heavily Vegetated Areas based on High Resolution Aerial Imagery and DEM: A Case Study on Hurricane Matthew Floods https://www.tandfonline.com/doi/abs/10.1080/01431161.2020.1823514	2020	Jiang & Sainju (University of Alabama)	N/A
Modeling Compound Flooding from Hurricane Florence Using ADCIRC https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/656871	2020	Blanton et al. (UNC-Chapel Hill)	N/A

Title and Link	Year	Lead Agency	Notes (if applicable)
Three-Dimensional Inundation Mapping Using UAV Image Segmentation and Digital Surface Model https://www.mdpi.com/2220-9964/10/3/144	2021	Gebrehiwot & Hashemi-Beni (NC A&T)	N/A
Using High Resolution Mass Spectrometry to Evaluate the Impact of Hurricane Florence in 2018 on Water Quality of North Carolina Coastal Aquifers https://ui.adsabs.harvard.edu/abs/2020AGUFMH163.0016R/abstract	2020	Rudd et al. (NCSU)	N/A
Communicating Climate Change in Eastern North Carolina: Rural Attitudes on Extreme Weather and Climate Resilience https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/20483/Rural%20Attitudes%20North%20Carolina_Final.pdf?sequence=1&isAllowed=y	2020	Elizabeth Rowe (Duke University)	N/A
Finding voices in the floods of Freedom Hill: innovating solutions in Princeville, North Carolina https://link.springer.com/article/10.1007/s13412-021-00701-5	2021	Grace-McCaskey et al. (ECSU)	N/A
From abstract futures to concrete experiences: How does political ideology interact with threat perception to affect climate adaptation decisions? https://www.sciencedirect.com/science/article/abs/pii/S1462901120301507	2020	Schwaller et al. (UNC-Chapel Hill)	N/A
Addressing Needs in Observed and Simulated Storm Surge Data for Uncertainty Quantification https://agu.confex.com/agu/osm20/meetingapp.cgi/Person/712070	2020	Asher et al. (UNC-Chapel Hill)	N/A
Assessing Compound Flooding from Landfalling Tropical Cyclones on the North Carolina Coast https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019WR026788	2020	Gori et al. (Princeton)	N/A

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Community flood vulnerability and risk assessment: An empirical predictive modeling approach https://onlinelibrary.wiley.com/doi/full/10.1111/jfr3.12739	2021	Wang & Sebastian (UNC-Chapel Hill)	N/A
Downscaling of Real-Time Coastal Flooding Predictions for Decision Support https://ccht.ccee.ncsu.edu/nh-2021-downscaling/	2021	Rucker et al. (NCSU)	N/A
Forecasting of Future Flooding and Risk Assessment under CMIP6 Climate Projection in Neuse River, North Carolina https://www.mdpi.com/2571-9394/2/3/18	2020	Pokhrel et al. (Southern Illinois)	N/A
High-resolution flood risk approach to quantify the impact of policy change on flood losses at community-level https://www.sciencedirect.com/science/article/pii/S2212420921003903	2021	Nofal & van de Lindt (Colorado State University)	N/A
The role of beach state and the timing of pre-storm surveys in determining the accuracy of storm impact assessments https://www.sciencedirect.com/science/article/abs/pii/S002532272030089X	2020	Straub et al. (UNC-Chapel Hill)	N/A
Sea Level Rise in North Carolina- Strategies for Mitigating Flood Risk https://docplayer.net/200704475-Sea-level-rise-in-north-carolina-strategies-for-mitigating-flood-risk.html	2020	David Nimer (Duke University)	N/A
Spatial Analysis of Flood Susceptibility Throughout Currituck County, North Carolina https://ascelibrary.org/doi/abs/10.1061/%28ASCE%29HE.1943-5584.0001948	2020	Giovannettone et al. (Virginia)	N/A

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Typology of Hazard Event Severity Metrics for Multi-Hazard Research https://ui.adsabs.harvard.edu/abs/2021EGUGA..23.6468W/abstract	2021	Wang & Sebastian (UNC-Chapel Hill)	N/A
Probabilistic Flood Loss Assessment at the Community Scale: Case Study of 2016 Flooding in Lumberton, North Carolina https://ascelibrary.org/doi/abs/10.1061/AJRUA6.0001060	2020	Nofal & van de Lindt (Colorado State University)	N/A
Distribution and Antibiotic Resistance Profiles of Salmonella enterica in Rural Areas of North Carolina After Hurricane Florence in 2018 https://pubmed.ncbi.nlm.nih.gov/33709047/	2020	Mao et al. (University of Illinois)	N/A
Examining Coastal Dynamics and Recreational Water Quality by Quantifying Multiple Sewage Specific Markers in a North Carolina Estuary https://pubmed.ncbi.nlm.nih.gov/32795790/	2020	Hart et al. (UNC-Chapel Hill)	N/A
Microbial Contamination in Environmental Waters of Rural and Agriculturally-Dominated Landscapes Following Hurricane Florence https://pubs.acs.org/doi/10.1021/acsestwater.1c00103	2021	Harris et al. (NCSU)	N/A
Search for Campylobacter spp. Reveals High Prevalence and Pronounced Genetic Diversity of Arcobacter Butzleri in Floodwater Samples Associated with Hurricane Florence in North Carolina, USA https://pubmed.ncbi.nlm.nih.gov/32769187/	2020	Niedermeyer et al. (NCSU)	N/A
Integrating Culture and Molecular Quantification of Microbial Contaminants into a Predictive Modeling Framework in a Low-Lying, Tidally-Influenced Coastal Watershed	2021	Price et al. (UNC-Chapel Hill)	N/A

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https://www.sciencedirect.com/science/article/abs/pii/S0048969721033039			
A Framework for Planning and Evaluating the Role of Urban Stream Restoration for Improving Transportation Resilience to Extreme Rainfall Events https://www.mdpi.com/2073-4441/12/6/1620	2020	Doll et al. (NCSU)	N/A
Floodplain Buyouts and Municipal Finance https://ascelibrary.org/doi/full/10.1061/%28ASCE%29NH.1527-6996.0000380	2020	BenDor et al. (UNC-Chapel Hill)	N/A
A Review of Funding Mechanisms for US Floodplain Buyouts https://www.mdpi.com/2071-1050/12/23/10112	2020	Peterson et al. (UNC-Chapel Hill)	N/A
Flood Flow Frequency Analysis to Estimate Potential Floodplain Nitrogen Treatment during Overbank Flow Events in Urban Stream Restoration Projects https://www.mdpi.com/2073-4441/12/6/1568	2020	Doll et al. (NCSU)	N/A
A Method for Probabilistic Surge Forecasting with High-Fidelity Models https://ams.confex.com/ams/34HURR/mediafile/Manuscript/Paper372745/ExtendedAbstractV2.pdf	2021	Plumlee et al. (UNC-Chapel Hill)	N/A
Pulsed Terrestrial Organic Carbon Persists in an Estuarine Environment After Major Storm Events https://meetingorganizer.copernicus.org/EGU2020/EGU2020-8587.html	2020	Asmala et al. (NCSU)	N/A
Recent Increases of Rainfall and Flooding from Tropical Cyclones (TCs) in North Carolina (USA): Implications for Organic Matter and Nutrient Cycling in Coastal Watersheds https://link.springer.com/article/10.1007/s10533-020-00693-4	2020	Paerl et al. (UNC-Chapel Hill)	N/A

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Simulating Coupled Surge and River Flow and its Influence on Compound Inundation in an Idealized Test Case https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/654239	2020	Feng et al. (UNC-Chapel Hill)	N/A
Storm-Driven Erosion and Inundation of Barrier Islands from Dune-To Region-Scales https://ccht.ccee.ncsu.edu/wp-content/uploads/sites/10/2020/04/Gharagozlou-2020-CE.pdf	2020	Gharagozlou et al. (NCSU)	N/A
Use of Geospatial, Hydrologic, and Geochemical Modeling to Determine the Influence of Wetland-Derived Organic Matter in Coastal Waters in Response to Extreme Weather Events https://www.frontiersin.org/articles/10.3389/fmars.2020.00018/full	2020	Rudolph et al. (NCSU)	N/A
NCHRP 15-61 Pilot Project - Climate Change Design (Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure) https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4046	2016-2019	Roger Kilgore et al.	N/A
NCHRP 20-44(23) Rainfall/Runoff Modeling for resilient Design (Pilot Test of Climate Change Design Practices Guide for Hydrology and Hydraulics) https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4858	2022	Siamak Esfandiary	N/A
Predicting Roadway Washout Locations During Extreme Rainfall Events https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2021-03	In progress	Barbara Doll (NCSU)	N/A

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Improving Resilience of Transportation Infrastructure to Hurricane Damage https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2021-08	In progress	B. Shane Underswood (NCSU)	N/A
Evaluation of Road Network Resilience to Natural Hazards using Network Analysis https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2023-16	In progress	Evan Goldstein (UNC Greensboro)	N/A
Programs			
NCDOT 2020-2029 Current State Transportation Improvement Program (STIP) https://connect.ncdot.gov/projects/planning/STIPDocuments1/NCDOT%20Current%20STIP.pdf	2023	NCDOT	N/A
Homegrown Leaders https://www.ncruralcenter.org/leadership/homegrown-leaders/	2021	NCORR	N/A
NC Climate and Health Program https://epi.dph.ncdhhs.gov/oeep/programs/climate.html	Not listed	NC DHHS	N/A
NC Environmental Public Health Tracking Program https://epi.dph.ncdhhs.gov/oeep/programs/EnvPubHealthTracking.html	Not listed	NC DHHS	N/A
Data Tools			
Geo-FRIT: A Web-based Geospatial Analytics Tool for Quantifying Freight Risk and Resilience in Transportation https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2022-18	In progress	Wenwu Teng (UNC Charlotte)	N/A
Billion-Dollar Weather and Climate Disasters https://www.ncei.noaa.gov/access/billions/mapping	2022	NOAA	N/A
Moving to Digital Flood Hazard Information	2009	FEMA	This Fact sheet lists FEMA digital flood hazard products and tools.

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https://mdfloodmaps.net/pdfs/KnowYourRisk/moving_to_digital_info.pdf			
FEMA Flood Map Service Center: Products and Tools Overview https://msc.fema.gov/portal/resources/productsandtools	Various	FEMA	The FEMA Flood Map Service Center (MSC) is the official source for a variety of products detailing communities' flood risk. It organizes products and tools into regulatory mapping products, regulatory product status, flood map tools, and non-regulatory products.
Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) https://www.atsdr.cdc.gov/placeandhealth/svi/index.html	2022	CDC	N/A
CDC Environmental Justice Index https://www.atsdr.cdc.gov/placeandhealth/eji/index.html	2022	CDC	N/A
Social Vulnerability Index (SoVI®) https://www.sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/data_and_resources/sovi/index.php	2010-2014	University of South Carolina	N/A
National Risk Index https://hazards.fema.gov/nri/	2023 update	FEMA	N/A
FEMA Community Resilience Index (CRI) https://experience.arcgis.com/experience/376770c1113943b6b5f6b58ff1c2fb5c/page/CRIA/	2022	FEMA	N/A
NC Environmental Health Data Dashboard (EHDD) https://epi.dph.ncdhhs.gov/oeep/programs/EnvPubHealthTracking.html	2023	NC DHHS	N/A
Resources related to Environment and Climate, Health Effects and Community Health, and Resources for Environmental Health and Community Resources	Varies	Varies	A full list of Environment/Climate and Health Effects/Community Health data sources can

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https://epi.dph.ncdhhs.gov/oe/programs/EnvPubHealthTracking.html			be found here. Scroll down to related resources.
North Carolina Flood Risk Information System (FRIS) https://fris.nc.gov/fris/Home.aspx?ST=NC	Not listed	NC Floodplain Mapping Program	N/A
Other Resources			
North Carolina Resilient Coastal Communities Program Planning Handbook https://deq.nc.gov/media/19867/download	2021	NC DCM	N/A
Natural Hazards Resilience: A Quick Start Guide for North Carolina Communities https://www.rebuild.nc.gov/media/495/open	2020	NCORR	N/A
Adaptation Clearinghouse https://www.adaptationclearinghouse.org/search/?sid%5B%5D=293	Ongoing	Georgetown Climate Center	Searchable by state, the Adaptation Clearinghouse supplies adaptation resources for a breadth of sectors.
Naturally Resilient Communities https://nrcsolutions.org/strategies/?fwp_hazards=coastal%2Ctidal%2Cstormsurge%2Criverineerosion%2Criverineflood&fwp_region=southeast	Not listed	APA, ASCE, TNC, Sasaki, EWRI, ASFPM, NACo ⁷ , EU Commission	Guide of nature-based solutions and included case studies.
FEMA Resources for Climate Resilience https://www.fema.gov/sites/default/files/documents/fema_resources-climate-resilience.pdf	2021	FEMA	N/A
Adaptation Types and Examples https://deq.nc.gov/about/divisions/coastal-management/coastal-adaptation-and-resiliency/adaptation-types-and-examples#Tab-	Not listed	NC DEQ	Collection of ideas sorted into Bank of Ideas, Community Planning, Ocean Shoreline Management, and Estuarine Shoreline Management.

⁷ APA- American Planning Association, ASCE- American Society of Civil Engineers, TNC – The Nature Conservancy, EWRI- Environmental & Water Resources Institute , ASFPM – Association of State Floodplain Managers, NACo – National Association of Counties

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